

COVID-19

PERSPECTIVES ACROSS AFRICA

COVID-19

FYMAT, ROMM, KAPALANGA

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Edited by:
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***COVID-19 Pandemic:
Perspectives across Africa***

Proceedings of a Conference

Edited by:

Alain L. Fymat, Norma R.A. Romm, and Joachim Kapalanga

Society for the Advancement of Science in Africa (SASA)

**Society for the Advancement of Science in Africa
(SASA)**

**Seventh Annual International (digital) Conference
Joint SASA and Ugandan Ministry of Health**

**October 15, 2020 – January 14, 2021
Kampala, Uganda**



Ten Years of International Advancement of Science in Africa (2010 - 2020)

Theme

COVID-19 Pandemic: Perspectives across Africa

Topics

1. Strategic lessons learned from the COVID-19 pandemic.
2. Strategies for public health policies and pandemic care delivery.
3. Strategies for vaccine preparedness and overcoming “vaccine hesitancy” or “denial”.
4. Strategies for multi-sector harmonization of government policies.
5. Strategies for multi-sector preparedness for the next pandemic.
6. Strategies for pandemic food security.
7. Strategies for environment-friendly pandemic policies.
8. Strategies for incorporating COVID-19 into overall disease control programs.
9. Strategic lessons learned for research agendas.

Acknowledgments

We are grateful to the several authors for their contributions to the chapters that follow. We would like to thank the International Institute of Medicine & Science, California, U.S.A., the University of South Africa, and the Schulich School of Medicine & Dentistry, Western University, Ontario, Canada for their benevolent support in our dedication of time and effort to this project, and more generally to the advancement of science research and education in Africa in this difficult pandemic period. We should also like to thank Dr. Monica Msanza Musenero, Uganda Presidential Advisor on Epidemics and Pandemics for her Welcoming Address on “Health Research, Health Policy, and Health Care Across Africa in the Age of the COVID-19 Pandemic”. We would further like to thank the several scientists who delivered Keynotes or Invited Addresses as well as the several Session Chairs and Moderators of the Panel Discussions. Lastly, our thanks also go to the members of the International and Local Organizing Committees and to the SASA staff for their dedicated effort and coordination of these webinars across several continents.

Forward

In December 2019, an acute pneumonia of unknown course emerged in the Wuhan Province of China. It started as an epidemic and was later declared by the World Health Organization as a pandemic. The disease, caused by SARS CoV-2, a coronavirus, quickly swept across the world leaving behind hundreds of thousands of dead, survivors of varying degrees of disability, and accompanying economic ruin. The World Health Organization initially designated the globally mushrooming health epidemic a health emergency of global concern, and eventually a pandemic, as the health emergency was on a relentlessly worsening trajectory. COVID-19 presented researchers, public health professionals, physicians, other health professionals, and national governments with enormous challenges. The world was not prepared for the pandemic, consequently, little was known about its clinical presentation as no one predicted the trajectory of cases and deaths with peaks occurring in different parts of the world at different times as the virus evolved further, affecting management and public health measures of control and prevention. The pandemic also offered unique opportunities for collaboration and solidarity in every sphere of human services. It also opened the eyes of the world to glaring inequities in access to quality healthcare, education, benefits of scientific research, and development. In the context of Africa, the pandemic was predicted to wreak havoc on African populations given the fragile health systems across Africa. Nations in Africa were ill-equipped to deal with such a pandemic. For unknown reasons, Africa was spared the worse.

Nevertheless, one important risk factor stood out prominently against measures to address the potential spread in Africa. Poverty, socio-economic conditions, and African tradition of social collectivism stood starkly in the ways of physical distancing, the use of face masks, staying at home during official lockdowns, the need to not attend funerals, burial ceremonies and other cultural gatherings, adhering to hand washing, and using sanitizers.

Against this background, COVID-19 naturally was selected as the main theme for the 2020-2021 SASA International Conference jointly co-hosted by the Society for the Advancement of Science in Africa, the Uganda Ministry of Health, and other partners (WHO). Participants brainstormed on various aspects of the pandemic and drew important lessons from experiences across the African continent and from elsewhere. Roles of governments, health professionals, and communities in preparing for future disasters, epidemics and pandemics were discussed as well as the need for African governments to invest in science, health systems, and education.

This volume encapsulates a range of perspectives and associated recommendations that sprung from delegates' belonging to a wide range of disciplines and across all areas of concern.

Accordingly, the health as well as socio-economic challenges glaringly manifested by the pandemic are discussed under various options for: i) preparation and control to render African societies more resilient; ii) response and treatment which meets the African contexts in question; iii) education and transformation to address poverty concerns; iv) considerations for envisaging and shaping new futures, ideally to cater for a more holistic and inclusive wellbeing; and v) adoption of scientific innovation to meet future demands for disease control.

The rich array of ideas and practical solutions presented augur well for researchers and practitioners alike to portend a better, more justice-oriented future, based on collaborative inquiry and action.

Prof. AKANMORI, Bartholomew Dicky
Regional Adviser for Vaccine Research and Regulation
WHO Regional Office for Africa, Brazzaville, Congo

Preface

Human history has been befallen by a long chain of famines, epidemics, and pandemics. During this current COVID-19 pandemic, our world remains under-prepared to predict, detect, respond, prevent infectious disease outbreaks, and *a fortiori* pandemics - whether naturally occurring, accidental, or deliberately released. These threats endanger lives, disrupt families and societies, and wreak havoc on economies. They represent the ultimate equal opportunity condition! They do not respect national boundaries, do not discriminate between different ethnicities, religions, social or economic status or even age, and can spread rapidly jeopardizing the health, security, and prosperity of all world countries. Indeed, physical distance alone no longer provides protection as pathogens can move from one point on Earth to almost any other place in the world within less than 36 hours!

Yet, the cost of failing to control outbreaks, ruining and losing lives, destabilizing the social fabric, and decimating economies is considerably greater than the cost of prevention. It is therefore in each country's security interest to strengthen global health security and manage the risk of infectious disease outbreaks that might further develop into full-blown pandemics.

It may surprise some of us but COVID-19 was predictable in some limited sense. There were reports, briefings, warnings about viruses bearing traces of their animal origins and of emerging infectious diseases ... but, for various reasons, they have not been heeded. Nonetheless, the manner in which COVID-19 spread to (and in many cases killing) older people, immunocompromised people, but also younger adults or even children and infants has taken us all by surprise. It should not have been so!

Now, perhaps more than ever before, we should recognize and seize this moment as the most opportune time to address the prevention and management of health crises. Highlighting global health security, strengthening multidisciplinary engagement and multisectoral coordination while emphasizing the importance of financial preparedness, will be paramount not only for containing the current pandemic but also for facing future health threats and pandemics. Further, improvements in early warning and detection, timely data sharing, laboratory testing, and joint outbreak response capacities will create and strengthen the mechanisms necessary to effectively detect and respond to emerging zoonotic threats, prevent pandemics, and thereby enhance global health security.

Having hosted several variants of the original causal coronavirus, this global warning applies particularly to the African continent where health security needs particular highlighting,

Fymat, Romm, and Kapalanga

multidisciplinary engagement and multisector coordination need strengthening, and financial preparedness is direly needed.

Prof.-Dr. Alain L. Fymat

International Institute of Medicine & Science, California, U.S.A.

About the Editors

DR. ALAIN L. FYMAT is a medical-physical scientist and an educator. He is the current President/ CEO and Institute Professor at the International Institute of Medicine & Science with a previous appointment as Executive Vice President/Chief Operating Officer and Professor at the Weil Institute of Critical Care Medicine, California, U.S.A. He was formerly Professor of Radiology, Radiological Sciences, Radiation Oncology, Critical Care Medicine, and Physics at several U.S. and European Universities. Earlier, he was Deputy Director (Western Region) of the U.S. Department of Veterans Affairs (Office of Research Oversight). At the Loma Linda Veterans Affairs Medical Center, he was Scientific Director of Radiology, Director of the Magnetic Resonance Imaging Center and, for a time, Acting Chair of Radiology. Previously, he was Director of the Division of Biomedical and Biobehavioral Research at the University of California at Los Angeles/Drew University of Medicine and Science. He was also Scientific Advisor to the U.S. National Academy of Sciences, National Research Council, for its postdoctoral programs tenable at the California Institute of Technology and Member of the Advisory Group for Research & Development, North Atlantic Treaty Organization (NATO). He is Health Advisor to the American Heart & Stroke Association, Coachella Valley Division, California. He is a frequent Keynote Speaker and Organizing Committee member at several international scientific/medical conferences. He has lectured extensively in the U.S.A, Canada, Europe, Asia, and Africa. He has published in excess of 525 scholarly scientific publications and books. He is also Editor-in-Chief, Honorable Editor or Editor of numerous medical/scientific Journals to which he regularly contributes. He is a member of the New York Academy of Sciences and the European Union Academy of Sciences, a Board member of several institutions, and a reviewer for the prestigious UNESCO Newton Prize, United Kingdom National Commission for UNESCO.

Dr. Fymat's current research interests are focused on neurodegenerative diseases (Alzheimer's, Parkinson's, dementias, epilepsy, and others), oncology (glioblastoma), epigenetics & ecogenetics, emerging infectious diseases, and nanomedicine & nanobiotechnology. These are represented in part in his latest books: "**The Odyssey of Humanity's Diseases: Epigenetic and ecogenetic modulations from ancestry through inheritance, environment, culture, and behavior**" Volumes 1, 2, and 3; "**From the Heart to the Brain: My collected works in medical science research (2016-2018)**"; "**The Human Brain: Wonders and disorders**"; "**Alzhei...Who? Demystifying the disease and what you can do about it**"; "**Parkin...ss...oo...nn: Elucidating the disease and what you can do about it**"; "**Dementia: Fending-off the menacing disease and what you can do about it**"; "**Cancer: The pernicious, clonally-evolving disease braided in our genome**";

“**Glioblastoma: Management and treatment**”; “**Lyme disease: The great invader, evader, and imitator**”; “**Pandemics: Prescription for prediction and prevention**”, and “**Nanomedicine: My collected works in nanomedicine research**”;

DR. NORMA R.A. ROMM, DLitt et Phil is a Professor in the Department of Adult Education and Youth Development at the University of South Africa. She is author of “**The Methodologies of Positivism and Marxism**” (1991), “**Accountability in Social Research**” (2001), “**New Racism**” (2010), “**Responsible Research Practice**” (2018), “**People’s Education in Theoretical Perspective**” (with V. McKay 1992), “**Diversity Management**” (with R. Flood, 1996), and “**Assessment of the impact of HIV and AIDS in the Informal Economy of Zambia**” (with V. McKay, 2006). She has co-edited five books—“**Social Theory**” (with M. Sarakinsky, 1994), “**Critical Systems Thinking**” (with R. Flood, 1996), “**Balancing Individualism and Collectivism**” (with J.J. McIntyre-Mills and Y. Corcoran-Nantes, 2017), “**Mixed Methods and Cross-Disciplinary Research**” (with J.J. McIntyre-Mills, 2019), and “**Democracy and Governance for Resourcing the Commons**” (with J.J. McIntyre-Mills and Y. Corcoran-Nantes, 2019). She has published over 100 research articles on social theorizing, transformative research towards social and ecological regeneration, Indigenous paradigms of knowing, and the facilitation of adult learning. [ORCID number: 0000-0002-1722-9720.]

DR. JOACHIM KAPALANGA, MD, MSc, PHD, FAAP, FACMG, DABMG, DABP is a physician-scientist and an educator who was educated at Yale University, the State University of New York (SUNY), Queens University, McMaster University and the University of Guelph. He is currently Professor (Adjunct) of Pediatrics at Schulich School of Medicine and Dentistry and South Western Ontario Academic Health Network - Knowledge Translation Group. He is also a faculty member at McMaster University and a Visiting Professor at Gulu University, Uganda. He is also Chief of Pediatrics at the Grey Bruce Health Services, Ontario, and a consultant pediatrician and medical geneticist at the Summer Side Medical Centre (SSMC), Prince Edward Island, (PEI), Canada.

Dr. Kapalanga has held faculty and leadership positions in various institutions and organizations. He was formerly Associate Professor and Head of the Division of Medical Genetics at Upstate Medical University/State University of New York (SUNY), Assistant Professor and Member of the PEI University and Health Research Institute; Clinical Instructor in Genetics at Yale University; Assistant Clinical Instructor in pathology and pediatrics at SUNY; and Lecturer at Dalhousie University. He was also Chairman of the Perinatal Committee of the SSMC / Prince County Hospital, Head of the PEI Newborn Screening Program, and PEI Representative at the Fetal Alcohol Spectrum Disorder Canadian Expertise (FACE) Research Round table. He was also appointed to the PEI Council, College of Physicians and Surgeons.

Dr. Kapalanga is a Fellow of the American College of Medical Genetics, Fellow of the American Academy of Pediatrics, Diplomate of the American Board of Medical Genetics, Diplomate of the American Board of Pediatrics, and an Associate Fellow of the Canadian College of Medical

Genetics. He is a member of the American Medical Association, American Society of Human Genetics, FACE Research Roundtable, Canadian Congenital Anomalies Network Surveillance Network, Canadian Medical Association, the Ontario Medical Association, and a founding member of the African Society of Human Genetics.

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Mike Walsh, University of Stirling Management School, Scotland.

Rudolf Wirawan, Adelaide University, Australia; Wirasoft, Adelaide, Australia.

Conference Program

CONFERENCE PROGRAM AT-A-GLANCE

Session 1 - October 15, 2020
Topics 1, 2

Moderators: Prof. Sam Lanfranco and Prof. Dennis Raphael

09:00 - 09:30

SASA Business Meeting 1 (Closed)

09.30 - 09:35

Welcoming Remarks

Prof. Leon Mutesa

Professor of Human Genetics and Director of Center for Human Genetics
College of Medicine and Health Sciences
University of Rwanda

09:40 – 10:00

Welcoming Address

Dr. Monica Msanza Musenero

Uganda Presidential Advisor on Epidemics and Pandemics
**Health Research, Health Policy, and Health Care Across Africa
in the Age of the COVID-19 Pandemic**

10:00 – 10:05

Welcoming Remarks

Prof. Alain L. Fymat

SASA Vice-Chair, Scientific Director, and Scientific Committee Chair
President and Professor, International Institute of Medicine and Science

10:05 - 10:30

Keynote Address

Prof. Leon Mutesa

**A strategy for finding people infected with SARS CoV-2:
optimizing pooled testing at low prevalence**

10:30 – 10:50

Invited Address

Dr Stephen Opiyo

Ohio State University

Local COVID Data Tracking and Use Across Africa

10:50 – 11:30

PANEL DISCUSSION 1

Strategic lessons learned from the Covid-19 pandemic

Strategies for public health policies and pandemic care delivery

Moderator: **Prof. Dennis Raphael**

School of Health Policy and Management, York University

Panelists: **Prof. Leon Mutesa, Dr. Stephen Opiyo, Prof. Sam Lanfranco**

Session 2 - October 26, 2020

Topics 2, 5, 9

Moderators: Prof. Sam Lanfranco and Prof. Dennis Raphael

09.30 - 09:35

Welcoming Remarks

Dr. Francis Adyanga Akena

SASA Executive Director of Administration and Chairman Local Organizing Committee

Dean Faculty of Education, Kabale University, Uganda

09:35 – 10:00

Keynote Address

Prof. Alain L. Fymat

SASA Vice Chair, Scientific Director, and Scientific Committee Chair

President & Professor

International Institute of Medicine and Science, U.S.A.

Predicting and Preventing the Next Pandemics

10:00 – 10:20

Invited Address

Prof. Norma R.A. Romm

Department of Adult Basic Education and Youth Development

University of South Africa

Strategies For Environment-Friendly Pandemic Responses

10:20 – 10:40

Keynote Address

Prof. Yann Meunier, MD, FAMS, FACHT, FACTM

Professor, International Institute of Medicine and Science
Former Director, International Corporate Affairs and Business Development,
Stanford Hospital and Clinics

**Containment and mitigation strategies:
international lessons from the COVID-19 pandemic**

10:50 – 11:30

PANEL DISCUSSION 2

Strategies for public health policies and pandemic care delivery
Strategies for multi-sector preparedness for the next pandemic
Strategic lessons learned for research agendas

Moderator: **Dr. Francis Adyanga Akena**

SASA Executive Director of Administration and Chairman Local Organizing Committee
Dean Faculty of Education, Kabale University Uganda

Panelists: **Prof. Alain L. Fymat, Prof. Norma R.A. Romm, Prof. Yann Meunier**

**Session 3 - November 12, 2020 – CANCELLED, SPEAKERS RESCHEDULED
Topics 4, 6, 7**

Moderator: Prof. Yann Meunier

09:30 - 09:35

Welcoming Remarks

Prof. Njoki Wane

SASA Executive President
Professor, OISE, University of Toronto

09:40 – 10:00

Keynote Address

Prof. Simon Onywere

SASA Director, Africa Region
Professor, Department of Environmental Planning and Management
Kenyatta University, Nairobi

10:00 – 10:20

Keynote Address

Invited Address

Prof. David Kitara Lagoro

Harvard T.H. Chan School of Public Health
Department of Global Health and Population, Boston, Massachusetts, USA
Gulu University, Faculty of Medicine
Proposed strategies for easing COVID-19 lockdown measures in Africa

10:20 – 10:40

Invited Address

TBA

10:50 – 11:30

PANEL DISCUSSION 3

Strategies for public health policies and pandemic care delivery

Strategies for multi-sector preparedness for the next pandemic

Strategic lessons learned for research agendas

Moderator: **Prof. Njoki Wane**

SASA Executive President

Professor, OISE, University of Toronto

Panelists: **Prof. Celestino Obua, Prof. Simon Onywere, Prof. David Kitara Lagoro**

Session 4 - November 26, 2020

Topics 3, 4, 8

Moderator: Prof. Yann Meunier

09:30 - 09:35

Welcoming Remarks

Prof. Njoki Wane

SASA Executive President

Professor, OISE, University of Toronto

09:40-10:00 EST (+8 hours = 17:40-18:00 Uganda time, same day)

Keynote Address

Prof. Celestino Obua

Vice Chancellor, Mbarara University of Science and Technology, Uganda

COVID-19 and HIV research in resource-limited settings

10:00 – 10:20 EST (+10.5 hours = 20:30 – 20:50 Bangalore time, same day)

Keynote Address

Prof. Balakrishna Shetty, MD, DNB, MD

Vice Chancellor, Sri Siddhartha University, Tumakuru, Bangalore, India

Member, Consortium Universities for Global Health, Washington DC,

Artificial Intelligence in Imaging and strategies for cost effective diagnosis

10:20 – 10:40 EST (+8 hours = 17:40-18:00 Uganda time, same day)

Invited Address

Dr Amit N. Thakker (*in absentia*)

Executive Chairman at Africa Health Business, YPO Gold

Africa Healthcare Federation

Strategies for multi-sector harmonization of policies

10:50 – 11:30

PANEL DISCUSSION 4

Strategies for vaccine preparedness and overcoming “vaccine hesitancy”
Strategies for multi-sector harmonization of government policies
Strategies for incorporating Covid-19 into overall disease control programs

Moderator: **Prof. Yann Meunier**

SASA Scientific Committee, Senior Health Care Consultant,
Director International Business Development & Corporate Affairs, Stanford Hospital and Clinics
Prof. International Institute of Medicine & Science

Panelists: **Prof. Balakrishna Shetty, Prof. Joachim Kapalanga, Prof. Celestino Obua,
Prof. Emilio Ovuga, Dr Amit N. Thakker, Prof. Njoki Wane**

Session 5 - December 3, 2020
Topics 3, 6, 7

Moderator: Prof. Sam Lanfranco

08:00 – 08:05

Welcoming Remarks

Prof. Dennis Raphael (replaced by Prof. Sam Lanfranco)

SASA Director, Scientific Committee Member
School of Health Policy and Management, York University

08:10 – 08:40 EST (6 hours = 14:10-14:40 PM same day)

Keynote Address

Dr. Matsidiso Moeti

WHO Director, Africa Region
Brazzaville, Republic of the Congo

08:40 – 09:00(6 hours = 14:40-15:00 PM same day)

Keynote Address

Dr. Bart Akanmori (*in absentia*)

WHO, Africa Region
Brazzaville, Republic of the Congo

09:00 – 09:20 (6 hours = 15:00-15:20 PM same day)

Invited Address

Prof. Kate Tulenko, MD, MPH, MPhil, FAAP (*in absentia*)

Founding President, Corvus Health
Director of CapacityPlus, US Agency for International Development
Coordinator of the World Bank’s Africa Health Workforce Program
Adjunct faculty, Johns Hopkins School of Public Health
Increasing health worker resilience in Africa during the Covid-19 pandemic

09:20 – 09:40 (6 hours = 15:20-15:40 PM same day)

Prof. Janet McIntyre, DLitt Phil

Visiting Research Fellow, Adelaide University, Australia

Adjunct Associate Professor, Flinders University

Honorary Professor, University of South Africa

Adjunct Professor, University of Indonesia

Research Associate, Universitas Padjadjaran

Planetary Passport for Representation, Accountability, and Regeneration

09:50 – 11:00 (6 hours = 15:50-17:00 PM same day)

PANEL DISCUSSION 5

Strategies for vaccine preparedness and overcoming “vaccine hesitancy”

Strategies for pandemic food security

Strategies for environment-friendly pandemic policies

Moderator: **Prof. Alain L. Fymat**

Panelists: **Dr. Bart Akanmori** (*in absentia*), **Prof. Joachim Kapalanga**, **Prof. Sam Lanfranco**,
Dr. Matsidiso Moeti, **Prof. Emilio Ovuga** (*in absentia*), **Prof. Dennis Raphael** (replaced by
Prof. Janet McIntyre), **Prof. Kate Tulenko** (*in absentia*)

Session 6 - December 10, 2020

Topics 1, 8, 9

Moderator: Prof. Sam Lanfranco

09:30 – 09:35

Welcoming Remarks

Prof. Sam Lanfranco

SASA Director of International Relation, Internet and Website

Emeritus Professor of Economics, York University

09:40 – 10:00

Keynote Address

Prof. Joachim Kapalanga

Professor of Paediatrics, Western University

Visiting Professor, Gulu University

Genetic, Epigenetic and Ecogenetic Factors in COVID-19

10:00 – 10:20 (+ 8 hours = 18:00-18:20 PM same day)

Keynote Address

Prof. Simon Onywere (*in absentia*)

SASA Director, Africa Region

Professor, Department of Environmental Planning and Management

Kenyatta University, Nairobi

Environmental strategies for pandemic prevention

10:20 – 10:40 (+ 8 hours = 18:20-18:40 PM same day)

Invited Address

Prof. David Kitara Lagoro

Harvard T.H. Chan School of Public Health

Department of Global Health and Population, Boston, Massachusetts, USA

Gulu University, Faculty of Medicine

Proposed strategies for easing COVID-19 lockdown measures in Africa

10:40 – 11:00 (+6 hours = 16:40-17:00 PM same day)

Invited Address

Ms. Houbeb Ajmi

CEO, Honoris United Universities, Tunisia

New technologies for a healthy and educated continent

11:00 – 11:30

PANEL DISCUSSION 6

Strategic lessons learned from the Covid-19 pandemic

Strategies for incorporating Covid-19 into overall disease control programs

Strategic lessons learned for research agendas

Moderator: **Prof. Joachim Kapalanga**

Panelists: **Dr. Houbeb Ajmi, Prof Sam Lanfranco, Prof. David Kitara Lagoro,**

Prof Yann Meunier, Prof Alain L. Fymat

11:30 – 12:00

PanAfrican Pandemic Proclamation

12:00 – 13:00

SASA Business Meeting 2 (closed)

Proclamation and Business Meeting deferred to next Session)

Session 7 - January 14, 2021

Topics 1 to 9

Moderator: Prof. Sam Lanfranco

9.30 - 9:35

Welcoming Remarks

Prof. Joachim Kapalanga

9:40 – 10:00

Dr. Francis Adyanga Akena

Faculty of Education, Kabale University

Examining Students Perceptions on Covid 19: Implications for Safe Schools Reopening

10:00-10:20

Dr. Nwankwo Mercy

Chinenye Public Health Department, Kabale University, Uganda

Strategies for multi-sector preparedness for the next pandemic in Uganda

10:20 – 10:40

Dr. Daniel Buyinza

Department of Chemistry, Kabale University

Fighting the next pandemic: A phytochemical approach from African flora - an overview

10:40 – 11:00

Dr. Ivan Gumula¹ and Dr. Daniel Buyinza²

¹Department of Chemistry, Faculty of Science, Kyambogo University, Uganda

² Department of Chemistry, Faculty of Science, Kabale University

Protease inhibitors from plant seeds and tubers as potential antivirals for COVID-19

11:00 – 11:20

Dr. John Michael Etoru and Sanni Tajudeen Adebayo (PhD Candidate)

Kabale University, Uganda

Migrant workers in the COVID-19 era: Is it worth the risks?

11:20 – 11:40

Morris Komakech (PhD candidate) and Prof. Dennis Raphael

York University

The Political Economy of Health in Sub-Saharan Africa:

The Evolution of Post-Colonial Governance and Infrastructure to Promote Health Equity

11:40 – 12:00

PANEL DISCUSSION 7

Moderator: **Prof. Joachim Kapalanga**

Panelists: **Mr. Sanni Tajudeen Adebayo, Dr. Francis Adyanga Akena,**

Dr. Daniel Buyinza, Dr. John Michael Etoru, Dr. Ivan Gumula, Mr.

Morris Komakech, Dr. Nwankwo Mercy, Prof. Dennis Raphael

CONFERENCE ADJOURNED

11/14/20

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Welcoming Remarks

Dear Colleagues,

A hearty welcome to this 7th International Annual Conference of the Society for the Advancement of Science in Africa (SASA). This year is a particular treat as the Conference is being held jointly with the Uganda Ministry of Health.

Several months have now elapsed since the outbreak of the COVID-19 pandemic, and its ravages have created havoc in many countries, African countries included, by disrupting their societies, institutions, healthcare organizations, economies, and peoples' lives. We are praying for the coming of the proverbial savior Messiah in the form of a vaccine that will be effective, free or affordable, available to everyone in every country, and accepted by all with little or no hesitancy. While testing was conducted, many issues were associated with not only its underlying methodology but also in the way it was administered as they affected its results. Further, while current therapeutics including *Dexamethasone* and *Remdesivir* appear to have been beneficial in severe cases, they have not prevented deaths. Still further, we are also concerned by additional waves of reinfection that have raised their ugly heads across many countries. Beyond that, we are hoping to find ways out of this viral storm that is engulfing us, and predicting or better yet avoiding future pandemics.

In addition to assessing the strategic lessons we have learned from the COVID-19 pandemic, our distinguished presenters and panelists will also consider a number of strategies in the following specific areas: public health policies and care delivery during a pandemic; incorporation of COVID-19 into overall disease control programs; multi-sector harmonization of government policies regarding avoidance or, better yet, preparedness for the next pandemic; environment-friendly pandemic policies; pandemic food security; psychosocial effects and their palliation; vaccine preparedness and overcoming “vaccine hesitancy”; and, of course, lessons learned for research agendas. We even contemplate issuing SASA's own version of the “Kampala Declaration” that was issued three years ago (in October 2017) by the Global Health Security Agenda (GHSA) Ministerial Meeting in Uganda.

Wishing to all stimulating, challenging, and thought-provoking interactions, I again extend to all present the warmest welcome to SASA's 2020-2021 Conference.

Prof. Dr. Alain L. Fymat
SASA Board Vice Chair, Science Director, and Science Committee Chair

Chapter One

Introduction

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In late 2019, a group of patients with a severe acute respiratory syndrome (SARS) of unknown cause appeared in Wuhan, Hubei province, China. Since then, outbreaks of this syndrome had quickly spread across the Chinese territory, resulting in thousands of confirmed cases. The Chinese Center for Disease Control & Prevention then organized an intensive outbreak investigation program. It attributed the etiology of this disease to a new virus belonging to the coronavirus (CoV) family. Initially, the new virus was called 2019-nCoV. Subsequently, experts from the International Committee on Taxonomy of Viruses renamed it SARS CoV-2 due to its similarity to the coronavirus responsible for the first SARS epidemic (SARS CoV) in 2002. On 11 February 2020, the World Health Organization (WHO) announced that the disease caused by the new CoV should be called “COVID-19”, which stands for “coronavirus disease-2019”. Because of its alarming speed of transmission, the WHO subsequently, *albeit* somewhat belatedly, declared a pandemic state on 11 March of the same year. Although SARS CoV-2 is not the most lethal among coronaviruses, its speed of propagation makes it one of the deadliest viruses known.

This volume represents the Proceedings of the Seventh Annual International (digital) Conference that was held jointly by the Society for the Advancement of Science in Africa (SASA) and the Ugandan Ministry of Health during the period October 15, 2020 – January 14, 2021. While these two institutions held several joint webinars during the preceding months, these will not be covered here. These Proceedings are divided into five Parts. **PART A** is dedicated to the phase of preparation and control of the pandemic by African countries; **PART B** to response and treatment, **PART C** to education and its transformation, **PART D** to what the future portends, and **Part E** presents SASA’s PanAfrican Pandemic Proclamation. Because of space limitations, it was not possible to include here all presentations made before or during the Conference. However, this should not detract in the least from their quality, appropriateness, and interest. Actually, some of them have already been published elsewhere in the scientific literature.

PART A includes seven chapters (Chapters 2 through 8). **Chapter 2** is part of a larger project called “Re-inventing democracy in the digital age”, which was funded by the United Nations Democracy Fund. Participants from five geographical regions (Africa being one of them with 16 participants) engaged with each other and deliberated face-to-face upon options for re-inventing democracy in the digital age. A triggering question kindled ideas that were presented and debated, resulting in a rich array of concrete proposals. It elicited a number of proposals from a group of volunteer participants from various countries in Africa. The overall objective was rendering African countries more resilient, sustainable, and better prepared for COVID-19 and similar future pandemics. In **Chapter 3**, it is noted that a third of the African continent’s population is living in a water scarcity situation owing to underdevelopment, low water resources usage, and poor financing and technology, but not inadequacy of available water resources. It is feared that the COVID-19 pandemic may worsen this water scarcity situation but, counteractively, serve as a wakeup call for more alternative water sources. To remedy the situation, it is proposed to extend the beneficial effects of the Kilimanjaro concept that was introduced for East Africa Rift Valley-bound areas. That concept offers a potential solution to enhance water security. It can also achieve the United Nations’ Sustainable Development Goals on clean drinking water provision in regions where groundwater is highly contaminated with toxic geogenic contaminants such as fluoride. **Chapter 4** builds on a review of the well-established Rwanda’s efforts in achieving health equity through proactive, health-related public policy in a variety of domains. The key underlying features are that country’s relatively long life expectancy, lower infant mortality rates, and low inequalities in access to health care. By ensuring state control of the public policy environment and implementing an anti-corruption agenda, Rwanda has advanced concrete and meaningful equity agendas with focus on legitimate community participation, bolstered education, enhanced research capacity, and promoted intersectoral collaboration. The chapter examines whether these achievements carried over into its response to the COVID-19 pandemic, culminating in the affirmative, including access to available vaccines and success in distributing them amongst the population. In **Chapter 5** sixteen measures are proposed for limiting and controlling the spread of COVID-19 in Africa while advancing their sustainability and limiting their adverse individual and societal effects. These include: vaccination, increased testing, public engagement and sensitization, decentralization of services, creation of task forces down to village levels, upgrading of health facilities, stockpiling personal protective equipment, strengthening referrals and active surveillance of cases, bolstering internal funding mechanisms, and supporting the global health security. Additionally, it advocates the creation at the ministerial level of a COVID-19 control program and the support of state-regional collaboration. **Chapter 6** elucidates how ten young adults (in their 20s to mid-30s) from various African countries have experienced their individual and collective agency as impacting social and ecological outcomes in their societies. It also considers how their agency has been crucial during the COVID-19 pandemic. The participants’ stories are recounted through an open-ended set of questions intended to draw out what these participants consider to be their most outstanding contributions (individual or collaborative) to African society. The chapter further focuses on some of the insights harvested from these elucidations. How Ghanaians perceive and experience fear under quarantine in the various designated quarantine centres is examined in

Chapter 7. The results showed that, while aligned with the World Health Organization (WHO) Guidelines, the quarantine protocols adopted exhibited some exceptions that partly compounded the fear experienced. This chapter contributes to issues of distinct emotions and individual viewpoints under mandatory quarantine during the COVID-19 pandemic, specifically in Ghana. The last contribution in Part A, **Chapter 8** examines the value of global workers' migration both for the migrants themselves and the host countries. Migration from the developing countries to the developed ones has increasingly become a major new security challenge for European and American governments. Within Africa and the Middle East, it has resulted in undesirable consequences for the migrants. Rather than restraining, the COVID-19 pandemic has seen an increase in migration with attending risks and effects on the health sector of the recipient countries. The authors call for the social re-engineering of migration, including labor and human rights.

PART B comprises four chapters, Chapters 9 through 12. In **Chapter 9**, the role of imaging (high-resolution computed tomography) in the diagnosis and management of COVID-19 and its advantages over laboratory testing (particularly, real-time polymerase chain reaction, antigen tests, serological tests, immunological tests, and antibodies detection) is examined. High-resolution computed tomography of the chest is used for involvement of the lungs due to the viral disease. It provides fairly reliable but indirect evidence on the causative pathogen in a particular clinical set-up/ It is highly reliable for assessing lung involvement and disease progression. With uncertainties about the causative pathogen and the non-availability of definitive antiviral medicines, the management of structural changes in the body by imaging seems to be more promising than laboratory tests. It is shown that imaging is a better diagnostic tool than laboratory tests and is vital for confirmatory analysis and evaluation of disease severity in patients with suspected SARS CoV-2 infection. It helps scoring and quantifying the disease and in proper management with oxygen, steroids, and anti-coagulants. **Chapter 10** shows how the lessons learned from previous epidemics in Africa helped the continent mitigate the ravages caused by COVID-19. Nonetheless, the disruption of health systems remains severe and has consequences, especially for women and children. In Ghana, for example, strengthening of health systems will require increased community involvement and remedying pre-existing engagement gaps in human resources. **Chapter 11** deals with vaccine manufacturing in Africa. Plunged in the midst of yet another pandemic, Africa still tragically has to import 99% of its vaccines from international procurement mechanisms. The governing responsible factors (external, internal, policy, international, continental, regional, and national) are discussed. Fortunately, the African Centers for Disease Control & Prevention in partnership with the "2021 Vaccines Summit" charted a path to modernize and develop regulatory bodies for medicines through the creation of an African Medicines Agency that will jump-start vaccine manufacturing. Nonetheless, if Africa is to become self-sufficient in manufacturing its needed vaccines, a different approach must be hammered out with its international partners with the objective to empower the continent's own researchers and businesses. When it comes to public health, COVID-19 has shown that vaccines are an international need. Countries that lack vaccines could cause resurgence of the pandemic through successive waves, including several variants of the original coronavirus.

Intellectual property rights could be a major roadblock in Africa's road to vaccines' self-sufficiency. Their temporary waiver may not be a viable solution as COVID-19 vaccines can indeed be incredibly difficult to make. In the present situation, unfreezing countries of their overcapacity or overstocks could have a more immediate and beneficial result. Scientists and researchers, and not only manufacturing companies and governments, have the knowledge and experience to influence the debate and should do so. Vaccine technology should not be the source of profiteering, especially to the detriment of poor countries who could ill afford it. This could also have a boomerang effect in that unvaccinated countries in times of pandemics could be the source of further infections, additional pandemic waves, and numerous variants, as already seen. Vaccine technology should perhaps be considered a future public good. **Chapter 12** is a literature study that explores African traditional healing practices and technologies. It underlines the subjugation of spiritually-charged, traditional healing especially is the treatment of COVID-19. An alternative response to Western healing practices and technologies can offer alternatives as well as ensure relevance of treatment to African indigenous people. This is of importance if we note that more than 80% of the world's population relies on traditional healing modalities and herbals for primary health care and wellness. It is, however, concerning that (African) traditional healing still receives some degree of rejection in favor of Western medicine. It is further dismissed as it is guided by *botho (ubuntu)* – caring, unity, and community. There remains a need to understand African traditional healing practices and technologies and the role they can play in treating ailments such as COVID-19.

PART C includes three chapters, Chapters 13 through 15. Note that despite the range of interventions, the pandemic has radically changed the education landscape, higher education being no exception. In fact, UNESCO refers to the pandemic as the most severe “global education disruption in history” with teaching and learning within educational institutions grinding to a halt and impacting more than 190 countries, 1.6 billion learners, 300 million higher education students, and 100 million teachers and school personnel. **Chapter 13** analyzes the impact of the COVID-19 pandemic on global endeavours to achieve the 2015 United Nations' Sustainable Development Goals. It reviews the mitigation strategies used in the education sector, focusing on low income countries, specifically in Africa, and considers the intersections of the pandemic with poverty and gender. It argues that the pandemic has thwarted endeavours to ensure inclusive and equitable quality education and promotion of lifelong learning opportunities for all. For its part, **Chapter 14** makes the case that design choices protect and regenerate living systems, known as “Mupo” in the Venda tradition such as, for example the education system, and being mindful of the implications of social, economic, and environmental choices. It highlights the protection of living systems when challenged by pandemics and their attendant poverty, climate change, food insecurity, unemployment, and other activities. The foundational case study discussed resonates with the philosophy of Indigenous scholars' and sages' expressions of relational knowing and being. It focuses on new hopeful narratives supporting food security and employment, and applied them to the locality of Venda in South Africa. **Chapter 15** discusses the impact of COVID-19 on education (formal, indigenous) and the anticipated post-pandemic

effects. After considering the place of Indigenous education and its post-pandemic survival, it proposes a way forward by embracing disruptive pedagogies.

PART D incorporates six chapters, Chapters 16 through 21. **Chapter 16** is interested in the reframing of economic development that would not return to pre-COVID-19 *modus operandi*. It is largely grounded on community-based research that was undertaken during the period (December 2020-January 2021) in Nwoya district, Uganda. It questions the current global economic system that is geared to the increased wealth accumulation concentrated in the hands of the very few, the continued plundering of resources, the attendant ecological damages, and the associated public health crises. It offers a vision of new possibilities based on *Ubuntu*-type principles of relationality for holistic wellbeing. It discusses the results of a workshop in which participants deplored the purely pecuniary approach to economics (so-called “business as usual”) and rather embraced new and responsible ways of doing business. They further condemned the many injustices that pervade societies, pleading for collective resistance. The chapter outlines the paradigmatic approach and commitment to a decolonizing agenda that is in harmony with the United Nations Sustainable Development Agenda. **Chapter 17** is a compilation of a socioeconomic survey of experiences from Eastern, Southern, Central, Western, and Northern Africa from among the greens, the business community, and the general population who contributed their views on the basis of their respective country experiences. The points of discussion include trade and tourism. A recovery program is outlined to include a revised economic model from import-based to export-based or self-sustenance, investment in e-governance, revival of international collaborations, and women empowerment and gender equality. In **Chapter 18**, it is recalled that the African continent had been predicted to suffer unprecedented devastation compared to the rest of the world – a prediction that, fortunately, did not materialize. Nonetheless, this gloom prediction resulting from the COVID-19 pandemic will have an impact on HIV infection that has disproportionately burdened the continent. The interaction between the COVID-19 pandemic and the HIV epidemic in the African context is examined with the conclusion that it will inevitably lead to disruptions in the provision of HIV services. Mathematical (epidemiological) models actually projected that a 6-month interruption of supply of antiretroviral therapeutic drugs across 50% of the HIV population would lead to 1.63 times increase in HIV-related deaths over a 1-year period. Fortunately, the reality contradicted these dire predictions. The reason is that most African countries openly declared the existential threat of COVID-19 to health, while some other countries downplayed or plainly ignored it. **Chapter 19** is an overview of a phytochemical approach from African *flora* to fighting the next pandemic. African medicinal plants are indeed rich in such natural bioactive metabolites with recognized therapeutic values against several human diseases, including deadly fevers. Ethnomedical and phytochemical studies on the African medicinal plants have led to isolation of promising antiviral, anti-inflammatory, anti-parasitic, analgesic, and antimicrobial metabolites. African scientists (ethnobotanists, phytochemists, microbiologists, and pharmacologists) are challenged to collaboratively intensify the search for such phytochemicals and develop them into functional medicines for the various diseases/pandemics devastating the continent. **Chapter 20** provides perspectives on COVID-19 from genetics, epigenetics, and ecogenetics viewpoints.

Current observations of the pandemic effects suggest that genetic factors are involved, and indeed play a critical role, in the etiopathogenesis of the disease and its complications. Many therapeutic strategies under study and development do indeed rely on understanding the role of epigenetics. In **Chapter 21**, the ten cardinal socioecological factors responsible for the occurrence of pandemics are identified. This is the basis of the SASA PanAfrica Pandemic Proclamation in **PART E** of this book. The needed infrastructures and international developments are set forth for their effective prediction and prevention. The organizations pursuing a global health agenda are selected, extending the “One health” paradigm to the “One-World-One *ecoHealth*” paradigm. The role and application of decision-making of policies driven by epidemiological modeling are discussed. Enabling technologies are reviewed for predicting and preventing the next pandemics and a needed research program is outlined for predicting and preventing the next pandemics.

Lastly, **PART E** provides the SASA PanAfrican Proclamation that identifies the socioecological factors responsible for COVID-19 and other pandemics, and offers SASA independent *pro bono* research and education services to any requesting African government or institution.

Chapter Two

Rendering Africa more resilient, sustainable, and better prepared for COVID-analogous pandemics: Proposals from across seven African countries

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Abstract - This chapter details a number of proposals for rendering African countries more resilient, sustainable and better prepared for COVID-19 and similar future pandemics. The proposals were solicited from a group of participants from various countries in Africa, who previously (2016) participated in week-long face-to-face dialogues as part of a project entitled “Re-inventing democracy in the digital age” funded by the United Nations Democracy Fund and organized by the Futures Worlds Center. Many of the youth pioneers (aged 18-30) who participated in the 2016 sessions subsequently continued to liaise with one another via various virtual forums. In August 2021, spearheaded by the Future Worlds Center, we decided to set a “triggering question” for these participants to reflect upon and engage around with each

other, with the aim of writing a chapter on responses to COVID-type pandemics, to share with audiences. The triggering question to kindle Ideas/proposals was: “What actions/reforms/policies should our country take in order to become more resilient, sustainable and better prepared for future crises such as the COVID-19 pandemic?” Volunteer participants were invited to share their Ideas regarding practical and forward-looking (visionary) responses to this question. They were invited in the first instance to share Ideas on a virtual platform called IdeaPrism in preparation for a video conference using Zoom in which clarifications of the Ideas were solicited from the Idea-originators, by others asking questions. The clarification questions were mainly around actual or potential ways of actioning the Ideas within and across countries. This resulted in a rich array of concrete proposals, which we detail in the chapter, along with an overarching synthesis.

Key words: Preparedness for crises; dealing with pandemics; actionable and forward-looking idea-creation; dialogue to deepen understandings of ideas; bottom-up participation in democracy.

Abbreviations

FWC:	Future Worlds Center
ICT:	Information and Communication Technology
IT:	Information Technology
KEMSA:	Kenya Medical Supplies Agency
MAYO:	Marvel Acts Youth Organization
NTV:	(Kenya) National Television
SDD:	Structured Democratic Dialogue
TQ:	Triggering Question
UNDEF:	United Nations Democracy Fund

1. Introduction

The writing of this chapter is part of a larger project called “Re-inventing democracy in the digital age”. This project was funded (2016-2017) by the United Nations Democracy Fund (UNDEF) on the basis of a proposal for funding put forward by the founding CEO of the Future Worlds Center (FWC) – Yiannis Laouris. Participants from five geographical regions – with Africa being one such region – engaged with each other (in separate groupings) to deliberate face-to-face for a week upon options for re-inventing democracy in the digital age. From Africa 16 participants were involved. A pictorial description of the methodology utilized in the project – called Structured Democratic Dialogic (SDD)¹ is offered in Laouris *et al.*, (2017: 14).

¹ The methodology was registered as a collective service mark by the Institute for 21st Century Agoras under the name Dialogic Design Science in 2002.

Briefly put, typical SDD processes are always structured around a set of Triggering Questions (TQs), one of which triggers discussion around identifying and prioritizing challenges being faced (as seen and discussed by the participants) and another which triggers discussion around identifying the most influential Ideas on the level of action which would constitute effective intervention towards a (more) collective wellbeing/quality of life. In response to each TQ, participants submit Ideas, which are clarified by the originators of the Ideas, also in response to clarification questions asked by other participants. The participants then move towards developing a shared language to communicate Ideas and their meaning. Thereafter, mapping processes ensue, which maps their collective agreements regarding the Influence of Ideas on other Ideas (aided by a software tool called the Cogniscope).² The TQs as formulated for the 2016 re-invent democracy dialogues, were intended to trigger participants' deliberations around the roots of shortcomings of current systems of governance, and final mapping of what was (collectively) deliberated to be the most influential action options that could best serve as points of intervention for the re-invention of democracy in the digital age.

SDD processes are based on inviting a wide range of concerned stakeholders to the discussion. In the case of deliberating about our future, the youth are of course prime contenders for participation. Hence the re-invent democracy project focused on “youth” as participants (18-30 years of age). The youth who became core participants in the project were chosen on the basis of a number of criteria that the FWC team applied in assessing the applications submitted, following the project being advertised in various forums (using global alliances of the FWC and various social media). For example, years of relevant experience and prior relevant activities became criteria of selection. Youth were also selected on the basis of their being potentially influential as young leaders, and as belonging to associations with wide networks. The commitment to the project (as sensed by the FWC team by perusing the applications with the attendant videos) was taken into account. Their country of origin was also considered, so that participants from a range of countries in the region could contribute to the discussions. The FWC team also ensured a balanced gender distribution of participants. In the African cohort, countries that were represented were: Cameroon, Ghana, Kenya, Malawi, Uganda, Zambia, Zimbabwe (with 16 core participants). The week-long dialogues were held in Kenya (9-13 May 2016) at the Kenya Institute of Curriculum Development.³

In the arrangements towards writing of this chapter, with specific reference to rendering Africa more resilient, sustainable and better prepared for COVID-analogous pandemics, participants from the original African cohort were invited to participate in a two-hour virtual symposium

² The Cogniscope software facilitates the gradual development of an influence map (or influence tree), based on people's collective deliberations around pair-wise comparisons between ideas. The Cogniscope implements the Interpretive Structural Modeling algorithm, initially developed by Warfield (1973; 1994) and adapted by Christakis (Christakis and Dye, 2007) and further optimized by the first author of this article (ISM Parallel, 2015), to reduce the number of pairs of ideas that the participants should consider for an influence relation.

³ The report on the results developed by the African cohort can be found at: http://reinventdemocracy.info/w/images/8/84/RD_AFRICA_Initiative_Report_2018HIGHRES.pdf.

to be followed by working together virtually on this chapter. 12 participants expressed interest. In arranging (via doodle) a time and date suitable to the majority, 6 were able to attend the symposium (held on 24 August 2021), and another posted 3 Ideas on IdeaPrism for the group to see. Participants from the following countries participated: Cameroon (additionally sharing from experience in Madagascar), Kenya, Ghana, Malawi, Zambia, Zimbabwe.⁴ It should be emphasized that in this symposium (2021), we did not implement a full SDD process as described in the literature (e.g., Christakis and Bausch, 2006; Cisneros and Hisijara, 2013; Jones, 2008; Kakoulaki and Christakis, 2020; Laouris, 2012; Laouris *et al.*, 2009ab, 2018; Flanagan, 2021). Instead, we took as basis the collaborative thinking and collective intelligence that had been developed in the 2016 interactions of the African cohort, and we asked these SDD-experienced participants in a less structured narrative style to now consider a TQ specifically relevant to addressing crises such as the COVID-19 pandemic.

The TQ was: *“What actions/reforms/policies should our country take in order to become more resilient, sustainable and better prepared for future crises such as the COVID-19 pandemic?”* The intention was to generate meaningful dialogue towards designing a feasible as well as imagination-imbued future. This can be likened to what has sometimes been called an asset-based approach (Kretzmann *et al.*, 2005; Mathie and Cunningham, 2008; Syarifuddin and Nildawati, 2017; Woldegies, 2014). As Syarifuddin and Nildawati (2017: 3365) put it, the aim is to “identify strengths in the community through Focus Group Discussion and Appreciative Interviewing”, with the intention to “map assets in the community”. As Chilisa (2012: 174) likewise expresses, the research processes (with all the participants being co-researchers) must be designed to avoid debilitating accounts of people and communities, as this is counterproductive to people’s collective participation in forwarding the future of which we all are part. Hence the dialogical processes have to be designed to encourage “asset-based” thinking and discussion around options for strengthening of such assets. The discussion which is the subject of this chapter was arranged accordingly.

One of the premises underlying SDD processes is that democracy as practiced within any SDD encounter or part thereof, as well as in the wider society, is clearly not merely a matter of aggregating (or adding up through voting) the initial ideas that people might put forward as “preferences”. Democracy as understood by proponents of SDD implies people together seeking convergence towards solutions that are likely to contribute to increased collective wellbeing (quality of life) overall. In the African context this is consistent with Adyanga’s point that in pre-colonial Africa, consensually-oriented decision making was often valued and implemented in various ways (2019: 38). For example, he points out that a Village Council was often responsible for “equitable uses of land” and he argues that council members needed to be trusted by the community – otherwise they could be removed from membership of the Council or any other

⁴ In September 2021, participants were invited to explore the additional question of the role of people as individuals and collective agents in making a difference to social outcomes, also in the COVID era. In exploring this question, more participants took part. The authors’ deliberations around agency are presented in Chapter 5 of this volume (Romm *et al.*, 2022).

leadership position. He remarks that post-colonial African leaders are oft-times governing in terms of their own and foreign-led economic interests, insofar as this suits them (Adyanga, 2019: 41). Adyanga contends that the selfish interests of many current leaders in Africa can be contrasted with ancient democratic traditions in Africa, where there were various mechanisms in place to generate a collective style of decision-making which could serve the common good, and which would expect chosen leaders to solicit community participation in decision-making. Adenkule similarly contends that “the elements and indices of democracy ... were present in one form or another in precolonial Africa” (2012: 18). According to Adekule, “African cultures infused communal values into their political practices (p. 18). Other scholars who have located such values as “present” (though not in perfect ways) in Indigenous African cultural traditions prior to colonization are, for instance: Ani (2013); Bassey (2019); Bates (2010); Chirawurah *et al.*, (2019); Matlosa (2007); Romm (2015, 2017). (These authors all argue that processes of colonization impinged negatively on such values.)

The proposals as expressed in this chapter should be read in the light of a consideration of prospects for strengthening African democracy, as part of the process of preparing for and addressing COVID-19 type pandemics. The proposals point to how people’s collective agency as citizens can input into the functioning of governance systems and also points to the role of the various NGOs in which many of the participants in the re-invent democracy project are actively involved.

In structuring the chapter, we firstly (in Section 2) offer an explanation of the purpose and importance of the TQ which was posed in 2021, and the types of Ideas that this TQ stimulated. Sections 3-8 in turn explain each specific Idea and summarize the clarifications thereof as solicited by the group (which in each case included everyone present in the Zoom meeting, including the facilitator). The clarifications and additions to the Ideas went through yet another process, in that we set up a google document so that all authors of this chapter could examine and write into the draft chapter (with the preliminary draft created by Norma Romm, who had participated in the meeting by asking clarifying questions during the discussion and who synthesized the Ideas into the overarching narrative, finalized in Section 9). This meant that all participants had the opportunity to contribute to the chapter’s construction by modifying/adding input – whether or not they had participated in the Zoom discussion of 24th August. Audiences are invited likewise to engage with the ideas as presented in the chapter, including with our synthesis and Conclusion, which are not meant to be prescriptive but to offer a sharing of Ideas such that others can decide how transferrable these are to their contexts of action (cf. Anney, 2014: 277; Romm, 2018:184; Woldegies, 2014: 89).⁵ As indicated by Msila (2017: 56), sharing is an African obligation and it is in this spirit that we have presented the ideas in this chapter.

⁵ For readers to be able to assess transferability to their contexts, rich and dense descriptions/narratives need to be created – hence we have ensured in Sections 3-8 below that the richness of the Ideas and their clarifications have been detailed in this chapter.

2. The value-laden nature of the question: Triggering of valued action-oriented responses

The TQ was formulated so that the group would concentrate on possible actions/reforms/policies that could (and should) be taken in order to become more resilient, sustainable and better prepared for future crises such as the COVID-19 pandemic. This was with a view to us all writing a chapter for this book title, namely, *COVID-19 Pandemic: Perspectives across Africa*. The TQ was thus tailor-made to suit this purpose. Yiannis Laouris initially set the question (after Norma mooted with the group the possibility of us creating a contribution for the book). He invited people on the WhatsApp group of the African Chapter of participants in the Re-inventing Democracy project, to reformulate the TQ if they felt that it could be better expressed in view of the book topic. But people did not venture to offer new suggestions, thus indicating their satisfaction with its formulation. What is significant about the TQ is that it is clearly not meant to be neutral in content; it is meant to urge people to consider what actions/reforms/policies our country *should* take in order to become more resilient, sustainable and better prepared for future crises. It is also requesting people to consider their local knowledge about “our country” and implicitly other ones too – with the implication of this being a country in Africa. The TQ urges people to consider what seems both feasible and imaginable in the country for the benefit of the country as a whole being more resilient etc., and not just for the benefit of a few individuals (but for the “collective good” or “common good”). Participants were requested to make their proposals SMART (Specific, Measurable, Assignable, Realistic, and Time-bounded) and peers to ask questions that would encourage them towards that end; like “how”, “who”, “when”, etc.

The setting of this TQ was an important start to the dialogical process. As indicated above, it already geared people to immediately gear their attention to how life for people as a whole in the country could be “better” if certain actions were to be taken, based on potentials that they could envisage (with a moral eye too) as feasible and imaginable. The TQ triggered a number of Ideas that were posted before the symposium on a shared virtual platform called IdeaPrism.⁶ Some participants posted more than one Idea for everyone to see (and some already included clarifications of their various ideas). The posting of the Ideas on IdeaPrism served two functions: i) it helped the participants who posted Ideas to think carefully about how the TQ could usefully be answered and ii) it helped us all (those who looked!) to start to think about our questions that we may wish to ask by way of (further) clarification.

During the actual Zoom session, the facilitator (Laouris) allowed most of the Idea-originators to answer questions from the group only in relation to **one** of their Ideas, due to time limitations. (The facilitator explained that he would rather that we do some Ideas “well and good” instead of many ideas “fast and not so good”. He also explained that the google doc would provide an opportunity for further inputs.) But two participants were given the chance during the

⁶ The Ideas that were posted on IdeaPrism before the symposium can be found by creating an account in this App and requesting guest access to the Dialogue “Perspectives across Africa about the pandemic.”

Zoom session to refer briefly to another of their Ideas, as these seemed very linked and the clarifications were moving across the two. During the discussion we also briefly linked one of the Ideas posted by a person who could not be present during the Zoom meeting to a proposal of another (present) person, as part of the clarification process. In any case, the TQ served its purpose of generating pertinent Ideas/proposals that formed the basis of a stimulating discussion/learning encounter. It can be said that the Idea-originators learned from hearing the types of clarification questions that were posed to them (as they had to reflect more deeply in the light of the questioning) and the people listening of course learned by hearing the various responses and hearing about possibilities for concretizing the Ideas – and hopefully audiences of this chapter too will find some of the discussions relevant and inspiring for their contexts of action. In short, the TQ (as expected) stimulated the development of Ideas and a learning process around options for generating responses to crises (such as COVID-19 type pandemics) that have and might occur.

3. Idea 1: Proper resource allocation and structured road map to deal with pandemics

This Idea was contributed by Abdulkarim Taraja (from Kenya) on IdeaPrism as his first idea out of the 4 Ideas that he had posted on IdeaPrism. It was the only one that was discussed during the Zoom meeting, due to time limitations. He clarified it on IdeaPrism as: “In Africa, many governments are never adequately prepared to tackle crisis even those that reoccur year in year out. During the Budget Making process, less attention is given to any potential disasters and when these eventually happen, they look for the international community to assist, much of the resources going to few individuals in government like in the case of KEMSA scandal in Kenya in 2020 through media investigative documentary titled ‘COVID-19 Millionaires’ by the National Television (NTV Kenya)”.

During the Zoom discussion he continued to clarify that pandemics have taught us many things, such as the need to have a structured way of putting aside resources to prepare for crises. He noted that this has not been something that African countries have put a lot of effort into. He referred to global citizenship (which includes empowerment of citizens as a concept) and that it implies for him that the government and all citizens must come up with a structured way of allocating resources and make a road map to deal with crises such as pandemics. He indicated that if no budget has been set aside, it becomes a problem. In response to a question as to how citizens can become involved in the budgeting process, he stated that here in Kenya the 2010 Constitution makes provision for Budget Making in which citizens are allowed to contribute to the budget making process through the Public Participation. This offers an opening for citizens to insist and share opinions and priorities on allocating resources for use in the event of crises occurring. This is important because when COVID-19 came nobody seemed to know what to do, and which ministry is responsible for what or in charge.

In response to questions about the details of how the national budget can account for this, he suggested that a certain percentage, say, 2% of the yearly budget can be set aside to deal with crises such as pandemic(s). If by the end of the year it has not been used then as in any budget, it returns to the treasury for re-allocation. He also indicated that if it turns out that 2% is not sufficient, then extra money can be raised, for example, through international bodies such as the United Nations (UN). But having some money set aside “from the word go” would be helpful. One person queried on the chat box what kinds of crises would be prioritized, for example, let us say a crisis such as a flood occurs, and uses all the budget, how would a crisis such as the pandemic then be addressed? Abdul replied that the government would have to adjust the national budget to deal with catastrophes through the supplementary budget – such as locusts’ invasion and floods in 2019, but again if necessary international disaster funds could be drawn on.

Another person queried (on the chat box) who would manage the fund or plan and whether there would be a committee to do so. (Here she was already offering thoughts/options for reflection.) Abdulkarim responded that, yes, indeed there must be a committee and this was one of the advantages of creating the fund in that it would be overseen by a committee. The committee then drafts the road map or simply the guidelines of how the funds should be used by the committee which will then account for the funds.

Yet another participant asked how priorities would be set – for example, could the funds be used for aiding people who lost jobs due to the pandemics? To this, Abdulkarim replied that the fund would have to be set aside for COVID-19 type health crises only – so it would be used for supplying drugs, chemicals, improving medical infrastructure and other related issues to mitigate the health effects of the pandemic. As far as cushioning citizens in terms of their economic losses, stimulus programs would have to be created by the executive and parliament, but not as part of the roadmap, which should be focused on health-related effects. This idea on resource allocation and management had also been raised by Melvis Kimbi in IdeaPrism, who noted that “Countries like Cameroon and Madagascar should have an emergency fund, voted in the national budget, and sufficient enough to cover the essential needs of the population in times of a crisis or pandemic like COVID-19.” She further expounded that “with such a budget line well-managed, they can ensure that urgently needed humanitarian assistance reaches those in need at the earliest time possible.”

4. Idea 2: Prioritize IT in development planning (short, medium or long term)

This Idea was posted on IdeaPrism by Abiba Abdallah (from Ghana). (She wore a T-shirt during the Zoom meeting which displayed her advocacy and allegiance to global citizenship.) In clarifying her Idea, she indicated that the context of her proposal is that most businesses or organizations had to go online due to Covid-19 challenges, but people were not necessarily

equipped to handle this transition. She explained that as far as public organizations are concerned, IT could be used effectively in e-government and also in the educational and health sectors.

She was asked a clarification question as to how citizens could encourage the government to prioritize IT in planning – that is, how would the government become encouraged? She replied that citizens can actively become engaged in the planning process because at district level and municipal level the districts and municipalities set up dates and they invite stakeholders on board – so these could be forums for pushing for IT plans. Likewise, inter-municipal and interregional forums can also be used to push for (more) use of technology.

Another participant asked a question by noting that when people raise the issue of IT and technology in Africa or in Ghana (from which both he and Abiba come), the defense is that this could lead to further unemployment. At the moment often 3-4 people do things that one person could do (if aided by technology) and in our country illiteracy (on a technical level) is high; so, a lot of people will then not have work. So, the issue of unemployment is a concern that could be raised when one pushes for more IT. He asked: What do you say to this defense?

Abiba replied that, yes, there are pros and cons in every situation. Some people may experience the challenge of unemployment, so there would need to be policies put in place to address the question of the manual way of doing things and the consequences of changing this. She noted that, for instance, the government is already promoting TVET (technical and vocational education and training) and she suggested that more digitalization should be encouraged so that people will be skilled in this aspect. So, in a crisis such as Corona, they would know how to go about their business – this would be a way to address the question of unemployment. Meanwhile in the educational sector (including servicing of schools) the corona virus has pointed to the importance of promoting digitalization so that those less privileged in IT could boost their skills in this sector. This would require capacity building of teachers in IT (ICT) as well as capacitating the children. As it happened, many kids were not educated for a year when Covid-19 struck. It took a year before students could go online to learn. So, learning through the internet needs to be prioritized. And this should include not only theoretical aspects but the practical aspect of how to learn online. Kids need experience from a basic level. (This could also supplement in-person teaching and learning in future.)

A participant interjected a question as to how Abiba felt that digitalization could have helped the COVID-19 pandemic in Ghana – and what types of digitalization, that is, what kinds of IT did she have in mind in industry, in education, and/or health? How would this be supportive in addressing the pandemic? She answered with reference to her example from the educational sector and stated that here specifically the educational service needed to put up a system that enabled kids to go online to learn – if that initiative had been taken before COVID-19, it would have helped drastically and have reduced the number of kids who were not educated for a year.

Another participant (Norma) at this point also mentioned that Melvis Kimbi had posted an Idea on IdeaPrism which might help to further cast light on the question of the value of IT. Melvis had posted that: “In both Cameroon and Madagascar, there is a need to promote alternative working conditions such as teleworking. A large part of the population has been rendered jobless by the pandemic as all work is done manually, on site and in clusters. This means that a lot of people are still computer-illiterate and the system needs to work on building potential in the ICT domain”. Norma referred to this and asked Abiba if she would agree that if people were rendered more ICT competent this would enable them to do teleworking and so be able to get employment for example, during the pandemic, where lots of people doing manual work lost jobs. Would this fit in with Abiba’s point that some jobs may be lost if IT is pushed, but others may be created (e.g., teleworking)? Abiba replied that she agreed with that. The facilitator then mentioned that although Melvis is not here today – at the end we can read again her Idea on IdeaPrism.

5. Idea 3 (linked to Idea 4): Improve preparedness mechanisms and strategies at the local and national levels

This Idea (and a related one referred to later, namely, “Appoint independent fundraising and budget monitoring board), was posted on IdeaPrism by Abel Mavura (from Zimbabwe) and clarified by him during the symposium. He indicated that, speaking from his base in Zimbabwe, we need to come up with proper mechanisms at local and national level. He expressed concern that there may be some mechanisms to deal with crises at national level, but it is problematic when these are not applicable to local or rural areas where there may be specific problems that people are facing. So, we need to develop context-specific mechanisms to use when preparing for this kind of pandemic. He also stated that the government needs to come up with relevant committees because during COVID-19 a lot of things were going on including lots of corruption and the government was not able to account for some of the resources that had been used. Hence a committee is needed which will delineate what kinds of materials and resources are required to respond – responsible people need to understand what is needed and develop strategies at local and national level. What is important is that in this process the planners are in touch with the local level and the voices of marginalized people: ideas must come from below from the local people and not only involve the top level.

By way of a clarification question he was asked what concrete steps or actions would need to be taken to provide evidence that the country is prepared in the way that he was envisaging. He responded that there are several concrete actions. As part of the improvement of preparedness, the government would need to prove that they have people who are capable to implement strategies at national and local level. He mentioned that the national government is usually not able to handle things from their offices without understanding the communities and the areas that need specific actions – which need to be different in different provinces to take account of local conditions and cultures. The facilitator wrote anonymously in the chat box (and asked Abel) how we would know that a country meets the preparedness criteria. What are the indicators – money,

equipment, people? What? That is, is it possible to propose a checklist to “measure” how well prepared a country is? Abel responded that budgets is a basic benchmark and resources too in the form of equipment, and committees need to be set up that are responsible for mobilizing the resources and reporting back to Parliament on this. They would have to show that this is the material we have in place and how it can be distributed and who is going to receive it – is there enough for everyone? Someone else wrote in the chat box by way of a question: “How will citizens be involved so they can hold government accountable should there be any failure”? Abel did not directly respond to this, but another participant followed up and asked how the government would be encouraged to become more “well prepared” – how would people’s voices be heard – that is, how could the government be motivated to respond to these (also given his earlier statement about corruption and people maybe not wanting to be accountable for the way budgets are spent)? (The person who had asked the related question on the chat box indicated that this was similar to her question phrasing.)

In answer to this “how” question, Abel stated that this moves into his second Idea, namely, the need for a budget monitoring committee, which will help in the reporting process. This he indicated would help to fight against corruption – for this we would need an Independent Board constituted by people from different parts of society and from different organizations and also people representing the voices of the people not coming from the ruling party. An independent board could ensure that the government accounts for the resources and implements things correctly.

This led to the question of whether the government would agree to set up this independent board. Abel responded that, yes, they would agree because this can be done through Parliament – where there are other people (other than the ruling party) contributing, and the ruling party has to listen to people from opposition members and people representing those who come from different backgrounds.

The next person was then asked to choose their best idea and one they felt most relevant with impact for the pandemic.

6. Idea 5: Building sustainable livelihoods for youth through urban farming

This idea was presented by Apollo Murigi (from Kenya). It was one of the 4 Ideas that he had posted beforehand on IdeaPrism. He indicated that in addressing pandemics, it is not only the government but also civil society and communities that play an important role. He referred to an organization (Miss Koch Kenya) where he was managing a number of programs – with entrepreneurship being one such program. As part of this program one of the approaches to livelihoods (with other values such as nutrition alongside this) has been to use space-conscious farming techniques such as vertical gardening and mushroom farming in urban areas (specifically informal settlements). Apart from the organization engaging youth in livelihood

activities in the fields of dance and the Arts, they are taught skills in urban farming. This proved to be crucial when Covid-19 happened. That is, because many jobs associated with the Arts and music became rendered redundant during COVID-19 (e.g., DJ jobs which need a club), these people might have been rendered unemployed. But with a number of other civil society organizations, they had all come together and introduced the youth to urban farming in urban spaces. So, for example, in a space of 10x10 meters, 30 people can get a livelihood from mushroom farming if this is done properly. The idea, plus other forms of farming, has proved successful in building sustainable livelihoods through empowering women and youth. To date, 180 youth and 220 women have been involved.

One of the participants (from Ghana) indicated that she loved this idea and that she had been involved in a similar project in certain urban areas with urban farming. But she now wondered about how one can cater for more remote areas – how could we help them to promote the marketing process? She mentioned that to take care of themselves and sell their produce, they had to travel far.

Apollo responded that thanks to this participant (Abiba's) involvement in the organization called Move the World, and thanks to her introducing him to another person in this organization (the co-founder of it), he had set up a meeting with the latter to indeed discuss this issue as relevant to Ghana as well as Kenya. The initiative that he had already started (as part of Miss Koch Kenya) in Kenya was to train the youth in e-marketing – using media such as Facebook, WhatsApp, Twitter – to secure orders for their produce. That is, youth and women are trained to market their produce online. He also mentioned that he had also organized a pilot project in a pastoralist area in Kenya, for setting up kitchen gardens in primary schools and in TVET so as to reduce their expenditure for food for the institutions and the community, which has an economic impact as well as a nutritional impact. So, it enhances food security. It is a process of continuous learning in schools and in households. He mentioned that this initiative started with a single organization (the one where he is program manager) and now they have 14 organizations that have joined (involving 37 Counties in Kenya). He emphasized that these are bottom-up initiatives which citizens have started and not the government. It is initiated by the communities and it is sustainable – and has high impact for people in terms of livelihoods, food security and nutrition, relative to the resources that are put in. (Micro-finance loans are sometimes put in place to help the start-ups.)

The facilitator referred in the chat box to another example of this – in relation to energy generation in Europe, which makes communities more independent in the case of electric crises: this, he noted, boosts the local economy while rendering people more resilient. He asked Apollo whether these ideas could spread to other countries in Africa, and Apollo then mentioned that this is do-able through partnerships; that is, if we come together with other organizations, in relatively low-cost kinds of operations, we can reach more countries. To this end, he has recently been liaising with the co-founder of Move the World in Ghana (thanks to his becoming connected with Abiba via the re-invent democracy project, who is involved in this

organization). Furthermore, thanks to his connection with Abel Mavura (founder of Marvel Acts Youth Organization, MAYO) from Zimbabwe through the re-invent democracy project, plans are underway. He stated that they are merging the areas in which they work and implementing in our respective countries. He mentioned that such activities can be strengthened through applying for joint proposals on the basis of ideas that are already running, which are easier to fundraise for – so we can reach more countries than we have reached so far.

Another participant asked whether there needs to be put in place by the government some policies or laws that would make it easier for such initiatives to spread. Apollo replied that it would be helpful if the government made it easier for youth groups and women's groups to register themselves as entities. This will legitimate their work and give it a legal basis so when they engage in this, they do not risk some people taking the profit and running away. So legal structures would be helpful. And, of course, if the government could subsidize some of the material to start with (such as seeds and seedlings) this would be helpful as a way of cushioning beneficiaries in crises, such as COVID-19 or other crises. For example, the start-up capital for mushroom farming is quite expensive, but once up and running it provides a livelihood. (He posted on the chat box in response to the question how the government might be supportive that “Yes, adopting this model as a national intervention either by law or as a practice would be especially great! It would lead to independence of the country in more ways than just food security.)

7. Idea 6: Prioritizing the making of corruption unattractive

This Idea, along with another one (about strengthening health systems and infrastructure of various African countries) was placed in the chat box by Bill Graham Osei Akomea (from Ghana). He was encouraged by the facilitator to focus on this Idea because the next person to speak had posted a similar idea to his one regarding the health system – so the facilitator suggested that it would be very interesting to discuss his Idea on corruption as we do not have anything about corruption so far. The facilitator mentioned that in Cyprus a lot of people became millionaires because of the pandemic (with corruption involved.) So, this is an angle not to miss. Bill proceeded to present his Idea and stated that he framed the Idea as *making corruption unattractive*. He clarified his Idea as follows:

In our part of the world [Africa] this is deadlier than the Corona virus itself. It is something endemic in the system – not only politicians and government officials; it is also in ordinary citizens who practice it. This pandemic now gives us the opportunity to sit up, for example, as a country such as Ghana to tackle corruption. In this COVID-19 season there are lots of issues that have come up that expose the corrupt nature of our society. For instance, donor organizations came to assist the country and the government also set up a COVID-19 fund and a lot of private companies contributed to the fund – but if you ask the ordinary citizen if they are satisfied with how the fund has been used, about 90% will say no – because of lack of transparencies. Even though the fund managers are highly reputable people who have distinguished themselves, but

ordinary Ghanaians think this fund was not well utilized – that boils down to corruption. The fund was supposed to be used to provide equipment etc., in the hospitals, but these are still not in the hospitals – so people ask, where did the money go?

There is a fee if you enter Ghana, you must do a COVID test – some of us think the fee is too much at 50 dollars to test for Covid – in Germany the test kits are available and cheap and some are done for free – in Ghana, Ghanaians pay 50 dollars and non-Ghanaians pay 150 dollars. The worst-case scenario is people confirming negative, but the authorities insisting that they are positive. People have evidence that they were actually negative, but tested positive – one woman tested herself live on social media and the results were negative, but the authorities said they are positive. Perhaps, just perhaps, the numbers we see and read on the news may be inflated to call for sympathy from foreign donors. But that point aside, look at people selling government-donated or private-donated equipment for money – hand sanitizers and masks for money. Meanwhile, when COVID-19 was at its peak, people increased their prices and did not think of their neighbors whether they could afford it – things that can make us all live (such as sanitizers).

This is deadlier than pandemic – so the government should prioritize the tackling of corruption. If corruption was not an issue, we would not have felt the pandemic as much as we did. The government did appoint a special prosecutor to deal with people, especially government officials, who commit acts of corruption, but the first person appointed blamed the government of corruption and as interfering with his work. Now a second person has been appointed and we all (across social divisions in the society) think this person can probably do this work well.

However, apart from an office that is tasked with tackling corruption, we need to go to the grassroots to school level and *sensitize children about the dangers of corruption* and inculcate attitudes in them that see corruption as anti-social and anti-moral: when these kids who grow up, they can then govern the country in terms of this morality. From the basic level this needs to be put into the school curriculum so that from primary level, kids will learn about the dangers of corruption. If attitudes change from that level, then we can be assured of a future where corruption is a thing of the past.

Here he paused for questions, and Apollo at this point wrote in the chat box that he thought Kenya was a unique case, where we had COVID billionaires! Companies registered to trade in cereals ended up supplying the government face masks at 10 USD for a single mask!

The facilitator asked incognito in the chat box, so how do we take advantage of COVID-19 to expose corruption and how do we fight it? He expressed the point that changing the curriculum at school level can take 20 years before the kids grow up; so, what can be done concretely now? He mentioned that we have seen corruption in prices, in the positive/negative tests, in companies who become equipment companies overnight, etc. Is the government just watching – how can

we fight it, or to address Bill's phrasing, how can we make it **not** attractive when people make so much money?

Bill replied that this is a difficult question! That is why he decided to perhaps look at generations to come. If they are socialized into a set of values that made them aware how anti-social corruption is, this would make it unattractive to them. But of course, if we focus on the kids only, we will lose our generation, which we cannot do. So, some concrete steps for now are to say that:

1. Transparency should be improved – for instance, with the COVID fund, it is because of the issue of transparency that people did not trust the funds were managed well – what went into the expenditure? Or as another example, even with the COVID test – how much were we paying for the test – what goes into the costing? It is because people had the perception that billions of dollars were being made from the test, that they were dissatisfied.
2. Stricter and equal punishment are clearly also important to deal with those found to be corrupt. Obviously, every country has laws that punish people who practice corruption such as stealing or having money not accounted for, massaging figures, etc. – but when it comes to equality before the law, this is a problem – the big man often does not get punished. So we need to enforce the laws to the letter and make equal punishment.
3. The social media and increased use of them will help. For example, the COVID-19 test at the airport where figures were massaged, this was evidence from social media where the person tested herself live on social media and it came out negative; that is what social media does – so strengthening social media will expose some of the corruption. Access to information is very important. It is a pity, he noted, that he heard that some countries are banning some social media at times, so people do not get access to information. This is problematic because this is one way of exposing corruption because nowadays smart phones are cheap to afford: It should actually be easy to get access to information which is a human right.⁷

⁷ On the issue of the right to information, in an earlier (2019) Skype conversation held between Bill and Norma, he had mentioned to her that this is not easy, even in democratic systems. He stated using Ghana as an example, that people raise Ghana as an example of democracy in Africa, but their right to information bill had been in parliament for more than 15 years, until last year [2018] that it was passed. Norma asked: "Do you think it is from pressure from citizens or pressure from lawyers? Why did it get passed?", to which Bill replied that it was pressure from all civil society organizations and lawyers as well. Norma asked where he was part of that and he answered in the affirmative. Norma asked if he was pressing as a collective of lawyers (she knew he was a lawyer). He replied that he did it individually: "For example, there was the use of social media. I joined the social media group and when I had a forum, I added my opinions to the fight. And also, through some contributions that were made on radio, on programs related to the passage of the right to information law". In any case, this indicates the potential to "push" for the right to information (which is part of Bill's suggested transparency requirement for curbing corruption).

4. Another practical action to tackle corruption is education, not just in schools but also in government and other enterprises: people should be educated as to what is going on. For example, with the vaccine procurement, it transpired that the health minister had procured vaccines using a middle man to whom huge sums of money were paid. He stated on oath that no money was paid – but later a letter was discovered asking for a refund, which showed that money had been paid.
5. These are some ways of curbing corruption; but in the long run Bill urged us to look at the kids! The facilitator replied that he was always a visionary trying to get to the root of the problem.

The next person was then invited to present her Idea (and later he suggested that she could also add her second idea which was related to the first)

8. Idea 7 (linked to Idea 8): Improve on the quality of health care facilities and access

Rahab Wairimu (from Kenya) had posted this Idea along with another one on IdeaPrism. During the symposium she started off by clarifying her Idea to improve the quality of health care and also make this accessible to more people. She referred to the Kenyan context and stated that if we look geographically, we can see that certain areas are not covered by the health care system and also economically not everyone is served by the system because of the costs. So geographically there is a need to put up more facilities/medical Centers that are equipped and ensure there are sufficient personnel – that is, health care facilities to cover all areas and all socio-economic classes. In the medical system if we look back at the pandemic, if we had had enough facilities, we would have been better able to fight the infection and the system would not have become overwhelmed. So, a step ahead in containing the virus (and future ones) rests on improving the quality of health care and ensuring that this is accessible to all.

One of the participants asked a “how” question – that is, how did Rahab envisage that the government could be encouraged to do as she suggested? – how could pressure be put on the government to make sure that everyone would have health access in the case of this or another pandemic? Would the government be likely to agree that they could pour resources into ensuring high quality health care and full coverage across all geographical areas and all people who needed health care when the virus was rampant? Would it perhaps not be wiser to invest in medical technology that is more preventative, where research could be done on infectious diseases and how to better deal with them? The participant mentioned that these kinds of options had been placed on IdeaPrism in various formulations. While Rahab was replying, the facilitator noted on the chat box in support of her first Idea that “In Cyprus we established a national health program just months before the pandemic. If that was NOT there, a lot more people would have died”. He also mentioned on the chat box that what was being suggested related to “the other Idea that she [herself] had posted about preventing infections”.

Rahab stated that yes, she had placed such an Idea and had phrased it as: “Invest in Research and Development on Infectious Emerging Pathogens”. This could indeed be a preventative measure – but one problem is that the COVID-19 pandemic was not predictable. Nevertheless, she stated that it is important to do such research on pathogens and their likelihood of arising and also how they can be dealt with whether on a preventative level or how to better tackle them medically if/when they do arise. She mentioned that Kenya has had to deal with Ebola and COVID-19 and by now we should have recognized that there has not been much effort put into research on pathogens. We need research not just on medicines for medical conditions that are currently being researched, but around infectious emerging diseases. This goes back to the use of funds and at the moment funds are not being invested in this. She suggested that it does not necessarily have to be the government that gets funds to invest in this – it can be NGOs. But instead of just focusing on normal medicines the focus could be (also) on pathogens. The participant asked if she had an NGO in mind and she said yes, there are many health-related NGOs operating in Kenya and a particularly relevant one could be the one called “I Choose Life,” which has headquarters in Kenya. This NGO, for example, could add this Idea to their program of doing research.

Another related Idea that had been placed on IdeaPrism by Melvis Kimbi concerned what she called “Weak and Non-Existent Health Surveillance Systems”, that is, the absence of health surveillance systems at borders to better manage pandemics. She had noted that “The COVID-19 pandemic has shown that countries (in Africa) still have very weak/non-existent health surveillance systems along borders that can help check movement and ensure contact-tracing in case of a pandemic.” Indeed, in managing the pandemic, many countries did not seem to prioritize this basic public health procedure, be it at the internal level when it comes to declared cases or again at border crossings, giving way to more spread of the virus. In further explaining her point, she noted that “this is the case in Cameroon and other Central African countries where the lack of robust surveillance systems in times of epidemics/pandemics have allowed for the fast spread of diseases, like Ebola. And it has not been any different with COVID-19”.

The facilitator suggested that we now had a range of Ideas from the group (with each one presenting at least one of their Ideas) – and this would be a good point to close the meeting. He expressed that he was excited that the Ideas were to-the-point and rich and already sufficient to share with audiences. And the google doc to be posted as a draft for the chapter would be an opportunity for anyone to edit it.

9. Some pointers drawing together the Ideas in an overarching narrative (with additional references to relevant literature)

In this section we provide an overarching synthesized narrative of what we can say that Corona has exposed, and what lessons we as a group have harvested, which we share with African and global citizens as options for taking us into a better future. To construct our narrative, we also refer to some relevant literature. We start with the issue of corruption, which was a theme threading through nearly all the participants' clarifications of their Ideas. The theme was expressed in various guises: for example, in pointing to the potential for citizen participation in the budget-making process to prepare for crises, along with accountable government bodies to deal with resources and to define how they are to be used (Abdulkarim Taraja); in urging the setting up of committees responsible to mobilize resources for crises and report to Parliament (Abel Mavura); in pointing to examples of COVID-19 millionaires and billionaires (Abdulkarim Taraja, Apollo Murigi and Bill Akomea) and how the corruption that was exposed during the pandemic expressed the blatant immorality of people's not caring about the deadly effect of this corruption (for example, overpricing of sanitizers that would be a life-saver). Bill's detailed clarifications of his Idea during the symposium offered suggestions for "making corruption unattractive". Bill referred to four ways in which this might be tackled in our current generation, but indicated that the prospects for addressing it could best be served through *educating the new generation* in a different manner, specifically including the immoral and anti-social effects of corruption into the school curriculum.

Interestingly, in the South African context, the government in 2012 introduced a national workbook series for school children in all 11 official languages, where the morality of *Ubuntu* was built into the workbooks. Ubuntu is an African philosophy with an attendant morality that advocates caring, compassion, and relationships of reciprocity as part of a feeling of being connected to others and to "all that exists" in the web of life. (For a discussion on Ubuntu, see Section 2, Chapter 16 of his volume authored by Adyanga, Romm, and Johnson). McKay, who headed the team creating the South African workbooks, explains that instead of a *hidden curriculum* which is often operative in schools and which implicitly encourages children to be self-oriented and competitive in seeking individual success (as in many Western and other contexts, including educational systems in former-colonized societies), one can introduce what she calls a *parallel curriculum* (2018). Such a curriculum inspires discussion on, and practices associated with, moral values in all aspects of the curriculum (McKay, 2018). This is done through stories that are threaded through the workbooks, which show the role players caring for each other and for the environment, with questions inviting discussion around this. Another example – from the domain of IT – is CYBER KIDS' curriculum, which intermingles technology concepts with the mental development that should take place while delivering a particular module, along with examples of the social value and the importance of this specific knowledge in real-life, a concept encapsulated as KnowledgePackets (Laouris, 2014). This would also be compatible with Veugelers and De Groot's noting that across the globe there are different notions

of what a “citizen” is and that postcolonial studies (e.g., Torres, 2017) go beyond a conventional Western perspective of citizenship by emphasizing “social justice and societal transformation” as being an important component of citizenship education (Veugelers and de Groot, 2019: 16).

What Bill’s proposal adds to, while extending, these notions, is that the curriculum can focus specifically on the *immoral and anti-social effects of corruption*, so that children become socialized from the start to recognize how deadly this can be to others (in that resources that could be used to serve people become plundered, goods that could save people’s lives become overpriced, etc.). Corona has exposed the deadly effects of practices of corruption and brought to light the need to include this in our curricula (whether in Africa or indeed in other contexts too, for readers to consider as an option).

Gergen’s book on *Relational Being* (2009) and his chapter with Scherto (2020) on educational evaluation, points to the importance of education across the globe being more geared in the direction of helping people to experience the fulfillment of *collaborative efficacy* (working fruitfully towards a common goal), thus discouraging what Bill calls anti-social behavior. Likewise, the book edited by McIntyre-Mills, Corcoran-Nantes and Wirawan (2022, forthcoming) entitled *The Elgar companion to transformative education for regenerative development* also takes this line. Insofar as conventional Western-oriented approaches to schooling which prize individual self-efficacy have become infused in countries across Africa, this has not augured well for children seeing themselves as moral citizens, grounded in a *sense of themselves as essentially relational beings, connected with the world around them*, and not as separate individual entities. Magdoff and Williams likewise argue that to reach a socially just and ecologically healthy world, humans need to be socialized in terms of a recognition of our connectedness with others, so as “to enable prosocial behavior patterns to become dominant, and antisocial behavior, so prized and rewarded in capitalist societies, to fade into the background” (2017: 195). This would mean, in Bill’s terms, that people no longer consider a corrupt route to making money as “attractive”, as they would experience this as anathema to their (socialized) feeling of connectedness to others.

A related point raised by Bill was that sanitizers (for instance) became overpriced during COVID-19, and thus proved deadly – showing the lack of care of the business proprietors. And Apollo remarked that companies registered to trade in cereals ended up supplying the government face masks at 10 USD for a single mask – also indicating “business” practices that manifest an excessive profit motive based on corrupt tendering, *at the expense of caring for the consequences* in terms of looting public resources. What this points to again is that the (Western-inspired) model of humans as “homo economicus” – geared to fulfilling their economic self-interests – has come to dominate our economies (and the global economy). Murove argues that it is regrettable that certain “early modern economists attempted to divest economics from morality” and in this process the “idea of sympathy as social logic” was “hardened into a theory of self-interest” (Murove 2005: 154). Murove, like other authors before and after him, regrets the prevalence of this economic model and its effects in making people believe that selfish behavior is acceptable in “business”. In this regard McIntyre-Mills argues

that breaking with “business as usual”-type economic models is crucial in reconsidering how we can shift current economic trends post COVID (or in the COVID-19 era) to render people more passionate and compassionate as part of “doing business” (2020: 827). This tallies with Arko-Achemfuor and Dzansi’s account (2016) of doing *good* business. Apollo’s discussion on urban farming, with all his clarifications, also points to an allegiance to notions of livelihood as tied to a sense of community and a sense of contributing to a better life in the community not in terms of individual people getting maximum profit but in terms of developing a local economy to serve people, including their nutritional needs and also not to destroy the planet in the process (hence the green vertical farming intention, for instance).

Apart from this, Abiba’s suggestions as to how citizens can push for government to prioritize IT, is a way of mitigating the digital divide and the privileges associated with it, while aiding people in various sectors (including rural farmers in remote areas) to be economically and educationally included and skilled for working during and post-COVID-19. Rahab concentrated on how systems of health care could be rendered more inclusive, including people across geographical and socioeconomic groupings, while also indicating why and how research into infectious pathogens could and should be activated (e.g., by extending the remit of current health research). And Melvis pointed to other needed measures such as health surveillance systems at national borders to check movement and organize contact tracing in order to help manage pandemics such as Corona and others which may arise.

These were some of home-grown local solutions offered by the participants based on their insider knowledge of assets that can be strengthened, with the help of networks of organizations and of people committed to generating resilient and inclusive societies. The participants felt that overall Corona has taught us lessons by starkly exposing vulnerabilities and inequalities, and they offered suggestions for turning these lessons into opportunities for developing more resilient, sustainable and better prepared societies to address crises such as Covid-analogous pandemics – as part of the creation of a better, more inclusive social and ecologically-attuned existence.

10. Conclusion

In this chapter we drew collective wisdom from the various participants’ Ideas and Clarifications thereof, also in relation to other participants’ questions. We explained the mixed media methods that were drawn upon to set up and organize the discussion. The media were: WhatsApp™, Doodle™, Google calendar™, email, IdeaPrism™, Zoom™ and Google Docs™ – all used with the intention of us harvesting a set of rich ideas to share with wider audiences interested in joining the effort to strengthen our work as global citizens. This already attests to how the digital age and use of technology can incite and facilitate a re-invention of democracy, and in this case the sharing of ideas as to how citizens and governments can develop democratic solutions to crises, as a process of people learning together towards forwarding (in our various domains of individual and collective action) an allegiance to the “common good”. All of the

Ideas, and also the synergy between them, point to a vision of society where people – such as these participants – are committed to organizing an inclusive society wherein the welfare of people along with planetary welfare are accounted for. The TQ that was formulated provided a trigger for participants together to share and discuss visions of a mode of our being together in society (and with the planet) where the motive of enhancing overall wellbeing and not a pure profit (self-oriented) motive is exemplified in practice. The “who”, “how”, “when” and other questions of their peers have significantly increased the SMART-ness and comprehensiveness of their proposals. One cannot resist but to wonder whether a council of ministers or a national strategy committee would have produced a significantly more concise and effective list of actions compared to what 6 young people produced during a 2h structured deliberation process. This highlights the power of structured dialogue to harness the wisdom of the actors on the ground and to produce knowledge and proposals for actions that are comparable to those of experts. We have tried as a group to point to some ways in which citizens and government can instantiate this array of Ideas – based on lessons that we have learned from COVID-19 pandemic, which we have highlighted in our discussion.

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References

- Adenkule JO (2012). “Democracy and political change in pre-colonial Africa”. In S Sarsar and JO Adenkule (Eds.), *Democracy in Africa* (pp. 1-18). Durham, North Carolina: Carolina Academic Press
- Adyanga FA (2019). “Ancient governance in Africa”. In N Wane (Ed.), *Gender, Democracy and Institutional Development in Africa* (pp 37-65). London: Palgrave MacMillan.
- Ani EI (2013). “Africa and the Prospects of Deliberative Democracy”. *South African Journal of Philosophy*, 32(3): 207-19.
- Anney VN (2014). “Ensuring the quality of the findings of qualitative research: Looking at trustworthiness criteria”. *Journal of Emerging Trends in Educational Research and Policy Studies* (JETERAPS) 5(2): 272-81.
- Arko-Achemfuor A and Dzansi DY (2015). “Business doing well by doing good in the community”. *The Journal of Commerce* 7(2):53-68.
- Bassey N (2019). “Breaking the chain of development”. In A Khotari, A Salleh, A Escobar, F Demaria, and A Acosta (Eds.), *Pluriverse: A Post-Development Dictionary* (pp. 3-6). Chennai: Tulika books.

- Bates RH (2010). "Democracy in Africa: A very short history". *Social Research* 77(4): 1133-48.
- Chilisa B (2012). *"Indigenous Research Methodologies"*. London: Sage.
- Chirawurah D, Fishkin J, Santuah N, Siu A, Bawah A, Kranjac-Berisavljevic G and Giles K (2019). "Deliberation for development: Ghana's first deliberative poll". *Journal of Public Deliberation* 15(10): Article 3.
- Christakis AN and Bausch KC (2006). *"Co-Laboratories of Democracy: How People Harness their Collective Wisdom to Create the Future"*. Charlotte: Information Age Publishing.
- Christakis A and Dye K (2007). "CogniScope." Available online at: <https://www.academia.edu/download/31196113/CogniScopeCh17KEVINDYE>.
- Christakis AN and Harris L (2004). "Designing a transnational Indigenous leaders' interaction in the context of globalization: A wisdom of the people forum". *Systems Research and Behavioral Science* 21(3):251-9.
- Cisneros RT and Hisijara BA (2013). *"A Social Systems Approach to Global Problems"*. Cincinnati, OH: Institute for 21st Century Agoras.
- Flanagan TR (2020). "Structured dialogic design for mobilizing collective action in highly complex systems". In GS Metcalf, K Kijima and H Deguchi (Eds.), *Handbook of Systems Sciences* (pp. 765-85). Singapore: Springer.
- Gergen KJ (2009). *"Relational Being: Beyond Self and Community"*. New York: Oxford University Press.
- Gill S and Gergen K (2020). "Educational evaluation: A relational perspective". In McNamee, MM Gergen, C Camargo-Borges, and EF Rasera (Eds.), *The Sage Handbook of Social Constructionist Practice* (pp. 402-12). London: Sage.
- ISM Parallel (2015). Available online at: https://www.futureworlds.eu/wiki/ISM_Parallel.
- Jones P (2008). "Dialogic design: Harnessing collective wisdom for democratic design and action". *Proceedings of the Tenth Anniversary Conference on Participatory Design (PDC) 2008* (<https://dl.acm.org/doi/proceedings/10.5555/1795234>)
- Kakoulaki M and Christakis AN (2018). "Demoscopio: The demosensual (r)evolutionary utopia". In JJ McIntyre-Mills, NRA Romm and Y Corcoran-Nantes (Eds.), *Balancing Individualism and Collectivism* (pp. 429-60). Cham: Springer.
- Kretzmann JP, McKnight JL, Dobrowolski S, and Puntteney D (2005). "Discovering community power: A guide to mobilizing local assets and your organization's capacity." A Community-Building Workbook, School of Education and Social Policy: Northwestern University.
- Laouris Y (2012). "The ABCs of the science of structured dialogic design". *International Journal of Applied Systemic Studies* 4(4):239-57.
- Laouris Y (2014). "Teams construct knowledge during project-driven social interactions". *Educating in Dialog: Constructing Meaning and Building Knowledge with Dialogic Technology* 24:111-31.
- Laouris Y (2015). "Reengineering and reinventing both democracy and the concept of life in the digital era." In *The Onlife Manifesto* (pp. 125-142). Cham: Springer.

- Laouris Y *et al.*, (2017). “Democracy in the Digital Age: Manifesto”. Nicosia, Cyprus: Future Worlds Center. Online: http://futureworlds.eu/wiki/File:ManifestoDemocracy_in_the_Digital_Era_20181222.pdf
- Laouris Y and Michaelides M (2018). “Structured democratic dialog: An application of a mathematical problem structuring method to facilitate reforms with local authorities in Cyprus”. *European Journal of Operational Research* **268**(3):918-31.
- Laouris, Y, Michaelides M, Damdelen M, Laouri R, Beyatli D, and Christakis A (2009a). “A systemic evaluation of the state of affairs following the negative Outcome of the referendum in Cyprus using the structured dialogic design process”. *Systemic Practice and Action Research* **22**(1): 45-75.
- Laouris Y, Erel A, Michaelides M, Damdelen, M Taraszow T, Dagli I, and Christakis A (2009b). “Exploring options for enhancement of social dialog between the Turkish and Greek communities in Cyprus using the structured dialogic design process”. *Systemic Practice and Action Research* **22**(5):361-81.
- Magdoff F and Williams C (2017). “*Creating an Ecological Society*”. New York: *Monthly Review Press*.
- Mathie A and Cunningham G (2008). “*Community-Driven Development*”. St. Francis Xavier University: Coady International Institute. Accessed 6 April 2016 at: https://www.academia.edu/727934/mobilizing_assets_for_community-driven_development.
- Matlosa K (2007). “The state, democracy, and development in Southern Africa”. *World Futures*, **63**(5-6): 443-63.
- McIntyre-Mills JJ (2020). “The COVID-19 era: No longer business as usual”. *Systems Research and Behavioral Science* **37**(5):827-38.
- McIntyre-Mills JJ, Corcoran-Nantes Y and Wirawan R (Eds., 2022, forthcoming). “*The Elgar Companion to Transformative Education for Regenerative Development*.” Cheltenham: Edward Elgar.
- McKay, V (2018). “Introducing a parallel curriculum to enhance social and environmental awareness in South African school workbooks”. In JJ McIntyre-Mills, NRA Romm and Y Corcoran-Nantes (Eds.), *Balancing Individualism and Collectivism* (pp. 97-122). Springer, Cham.
- Msila V (2017). “Heutagogy, africanization and learning”. In MT Gumbo and V Msila (Eds.), *African Voices on Indigenization* (pp. 45–65). Wandsbeck: Reach Publishers.
- Murove MF (2005). “*The Theory of Self-interest in Modern Economic Discourse*”: Doctoral thesis, University of South Africa, Pretoria.
- Romm NRA (2015). “Reviewing the transformative paradigm: A critical systemic and relational (Indigenous) lens”. *Systemic Practice and Action Research* **28**:411-27.
- Romm NRA (2017). “Researching Indigenous ways of knowing-and-being: Revitalizing relational quality of living”. In P Ngulube (Ed.), *Handbook of Research on Theoretical Perspectives on Indigenous Knowledge Systems in Developing Countries* (pp. 22-48). Hershey, PA: IGI Global.
- Romm NRA (2018). “*Responsible Research Practice: Revisiting Transformative Paradigm in Social Research*”. Cham: Springer.

- Romm NRA *et al.*, (2022). “The role of people as individuals and collective agents in making a difference to societal outcomes, also in the COVID-19 era: African insights”. In Alain L. Fymat and Joachim Kapalanga (Eds.), *COVID-19: Perspectives across Africa* (Chapter Six, this volume).
- Syarifuddin N and Nildawati A (2017). “Asset-based community development (ABCD) model: An approach for improving environmental and behavioral health”. *Advanced Science Letters* **23**(4): 3364-6.
- Torres CA (2017). “*Theoretical and Empirical Foundations of Critical Global Citizenship Education.*” New York, NY: Routledge.
- Veugelers W and de Groot I (2019). “Theory and practice of citizenship education”. In W Veugelers (Ed.), *Education for Democratic Intercultural Citizenship*” (pp. 14-41). Leiden: Brill Sense.
- Warfield JN (1973). “Binary matrices in system modeling.” *IEEE Transactions on Systems, Man, and Cybernetics*, (5): 441-9.
- Warfield JN (1994). “*Science of Generic Design: Managing Complexity through Systems Design.*” Iowa State University Press.
- Woldegies BD (2014). “*Economic Empowerment through Income Generating Activities and Social Mobilization: The Case of Married Amhara Women of Wadla Woreda, North Wollo Zone, Ethiopia*”. Doctoral thesis, Antioch University, Yellow Springs, Ohio.

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Chapter Three

Rainwater harvesting contributing to water security - Universality of the Kilimanjaro concept

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Abstract – The Kilimanjaro concept (KC) was introduced for East Africa Rift Valley-bound areas as a potential solution to achieve the United Nations (UN)'s sustainable development goals (SDG) on clean drinking water provision in regions where groundwater is highly contaminated

with toxic geogenic contaminants such as fluoride. KC advocates leaving no rainfall drops unused, and controlling quality through low-cost measures such as the use of iron-based filter. In this study the universality of KC is once again demonstrated as a potential solution to enhance water security that has been challenged in recent years with Lake Victoria's level rising during the rainfall season. Rainwater harvesting (RWH) potential through KC is demonstrated, whereby, with increased runoff harvesting for meeting drinking water demands, challenges of Lake Victoria level rising are reduced, and volumes that would have otherwise drained-off are contained. The harvested water is shown to be sufficient to meet daily demand in most times of the year and, where in deficit, a dual supply approach is recommended with alternative supply such as ground- and stream-water so that the demand is always fully met.

Keywords: *Drinking water; Kilimanjaro Concept; rainwater harvesting; Lake Victoria Basin; Lake level rising; zero-valent iron.*

Abbreviations

AWV:	Africa Water Vision
COVID:	Coronavirus Disease
EARV:	East Africa Rift Valley
FAO:	Food & Agriculture Organization
GIS:	Geographic Information System
KC:	Kilimanjaro Concept
NWD:	Number of Days without Water
RUR:	Rainwater Usage Ratio
RWH:	Rainwater Harvesting
SDG:	Sustainable Development Goals
UN:	United Nations
UNEP:	United Nations Environment Program
UNICEF:	United Nations Children's Fund
WHO:	World Health Organization

1. Introduction

A third of the African continent's population is living in a water scarcity situation. To address this, the Africa Water Vision (AWV) 2025 was established, which highlighted that underdevelopment and low water resources usage in Africa was due to poor financing and technology, but not inadequacy of available water resources.

The COVID-19 pandemic may worsen the water scarcity situation in Africa but counteractively serve as a wakeup call for more alternative water sources. Recommended by health workers, hand-washing for at least 20 seconds, a minimal flow rate from a domestic water point would be 10 L/min = 0.17 l/s (MoWI, 2009). This implies that water consumed in washing hands per

person is 3.4 liters per 20 second. If one were to wash 10 times a day, that would be equivalent to at least 34 liters for only washing hands, but ... what about other uses? Nevertheless, availability of basic water services does not seem to be the limiting factor for having a hand-washing facility with soap and water at home (WHO/UNICEF, 2020a, 2020b). In the Middle East and North Africa, washing hands with soap and water receives too low a priority at home and in schools despite the availability of basic water services (WHO/UNICEF, 2020b).

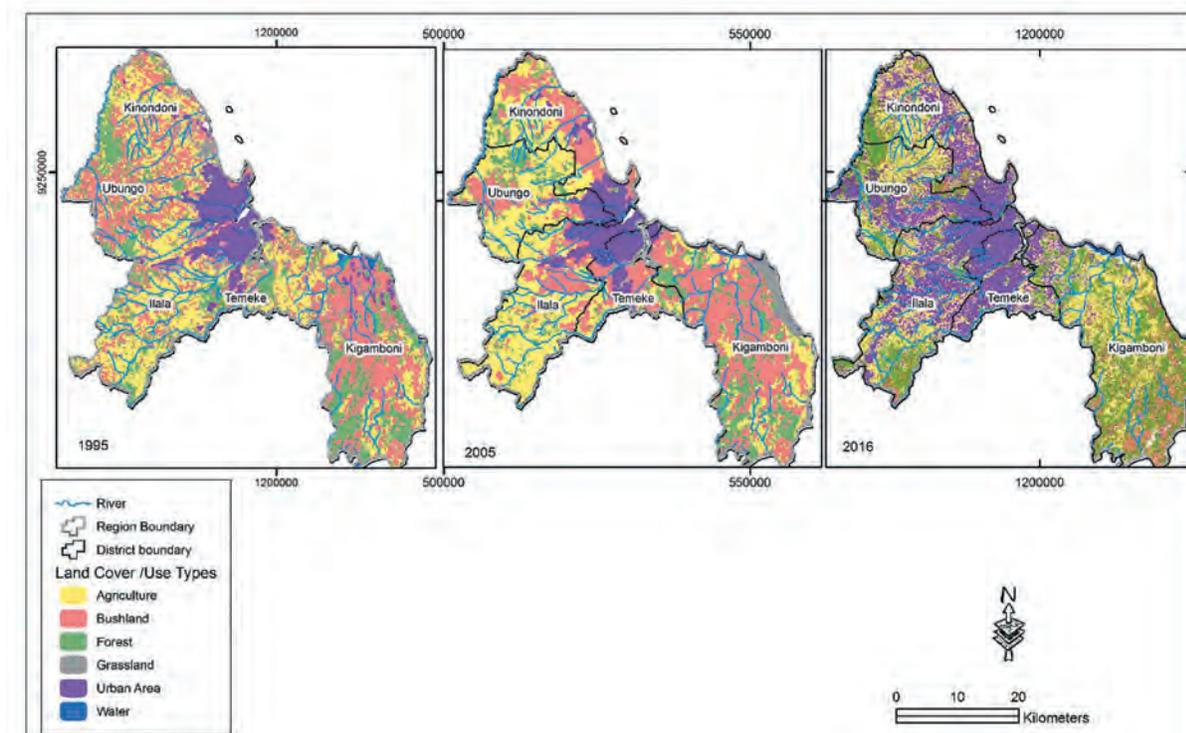


Figure 1 - Land use changes in Dar es Salaam region (1995-2016)

Historically, in African countries, water harvesting techniques have worked well in serving the demands of communities through harvesting of rainfall runoff. Technologies, such as “qanats”, which are artificial underground water channeling systems installed up to 305 m below the Earth’s surface, brought a continual stream of water to the Earth’s surface for agricultural and domestic uses. The Persians used qanats more than 3,000 years (ago Mohsen *et al.*, 2013). This technique later spread to northern African countries such as Egypt. Similar techniques were used in other countries such as “foggara” in Libya, Tunisia, and Algeria and “khattara” in Morocco (Hydria, 2009). Despite being in arid and semi-arid sub-regions with at most 10% of these areas receiving more than 300 mm of rainfall annually (FAO, 2000), these techniques ensured sufficient water supply throughout the year.

As of currently, water security for the future is alarmed by the graveness/magnitude of land use changes, as has been the case for Dar es salaam and Mwanza city in Tanzania. For Dar es Salaam (Figure 1), Tanzania, by 2016, urban area and agriculture had increased by a factor of 2.14 and 2.18 respectively, whereas forest area reduced by 0.44 and water by 0.56, that is since 1995.

2 - Rainfall the unexploited potential – Africa Water Vision 2025 perspective

The Africa Water Vision (AWV) 2025 highlights that there is low water resources usage in Africa due to poor financing and technology but not inadequacy of available water resources. This is confirmed by its low withdrawal for its major water uses of agriculture, community water supply, and industry (only 0.7% and 3.8% of rainfall and internal renewable water resources, respectively). However, poor spatial and temporal distribution of renewable fresh water sources has also been identified as a challenge.

Although improvement in rainwater conservation is being suggested among potential alternative water sources, it has not been incorporated within the Vision' framework for action. In addition, it has not been considered in need of development among nonconventional resources. Nevertheless, rainwater harvesting (RWH) can be incorporated with existing appropriate technologies, considering that it has low operational cost and is capable of performing with low technology and in a decentralized manner (Mwamila, 2016).

Looking at the trend in the water supply status, and unreliability and limitation to urban areas, centralized piped system for groundwater harvesting is expensive. It is also challenged with salinity and fluoride contamination, water fetching at far distances, and sources of questionable quality. A geographic information system (GIS)-based potential study by the United Nations Environment Program (UNEP) 2005 (Malesu *et al.*, 2006) established the good potential of RWH for African countries (nine countries were used as case studies) for such interventions. The study included rooftop RWH, surface runoff from open surfaces with storage in pans/ponds, flood-flow harvesting from watercourses with storages in sand/subsurface dams, and *in situ* soil water storage systems. At 80% runoff, for a metal rooftop, the harvestable rainwater from the high population, the medium rainfall rooftop domain ranges from 115.6 to 346.8 km³. The harvestable rainwater from the gently sloping, medium rainfall runoff domain ranges from 4.32 to 12.92 km³ (Mwamila, 2016).

Currently, the government of Tanzania is highly emphasizing the adoption of RWH techniques as an intervention with multiple benefits experienced simultaneously, that is, for meeting drinking and irrigation demands and for flood attenuation.

3 - Introducing the Kilimanjaro concept: Case study Tanzania

In the year 2018, a novel concept called the Kilimanjaro Concept (KC) for regional integrated water management was introduced based on RWH (Marwa *et al.*, 2018; Ndé-Tchoupé *et al.*, 2019; Qi *et al.*, 2019; Pembe-Ali *et al.*, 2020). The concept implies that rainwater is harvested, stored on the Kilimanjaro mountains, gravity-transported to the point of use, eventually blended

with natural water and treated for distribution (Figure 2). The uses are not limited to human consumption but also runoff control and improving groundwater recharge.

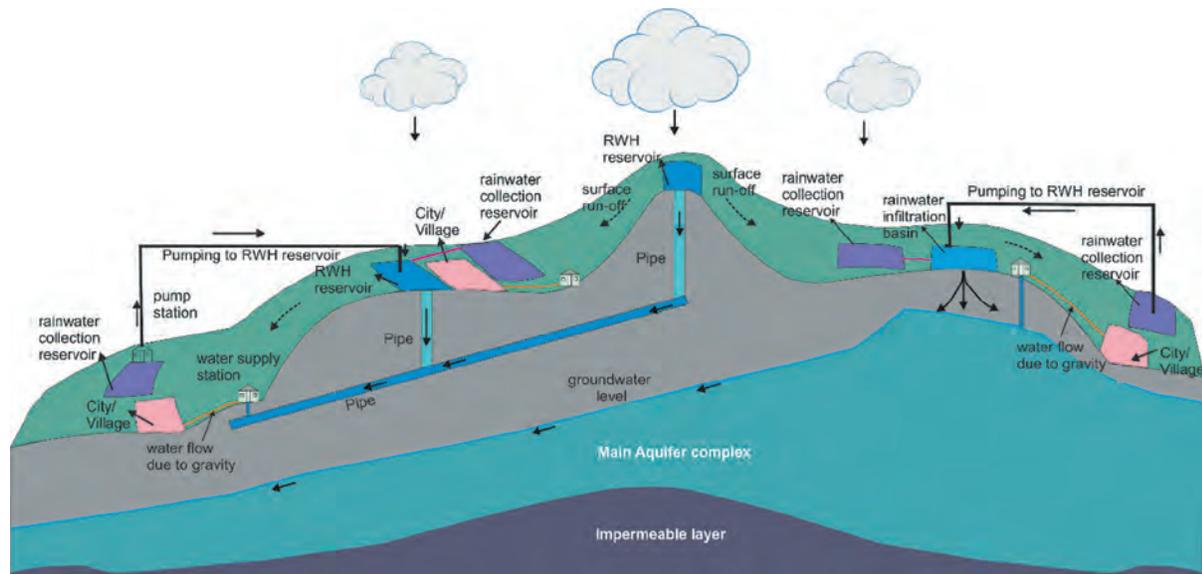


Figure 2 - Schematic illustration of the Kilimanjaro concept

KC clearly advocates for large capacity storage and long-distance transportation (if applicable) of harvested (and treated) rainwater (Qi *et al.*, 2019; Pembe-Ali *et al.*, 2020) as illustrated in Figure 3. Thus, adopting KC implies that safe drinking water is provided from rainwater, which is relatively easy to treat using affordable technologies (Marteleira and Niza, 2018; Ndé-Tchoupé *et al.*, 2019; Qi *et al.*, 2019; Huang *et al.*, 2021).

In KC, rainwater is harvested, locally stored in villages and cities, and then pumped for storage in stations on mountains. Water from the storage stations is then gravity-fed to water treatment plants. The water is conveyed through a piped network to avoid contact with fluoride-rich geological materials. The diagram of Figure 2 is not drawn to scale (Ndé-Tchoupé *et al.*, 2019).

Typically, in developing countries, low-income households often rely on surface water sources or shallow groundwater wells, which are prone to microbial and anthropogenic pollution. In most informal settlements in urban and peri-urban areas, such drinking water sources are often in close proximity with on-site sanitation systems such as pit latrines and septic tanks. In such settings, the current approach to clean water provision is to drill deep boreholes, which is considered less prone to microbial and anthropogenic pollution. However, in the case of the East Africa Rift Valley (EARV) and other regions in Asia and South America, such groundwater contains high concentrations of toxic geogenic contaminants (As, F, U), exposing communities to serious health risks. Such settings further motivated the KC (Figure 3).

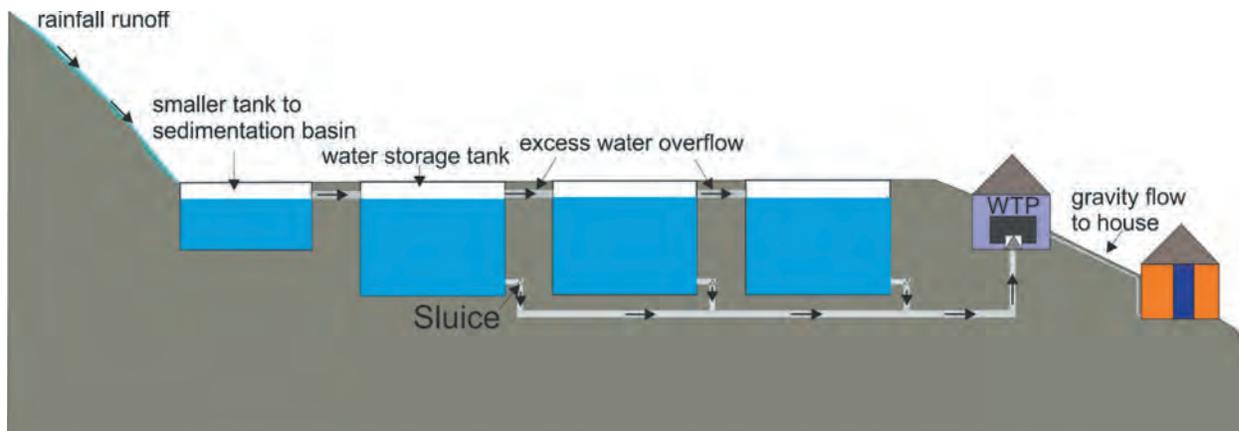


Figure 3 - A cascade of an interconnected system for the storage of harvested rainwater/stormwater

(Reference: Qi et al., 2019).

Table 1 presents a comparative summary highlighting the novelty and benefits of the KC versus the traditional approach to drinking water provision based on borehole drilling.

Table 1 - A summary comparison of the potential benefits of the Kilimanjaro Concept versus the current bore-based drinking water supplies

Kilimanjaro Concept	Borehole-based drinking water systems
(1) Safeguards human health against toxic geogenic contaminants in regions with highly mineralized geological systems	(1) Exposes human health to highly toxic geogenic contaminants.
(2) Harvested rainwater will be analyzed and, if need be, treated using low-cost Fe0 filters, which are known to remove a myriad of contaminants.	(2) Beyond borehole drilling, water quality is rarely tested, and even in cases where analysis is done, treatment methods for removal of geogenic contaminants are often ineffective and expensive
(3) Harvested rainwater can be used to artificially recharge groundwater and increase groundwater level where aquifer material poses no risk of geogenic contamination.	(3) Excessive groundwater abstract causes a decline in groundwater levels and, thus, borehole failure.
(4) In coastal areas, an increase in groundwater levels due to artificial recharge can prevent saltwater intrusion.	(4) In coastal areas, a drop in groundwater table reduces total head, thereby promoting saltwater intrusion

(5) KC offers flexibility and can be adapted to various conditions including catchment types (roofs, roads, mountainous areas), and can be used either as a substitute or supplement for conventional water sources.	(5) High yield aquifers only occur in certain geological formations and localities, which may not coincide with human settlements.
(6) Rainwater harvesting, particularly when combined with artificial infiltration is well-known to attenuate flood risks by reducing Hortonian runoff volumes, peak flows, and erosion.	(6) Groundwater abstraction has no known capacity to attenuate floods and soil erosion caused by Hortonian runoff associated with high-intensity storms.
(7) Low-cost rainwater harvesting systems can be developed at household level, thus promoting ownership and control.	(7) Installation cost and equipment requirements are prohibitive for low-income households to own boreholes.

Reference: Qi et al., 2019

Current efforts towards the implementation of the KC in the EARV are demonstrating that harvesting rainwater is a potential universal solution to cover ever-increasing water demands while limiting adverse environmental impacts such as groundwater depletion and flooding (Pembe-Ali *et al.*, 2021). Indeed, all surface and subsurface water resources are replenished by precipitation (dew, hail, rain, and snow), with rainfall being the main source and major component of the hydrological cycle. Thus, RWH systems entailing carefully harvesting, storing, and transporting rainwater are suitable solutions for water supply as long as rain falls on earth. Besides its direct use, rainwater can be infiltrating into the subsurface when and where it falls, thereby increasing aquifer recharge while minimizing soil erosion and limiting floods.

4. Dual water supply with RWH for meeting drinking demands

Rainwater quantity sufficiency is determined by several factors including rainfall amount (I) and variance, catchment size (A), runoff coefficient (C) of a given catchment, demand of a served population, and storage size. The runoff coefficient is meant to incorporate the effect of evaporation, infiltration, and any additional water loss. Additional loss can occur through spills and leaks resulting from poor positioning and/or sizing of gutters and/or pipes.

With that in mind it has been established in some cases that dual water supply approach may be an option for ensuring a daily demand is fully met (Mwamila, 2016; Mwamila *et al.*, 2016a). This maybe a case in other countries with similar rainfall regimes as Tanzania. In Tanzania, only a third of the country has bimodal rainfall regime and the rest experience unimodal regime, mostly in the range of 400mm to 1200mm. Dual supply implies utilizing RWH and other sources such as ground- and surface-water. This has been well demonstrated by Mwamila *et al.*, (2016a)

by applying daily water balance model with cumulative water storage equation 1 and established such dual scenarios for various areas in Tanzania.

To further display the dual scenario, a similar approach is adopted in this study for areas within the Lake Victoria Basin (Figure 4), which in recent years has been troubled with lake level rising challenges that threaten the welfare of people and properties. RWH is among green technologies being suggested as a potential solution for tackling the challenges, reducing peak runoff through harvesting thus securing communities through serving as a safeguard and a water supply source. The study aims at displaying the potential of RWH in securing water scarcity challenges.

The RWH analysis incorporated the performance parameters for the dry season, including the number of days without water (NWD) (equation 2), and rainwater usage ratio (RUR) (Equation 3). This analytical approach has been used in several earlier studies on RWH systems (Qi *et al.*, 2019; Ndé-Tchoupé *et al.*, 2019; Mwamila *et al.*, 2015; Mwamila *et al.*, 2016a; Mwamila *et al.*, 2016b; Mwamila *et al.*, 2016c; Mwamila *et al.*, 2016]. In addition, the reliability of the harvestable rainwater system is determined (equation 4), which indicates the percentage of time when the demand is fully met.

$$V_t = V_{t-1} + Q_t - Y_t - O_t \dots\dots\dots (1)$$

$$NWD = \frac{T - \sum_{t=1}^T WD}{T} \times 100 \dots\dots\dots (2)$$

$$RUR = \frac{\sum_{t=1}^T Y_t}{\sum_{t=1}^T Y_t} \times 100 \dots\dots\dots (3)$$

$$Reliability = \frac{\text{Daily fully served in a year}}{\text{Total Days in a year}} \times 100 = \frac{\sum_{t=1}^T WD}{T} \times 100 \dots\dots\dots (4)$$

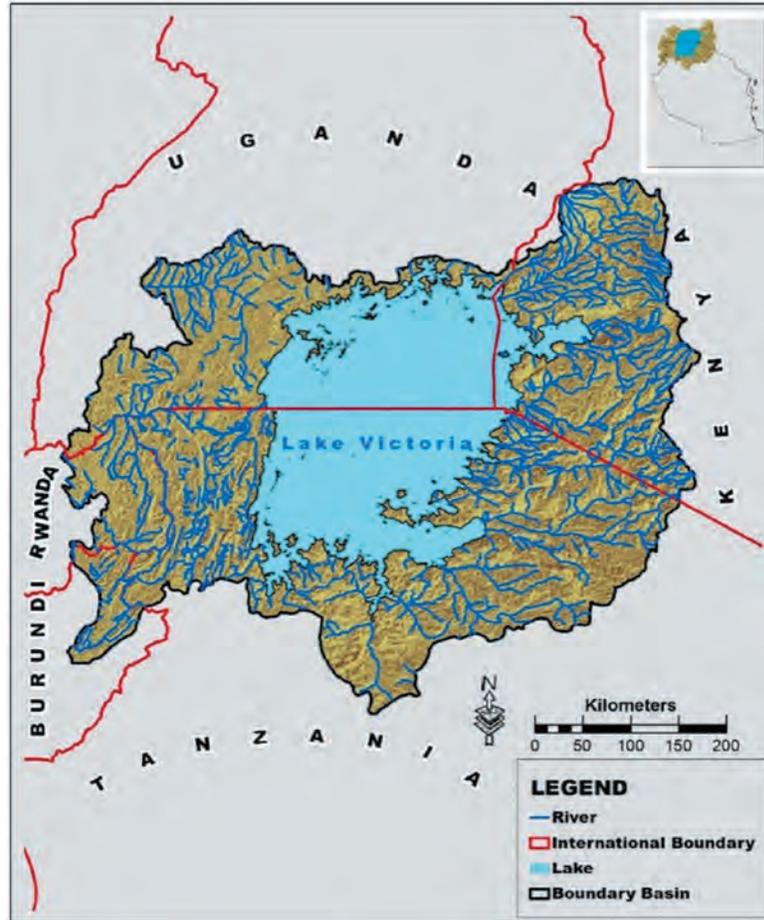


Figure 4: Lake Victoria Basin (Source: WRD 2019)

where, Q_t is the rainwater harvested on the t_{th} day; V_{t-1} is the volume of rainwater stored in the tank at the beginning of the t_{th} day; Y_t is the rainwater available for consumption or use during the t_{th} day; WD is the day on which the demand is fully met; T is the total number of days in the year or years considered; V_t is the cumulative volume of water stored in the rainwater tank after the end of the t_{th} day; and O_t is the overflow volume on the t_{th} day. All volumes are expressed in liters.

In the current study, all 365 days of the year were considered, a runoff coefficient of 80% for the metal roofs, and daily rainfall data were used in the analysis (Figure 5). Fixed demand conditions were considered, keeping in mind the fact that the minimal recommended daily water consumption per person is 25 liters (MWLD, 2002) and assuming an average household size of 6 members.

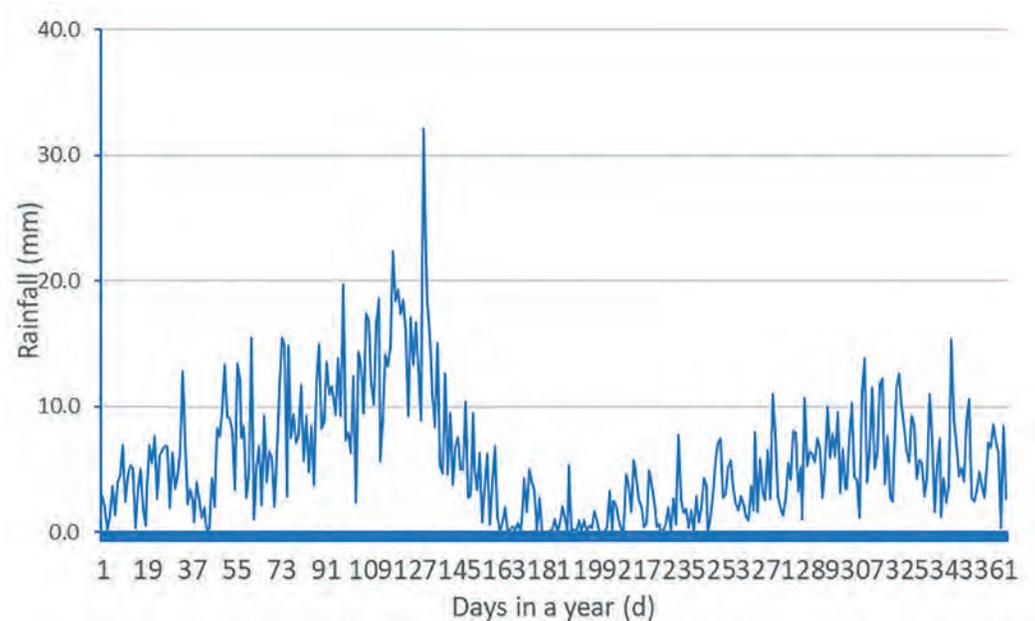


Figure 5 - Average daily rainfall data for Bukoba, Kagera Region (2009 – 2020)

(Source: Lake Victoria Basin Water Board)

For the study, various demand sizes were investigated between 180 to 1080 liters per day for typical roof catchments' sizes 100 m² (Figure 6) and 200 m² (Figure 7). In all cases, a storage size was estimated corresponding to an optimal reliability. A target reliability of at least 70% was referred to as a threshold, as recommended by Ndomba *et al.*, (2010). From the analysis, the focus is on maintaining a reasonable RUR and high reliability. An optimal storage (m³) of 17 and 70 is recommended for catchment sizes (m²) of 100 and 200, respectively (Figures 6 and 7). At the optimal storage of 17 m³, it was established that 97.8% of the household demand will be met through RWH and a corresponding RUR of 64.5% and 357 days of full demand supply will be achieved. As well at the optimal storage of 70 m³, it was established that 92.1% of the household demand will be met through RWH and a corresponding RUR of 93.7% and 336 days of full demand supply will be achieved. Hence, alternative complementary water sources (e.g., groundwater, springs) will need to meet the remaining demand of only 2.2% and 7.9% for catchments 100 and 200 m² respectively (Figures 8 and 9).

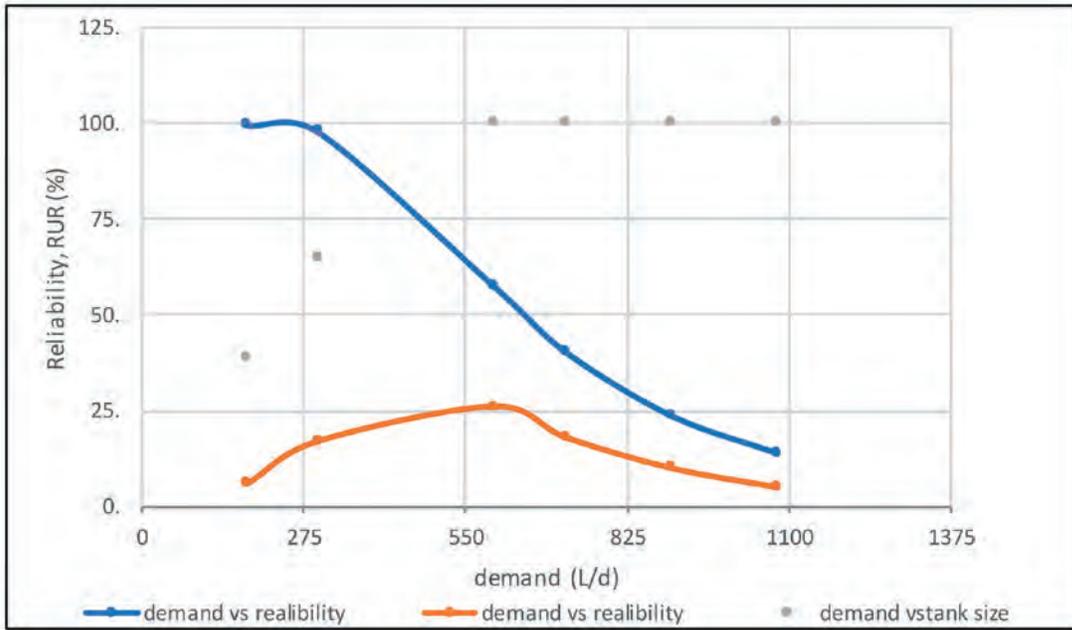


Figure 6 - Effects of individual demand variations on harvested rainwater storage and reliability with 100 m² catchment

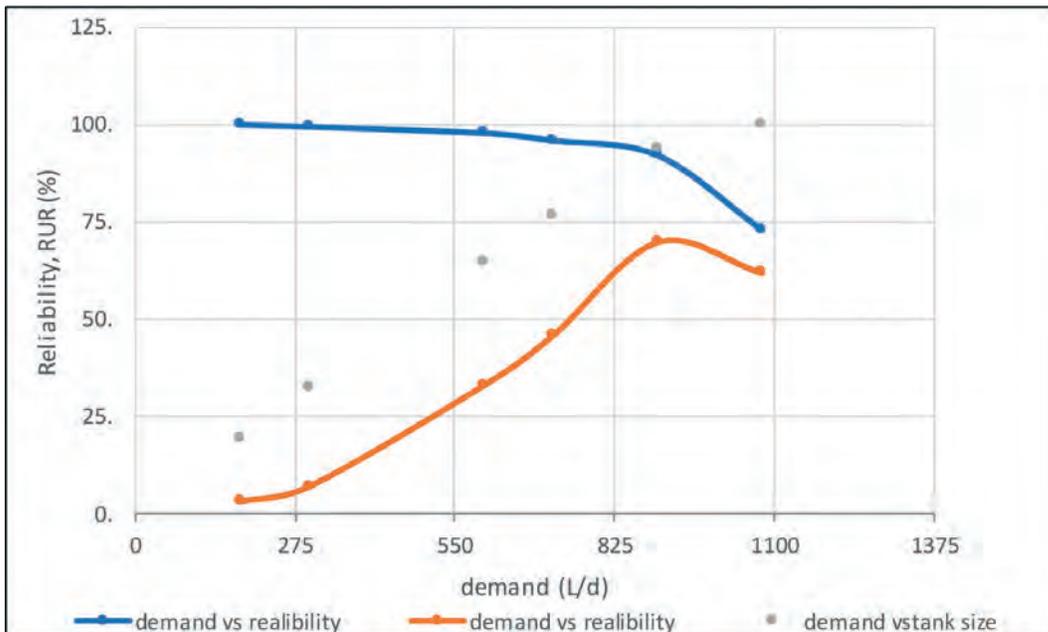


Figure 7 - Effects of individual demand variations on harvested rainwater storage and reliability with 200 m² catchment

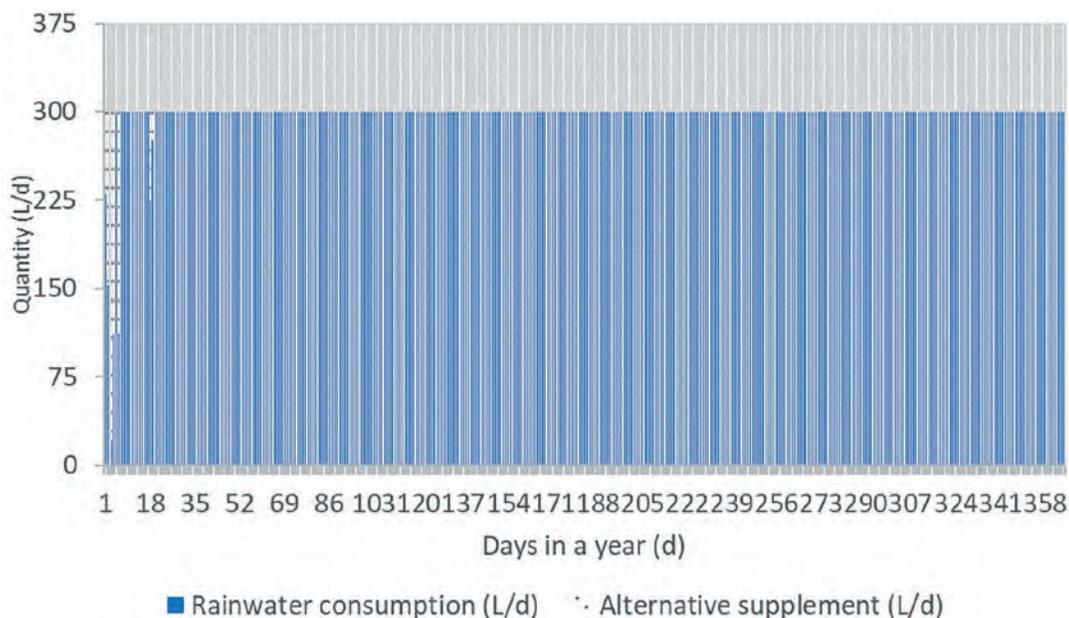


Figure 8 - Daily requirements supplied through RWH (blue bars) and the corresponding required supplementary supply (dotted lines) to meet a demand of 300 L d⁻¹ for a catchment area of 100 m²

Note that for any given day, the demand that is not met through RWH is met through supplementary sources to meet the total demand (i.e., 300 L d⁻¹).

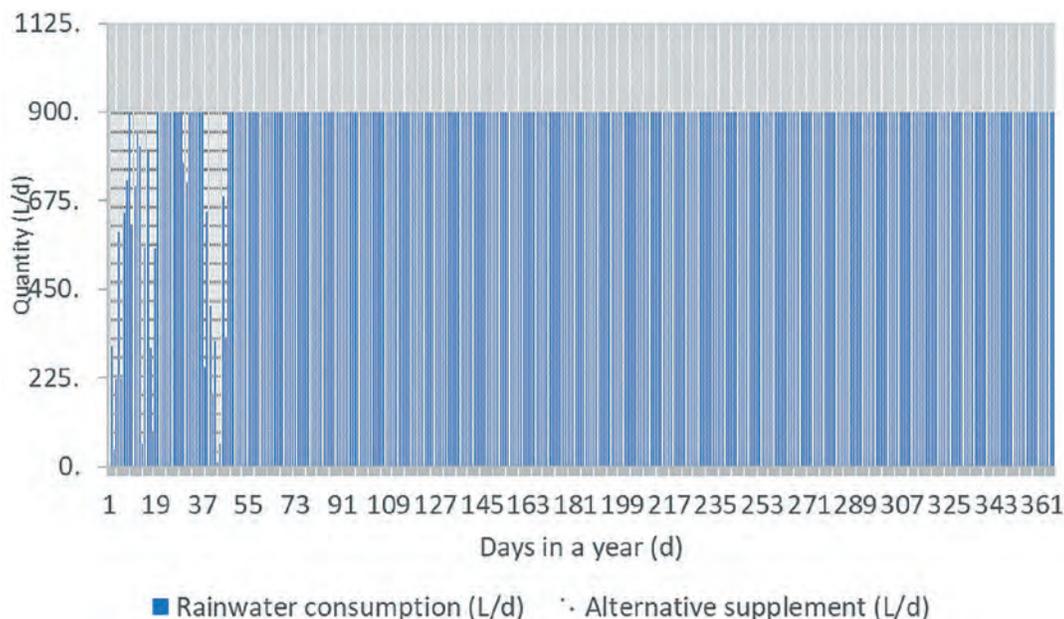


Figure 9 -Daily requirements supplied through RWH (blue bars) and the corresponding required supplementary supply (dotted lines) to meet a demand of 900 L d⁻¹ for a catchment area of 200 m².

Note that for any given day, the demand that is not met through RWH is met through supplementary sources to meet the total demand (i.e., 900 L d⁻¹).

Overall, the analysis displays a good potential for KC to be adopted in areas of the Lake Victoria Basin to meet household water requirements. A dual supply approach is required for full demand supply, where local RWH meets the bulk of the water supply, while other sources meet the remaining demand. In this regard, complementary sources include groundwater, springs, and blending of seawater and rainwater (Huang *et al.*, 2021) to meet drinking water standards, but these are necessary only when the demand exceeds the total amount of rainwater (local and foreign).

It is obvious that rainfall varies daily (Figure 5), while consumers' daily demands are supposedly fixed. As a result, daily harvestable rainwater fluctuations are inevitable as displayed in Figures 8 and 9, which impacts on the water available to meet the daily demand. Thus, RWH must be extended and/or water supply from alternative sources such as springs and streams should complement rainwater so that consumption remains limited to the demand size.

4. Contribution to achieving SDG-6

KC is in line with SDGs, addressing each target of the goal number 6 as elaborated in Figure 10. Its sustainability potential is assured through its approach embracing old age sustainable water and wastewater management techniques, accommodating social, technical, economic, and environmental aspects. Accessibility, quality, reliability, convenience, safety and quantity are key features of KC.

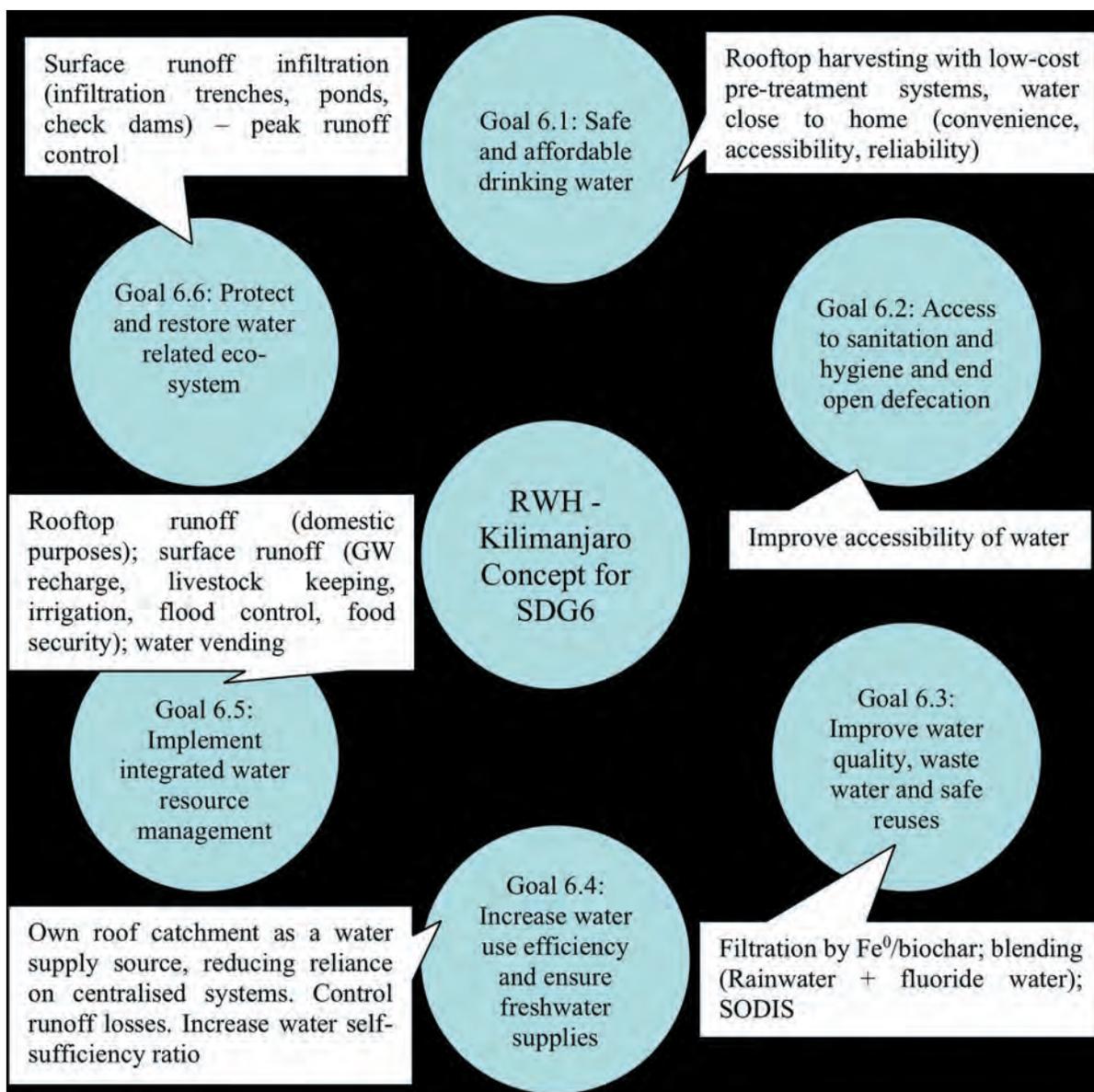


Figure 10. Illustrating the Kilimanjaro Concept linkage to targets of sustainable development goal number 6

References

- Africa Water Vision 2025. http://www.unwater.org/downloads/African_Water_Vision_2025.pdf (Accessed 16 July 2015).
- FAO (2000). "Global forest resources assessment 2000, main report. FAO corporate document repository, forest department. <http://www.fao.org/docrep/004/y1997e/y1997e0i.htm#bm18> (Accessed 21 Sept. 2015).

- Huang Z, Nya EL, Rahman MA, Mwamila TB, Cao V, Gwenzi W, Noubactep C (2021). Integrated Water Resource Management: Rethinking the Contribution of Rainwater Harvesting. *Sustainability* **13(15):8338**. <https://doi.org/10.3390/su13158338>.
- Hydria (2009). “Traditional water management in arid and semi-arid areas: Case studies of the Gheris oasis and Figuig oasis, Morocco. Hydria project. “http://www.hydraproject.net/en/cases/morocco/water_works.html (Accessed 24-9-2013
- Marteleira R and Niza S (2018). “Does rainwater harvesting pay? Water–energy nexus assessment as a tool to achieve sustainability in water management”. *Journal of Water and Climate Change* **9(3): 480-9**.
- Malesu M, Khaka E, Mati B, Oduor A, Bock TD, Nyabenge M, and Oduor V (2006). “Mapping the potentials for rainwater harvesting technologies in Africa: A GIS overview on development domains for the continent and nine selected countries”. *Technical Manual No. 7, World Agroforestry Centre (ICRAF)*, Netherlands Ministry of Foreign Affairs: Nairobi, Kenya, 2006.
- Marwa J *et al.*, 2018. “Defeating fluorosis in the East African Rift Valley: Transforming the Kilimanjaro into a rainwater harvesting park”. *Sustainability* **10(11): 4194**.
- Mohsen TJ, Han MY, Davoudi M, and Kim M (2013). “Review of ancient wisdom of qanat, and suggestions for future water management”. *Environmental engineering research* **18(2):1–7**.
- MoWI (2009). “Design manual for water supply and waste water disposal”. 3rd edition, Volumes I, II, and III, Ministry of Water and Irrigation, Tanzania.
- Mwamila TB (2016). “Rainwater harvesting potential and management strategies for sustainable water supply in Tanzania”. Ph.D. Thesis, Seoul National University, Seoul, Korea.
- Mwamila, TB, Han MY, Ndomba PM, Katambara Z (2016c). Performance evaluation of rainwater harvesting system and strategy for dry season challenge; *Journal of Water Practice and Technology*, **11(4): 829 - 837**. <http://dx.doi.org/10.2166/wpt.2016.090>.
- Mwamila TB, Han MY. and Kum S (2016b). “Sustainability evaluation of a primary school rainwater demonstration project in Tanzania”. *Journal of Water, Sanitation and Hygiene for Development* **6(3):447 -55**. <http://dx.doi.org/10.2166/washdev.2016.186>.
- Mwamila TB, Han MY, and Katambara Z (2016). “Strategy to overcome barriers of rainwater harvesting: Case study Tanzania”, *Journal of Geoscience and Environment Protection*, **4 (9):13-23**. <http://dx.doi.org/10.4236/gep.2016.4900.2>.
- Mwamila TB, Katambara Z, and Han MY. (2016a). “Strategies for household water supply improvement with rainwater harvesting;”. *Journal of Geoscience and Environment Protection* **4(9):146 – 58**.<http://dx.doi.org/10.4236/gep.2016.4901.1>
- Mwamila TB, Han MY, Kim TI, and Ndomba PM (2015). “Tackling rainwater shortages during dry seasons using a socio-technical operational strategy”. *Water Science & Technology: Water Supply* **15.5: 974 – 980**. <http://dx.doi.org/10.2166/ws.2015.053>.
- MWLD (2002). National Water Policy, Ministry of Water and Livestock Development, Tanzania.
- Ndé-Tchoupé AI, Tepong-Tsindé R, Lufingo M, Pembe-Ali Z., Lugodisha I., Mureth R, Nkinda, M, Marwa J, Gwenzi W, Mwamila TB, Rahman MA, Noubactep C, and Njau KN (2019).

- “White teeth and healthy skeletons for all: The path to universal fluoride-free drinking water in Tanzania”. *Water* **11**(1):131. <https://doi.org/10.3390/w11010131>.
- Ndomba PM and Wambura FJ (2010). “Reliability of rainwater harvesting systems in suburbs: A case study of Changanyikeni in Dar es Salaam, Tanzania. Nile Basin”. *Water Science & Engineering* **3**(3): 72-85.
- Pembe-Ali Z, Mwamila TB, Lufingo M, Gwenzi W, Marwa J, Rwiza MJ, Lugodisha I, Qi Q, Noubactep C. (2021). Application of the Kilimanjaro Concept in Reversing Seawater Intrusion and Securing Water Supply in Zanzibar, Tanzania. *Water* **13**(15):2085. <https://doi.org/10.3390/w13152085>.
- Qi Q, Marwa J, Mwamila TB, Gwenzi W, Noubactep C (2019). “Making rainwater harvesting a key solution for water management - The universality of the Kilimanjaro Concept “. *Sustainability* **11**(20):5606. <https://doi.org/10.3390/su11205606>.
- WHO/UNICEF (2020a). “Hygiene baselines pre-COVID-19: UNICEF Regional Office for West and Central Africa”. www.washdata.org. (Accessed 16/7/2020).
- WHO/UNICEF (2020b). “Hygiene baselines pre-COVID-19: UNICEF Regional Office for Middle East and North Africa”. www.washdata.org. (Accessed 16/7/2020).
- WRD (2019). “Benefits and challenges of transboundary water cooperation for Tanzania (2008/2009 – 2018/2019)”. Water Resources Division, Ministry of Water, TWP, WWF.

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Chapter Four

Have Rwanda's health equity achievements been extended to its COVID-19 response?

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Abstract - In a recent paper we reviewed Rwanda's efforts in achieving health equity through proactive health-related public policy in a variety of domains. The key features behind Rwanda's relatively long life expectancy, lower infant mortality rates, and low inequalities in access to health care are its (1) advancing concrete and meaningful equity agendas that drive the post-2015 Millennium Development Goals; (2) ensuring that goals to meet Universal Health Coverage incorporate a focus on legitimate community participation, improving quality and not only quantity of care; (3) bolstering education and the internal research capacity to improve local evidence-based policymaking; (4) promoting intersectoral collaboration to achieve goals, and (5) improving collaborations between multilateral agencies working to achieve improvements in health within their nation and across the world. It did so by ensuring state control of the public policy environment and implementing an anti-corruption agenda. In this paper we examine whether these achievements carried over into its response to the COVID-19 pandemic. We conclude that this has been the case. We direct readers to the emerging literature on Rwanda's response to the COVID-19 pandemic and identify areas for future inquiry.

Keywords: *Health equity; health-related public policy; 2015 Millennium Development Goals; Universal Health Coverage; COVID-19; Rwanda.*

Abbreviations

HWS:	Household Welfare Scorecard
IMF:	International Monetary Fund
MDG:	Millennium Development Goals
MOH:	Rwandan Ministry of Health
UHC:	Universal Health Coverage
NEPRC:	(Rwanda) National Epidemic Preparedness and Response Coordination
RRT:	Rapid Response Teams
SSA:	sub-Saharan Africa
WHO:	World Health Organization

1. Introduction

Rwanda's efforts in achieving health equity through proactive health-related public policy in a variety of domains is well established (Raphael and Komakech, 2020). The key features behind Rwanda's relatively long life expectancy, lower infant mortality rates, and low inequalities in access to health care are its (1) advancing concrete and meaningful equity agendas that drive the post-2015 Millennium Development Goals (MDG); (2) ensuring that goals to meet Universal Health Coverage (UHC) incorporate a focus on legitimate community participation, improving quality and not only quantity of care; (3) bolstering education and the internal research capacity within countries to improve local evidence-based policymaking; (4) promoting intersectoral collaboration to achieve goals; and (5) improving collaborations between multilateral agencies working to achieve improvements in health within their nation and across the world. It did so by ensuring state control of the public policy environment and implementing an anti-corruption agenda.

In this chapter, we examine whether these achievements carried over into its response to the COVID-19 pandemic. We consider Rwanda's responses to the pandemic and its success in curbing the spread of the virus, treating those so afflicted, responding to the deprivations brought on by the pandemic and responses to it, and its mortality rate. We also consider its ability to access the available vaccines and its success in distributing these amongst the population.

2. Methodology

We used Google Scholar™ to identify academic articles on Rwanda's COVID-19 experiences. Martin-Martin and colleagues (2018) shows Google Scholar “finds significantly more citations than the WoS Core Collection and Scopus across all subject areas” (p. 1175). We then used Google™ to identify popular and grey literature on these same issues. We identify key conclusions in these literatures of Rwanda's COVID-19 experiences and place these conclusions against what is known about Rwanda's previous efforts and successes in achieving health equity as discussed in Raphael and Komakech (2020).

3. Findings

There are surprisingly robust academic, grey, and popular literatures documenting the Rwandan COVID-19 experience. We identify seven main themes that emerge from this literature.

3.1 Relatively low morbidity and mortality

The general consensus in the academic, grey, and popular literatures is that Rwanda's morbidity and mortality rates -- as compared to other sub-Saharan African nations -- have been lower (Musanabaganwa *et al.*, 2021; Nachega *et al.*, 2021). This is not seen as the lack of ability to detect cases as Rwanda's testing and surveillance activities are seen as effective. The low morbidity rates and subsequent mortality rates have been attributed to Rwanda taking early action to detect and contain the spread of the virus (Carmody, McCann, Collieran, and O'Halloran, 2020).

Rwanda's well-developed health care system has contributed to this success. Rwanda's aims for a universal health care (UHC) system and insurance covers around 90% of its population (Ogbolosingha and Singh, 2020). Darah and Ndiang'ui (2020) provide this overview:

“As one of the fastest-growing economies on the continent, Rwanda earned a reputation for innovation in many sectors, including health care. The country provides nearly universal healthcare to its thirteen million citizens. It also uses drones to deliver essential medical products, such as blood donations, around the country, which reduces the wait time for patients in dire need. After the first positive case of COVID-19 hit on March 8, there was little surprise that the government formed and implemented a robust nationwide response. The country's timely reaction was aided by its previous success in combating Ebola from entering its borders in 2019 (p. 47)”.

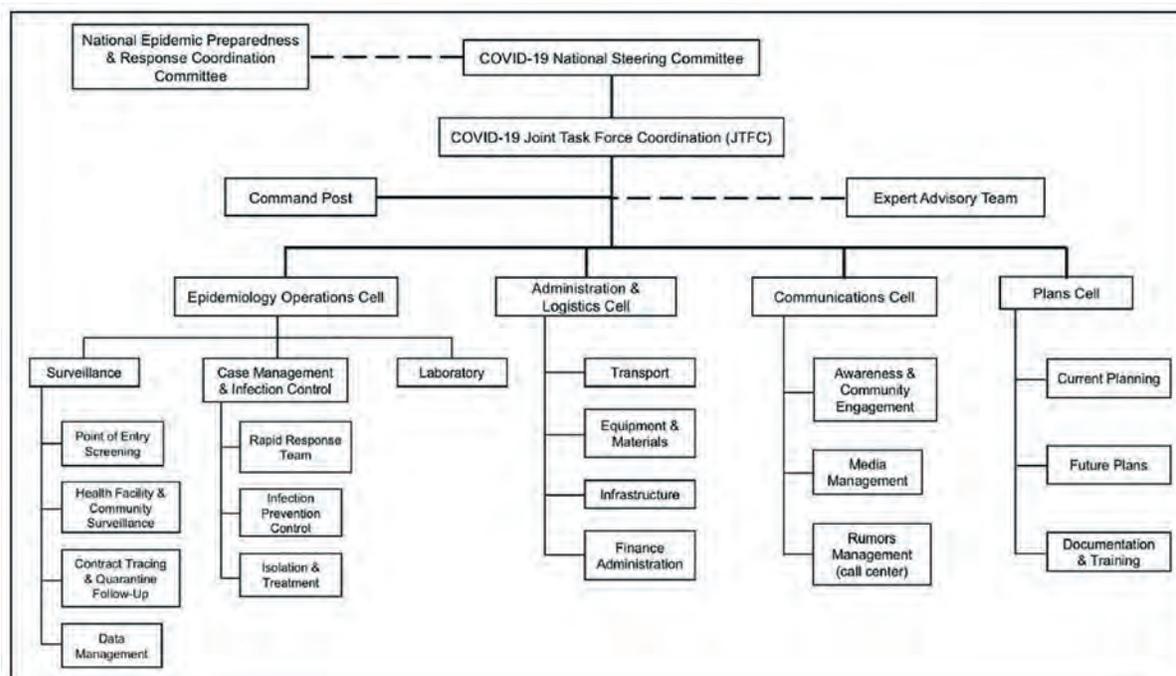
3.2 Organizational structures established

A very comprehensive overview of the Rwandan scene is provided by Karim *et al.*, (2021). The authors provide details concerning its first COVID-19 case on March 14, 2020 (a returning traveler) and activities current to December 2020. Rwanda performed more than 730,000 tests with 8,383 cumulative cases, 6,542 recoveries, and 92 deaths. Those who test positive are isolated and contact-tracing takes place.

The Rwandan Ministry of Health (MOH) developed guidelines and formed expert teams to “coordinate and organize the response plan; providing accurate, timely, and thorough information to the public; enforcing national prevention guidelines; and establishing designated treatment centers for COVID patients” (Karim *et al.*, 2021, p. 3). Details concerning the National Epidemic Preparedness and Response Coordination Committee (NEPRCC) and its collaborating structures are provided in Figure 1. As noted by Karim *et al.*, (2021):

“Much of Rwanda’s pandemic response has adopted or leveraged existing infrastructure from Ebola preparedness efforts in 2018–19, highlighting the advantages of comprehensive pandemic preparation experience for a country”.

Figure 1 - Rwandan Government CO+VID-19 response infrastructure



Source: Rwanda National Epidemic Preparedness and Response Coordination Committee

Beyond its health insurance coverage, Rwanda’s established modern diagnostic infrastructure features seven appropriately equipped diagnostic laboratories around the country. The diagnostic laboratories complement Rwanda’s resolve in surveillance, contact-tracing, and isolation mechanisms. Rwanda’s low mortality rate is attributed to its early stringent response such as upholding physical distance, ability to mobilize and train health care workers, police and college students to contact-trace, and employing human-size robots in the COVID-19 clinics to take vital signs and deliver supplies (Beaubien, 2020; World Health Organization, 2021).

3.3 Early Response

Much has been written about Rwanda’s early response to the threat of the COVID-19 virus (Carmody, et al., 2020; World Health Organization, 2021). Apparently, the experiences learned from the response to the Ebola virus outbreak served Rwanda well. Details are available concerning the establishment of early detection procedures at airports and border crossings. The International Monetary Fund (IMF, 2021) summarized these efforts as follows:

“The pandemic has progressed slower in Rwanda than in SSA peers, helped by relatively good preparedness of the health system, earlier adoption of more stringent measures, and stepped-up testing capacity”.

Further, Rutayisire and colleagues (2020) point out:

“For instance, people arriving in Rwanda since 21 March 2020 are subject to a mandatory 14-day quarantine in selected health and testing facilities. Individuals staying in such facilities around the country are provided with meals, medical care, and other needs while under quarantine and the costs are covered by the government (p. 268)”.

The Rwandan government announced a 14-day lockdown on March 21, with further extensions to April 30 (Ogbolosingha and Singh, 2020). Businesses and government offices were closed and stay-home orders were in effect with exceptions for visits to hospitals and healthcare facilities, and some commercial activity in the food, energy, financial, and security sectors. Nzaramba, Haguma, and Rwibasira (2020) provides details of the safety precautions applied to hotels, motels, restaurants, and food markets in Rwanda for COVID-19 (Figure 2).

Korukire and colleagues (2020) provide details on these lockdown procedures. All non-essential movements were banned and permission for essential movements, such as going to a health facility, the bank, or food grocery was obtained through applications to the police via the internet or by phoning a special number. On May 4, 2020 partial de-confinement was implemented for two weeks followed by a review. Korkukire et al, concluded that:

“The stay home measure has played a key role in the prevention of the spread of COVID-19” (p. 368).

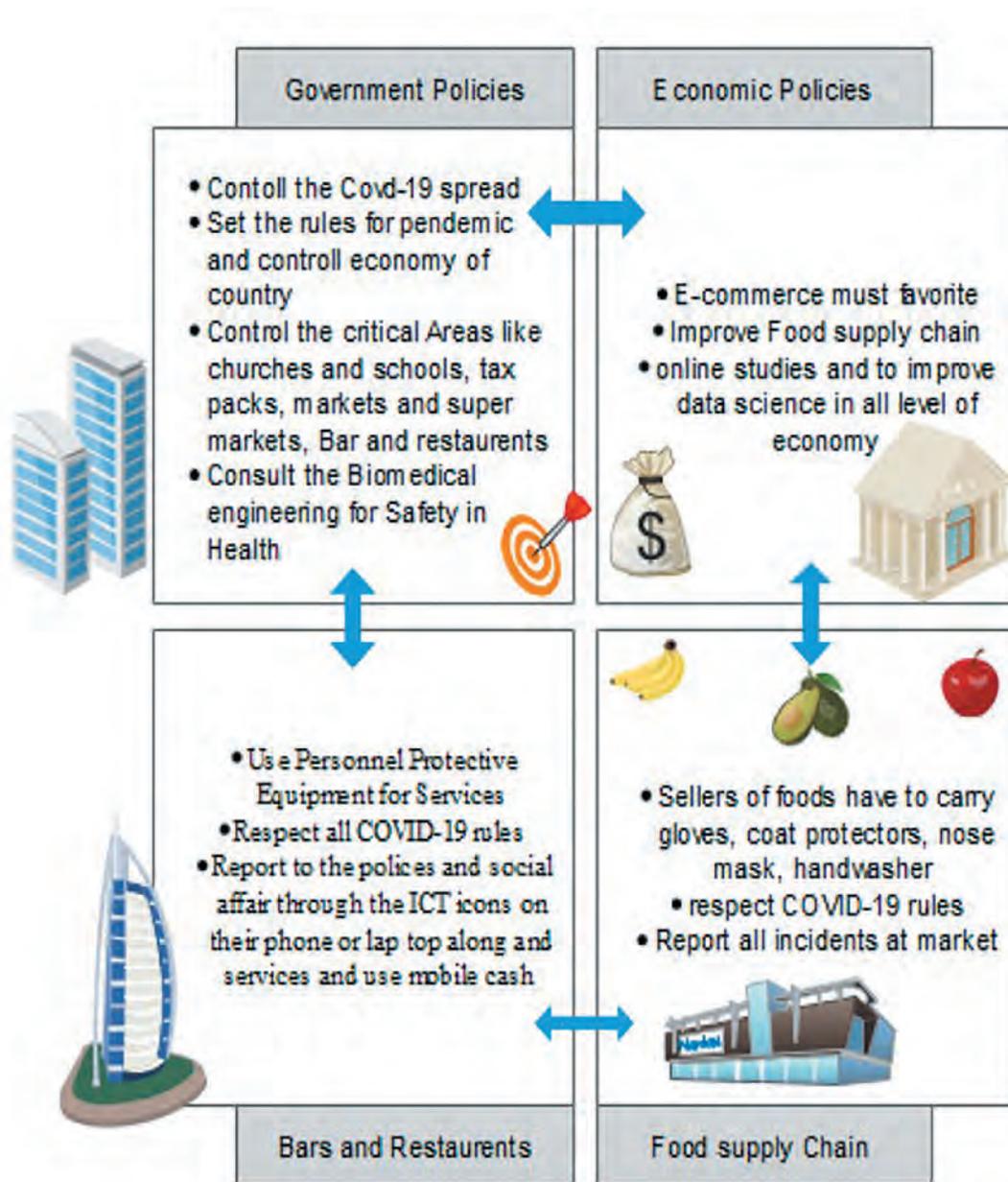
Thus, much of Rwanda’s ability to maintain low COVID-19 mortality can be attributed to a competent collaboration between the biomedical centers, the epidemic and surveillance response division, and the joint task force whose efforts led to a robust national preparedness and response plan (Karim *et al.*, 2021). Rwanda’s success in reducing COVID-19 morbidity and mortality affirms the country’s success in pursuing health equity policies and investing in an inclusive home-grown solution (Wallace *et al.*, 2020).

3.4 Innovative approaches to testing, tracking, and treatment

Right at the onset of the pandemic, Rwanda established novel means of testing for the virus including robots and group sample testing procedures (see Box 1). These activities were coordinated with the establishment of tracking and tracing procedures and the establishment of quarantine procedures (Nachega *et al.*, 2021).

Another important early development in Rwanda was implementing a strategy for pooled testing (Mutesa *et al.*, 2020). This was seen as viable as prevalence rates were low in Rwanda and capacities for testing were limited.

Figure 2. - Sustainable solutions for safety and precautions of hotels, motels, restaurants and food markets in Rwanda for COVID-19



The health care system mobilized to provide responsive care to those identified as infected. Research indicated that Rwandan front-line workers were well informed about COVID-19, knowing its symptoms, its means of transmissions, and appropriate responses (Ndishimye *et*

al., 2020). The authors saw this knowledge as helping to limit COVID-19 spread through public education.

The WHO (2021) provides a comprehensive overview of Rwanda’s response to the pandemic. It highlights:

“The positive effects of decisive leadership, whole-of-society coordination, and high-tech innovations in a country with limited resources”.

Details are provided on a variety of topics including using:

1. Robot health assistants at airports to screen passengers for the virus.
2. Drones for transporting urgently needed medical supplies to hospitals.
3. Convening a national crisis committee of key ministries (Health, Defence, Finance, Internal Security, and Local Government) to coordinate the implementation of a preparedness and response plan a week before the first case was reported.
4. A multisectoral approach in all 30 districts under the leadership of local mayors involving Rapid Response Teams (RRTs) at district levels with activities and outcomes being reported to the central level every day.
5. Testing on all suspected cases, contacts of confirmed cases, and other identified high-risk groups and clusters (such as in prisons).

Figure 3 provides the key priorities for Rwanda’s 2021 COVID-19 response plan.

Figure 3 - Key Priorities for Rwanda’s 2021 COVID-19 Response Plan

Key strategies
Surveillance at the community level
Hotline centres
Community event-based surveillance (eCEBS)
Monthly drive-through testing and testing of high-risk groups
Surveillance at facility level
Surveillance at district and provincial health facilities
Expanding the capacity for COVID-19 testing home-based care
Continuity of essential health services
COVID-19 vaccine introduction

3.5 Responding to deprivation brought on by the pandemic

Early on it was recognized that the restrictions imposed on movement, businesses, and recreational activities would have important effects upon the population that needed to be addressed. Rwanda instituted a variety of programs to respond to the material deprivation experiences experienced by many as a result of the governmental responses instituted to control the spread of the virus. These included provision of food and other basic needs (Rutayisire *et al.*, 2020). On March 17, to limit price gouging, fixed prices on food were implemented. This served to stabilize food prices which had increased over twenty percent across the nation in 2019 (Darah and Ndiang'ui, 2020).

The International Monetary Fund (IMF) summarized these efforts as follows:

“Key elements of the government’s response plan include a food distribution program, an expansion of the social safety net, and ongoing improvements in the targeting of social programs using a Household Welfare Scorecard (HWS)”.
(IMF, 2020, p. 5).

3.6 Vaccinations

Rwanda has put in place an ambitious plan to vaccinate 60% of its nearly 13 million population by end of 2022. With the scant supply of vaccines this far, Rwanda has demonstrated its organizational ability in vaccinating its most-at risk population including the frontline health workers. Although under 400,000 people have so far received their first vaccination, Rwanda has put in place an efficient system such as the cold-chain storage and a 48-hour distribution routine of vaccines across the country. In hard-to-reach locations, Rwanda deploys military helicopters to ensure that a timely and equitable distribution of vaccines is possible (Binagwaho, 2021; WHO, 2021). In addition to securing doses of the vaccine from the COVAX facility and India, Rwanda has undertaken a process by which vaccines can be produced within the country. This step is necessary as most of the industrialized western countries have opted to hoard vaccines, making access for middle- to low-income countries difficult (Binagwaho, 2021). Rwanda’s leadership is now in talks with WHO to establish a permanent vaccine production capacity to scale-up the production and distribution of the mRNA vaccines (UwiringiyimanaIiza, 2021).

3.7 Trust

Aïdi (2020) argues that the success of governments in containing the pandemic was a function of public trust. He reports that a study in 12 African countries examined respondents’ reaction to the statement:

“My government has done enough to stop the spread of coronavirus”.

Rwanda scored highest with 81% strongly agreeing to the statement.

Much of this probably has to do with Rwanda's anti-corruption initiatives, competence in promoting health equity, and its all-of-community approach, As detailed by us earlier (Raphael and Komakech, 2020), Rwanda does very well in extent of health insurance coverage and extent of income-related inequalities for antenatal care, births attended by skilled personnel and full immunization amongst one-year olds. It also does well on a composite index coverage of reproductive, maternal, newborn, and child health interventions. Its life expectancy and infant mortality rates are amongst the best in sub-Saharan Africa.

4. Area for Further Inquiry

Alice and colleagues (2020) considered the effects of COVID-19-related lockdowns on childbirth preparedness among Rwandan families and identified this as an important area of inquiry. While acknowledging restrictions in care most certainly will have effects, they note that "*as of June 2020, there was no pregnant mother or midwives who died from COVID-19*" (p. 219). Olive *et al.*, (2020) have urged inquiry into the impact of the pandemic on child health services in Rwanda.

Of interest, research on how Rwanda has managed intimate partner violence resulting from COVID-19 lockdown and other social measures seem worthwhile. There is need to scale-up anti-discrimination policies against women and young girls, some of whom are locked down with their abusers. Certainly, other sub-Saharan Africa (SSA) countries could learn from Rwanda's experience to develop inclusive policies and approaches to address IPV in the pandemic response.

Finally, we note that Rwanda is a very difficult country to manage as the historical ethnic divisions still remain under the surface of these successes. The ability of the government to maintain trust in light of these historical tensions is a significant achievement and will be necessary to maintain as it moves out of the pandemic era.

5. Conclusion

We have provided an overview of available literature concerning Rwanda's response to the COVID-19 pandemic. The literature is not exhaustive but offers a purview of the bold COVID-19 measures that Rwanda has pursued and succeeded where some of its SSA contemporaries have struggled. For a variety of reasons ranging from its integrated proactive approach to the pandemic, its utilization of modern technology, and its responsiveness to the needs of its population, we concur with Karim and colleagues' (2021) conclusion that:

"Rwanda's government and healthcare system has responded to the COVID-19 pandemic with innovative interventions to prevent and contain the virus. Importantly, the response has utilized adaptive and innovative technology and

robust risk communication and community engagement to deliver an effective response to the COVID-19 pandemic”.

We hope that policymakers and health officials from across Africa and the world at large pick a legitimate interest in evaluating Rwanda’s approach. Their success could become a model for low-income countries that have historically been dependent on western countries for drugs, technology, policy, and funds.

Note: To date (June 24, 2021) Rwanda has reported 34,143 confirmed cases of COVID-19 and 402 deaths therefrom, giving it a case rate of 2,574 per million and death rate of 30 per million. It achieves a favourable case rank of 58th and a death rate rank of 61st of 222 nations. However, June 23 saw Rwanda reporting the highest number of new infections in a single day, registering 964 new confirmed cases (New Times, 2021) extending a surge seen over the last week.

References

- Beaubien J (2020). “*Why Rwanda Is Doing Better Than Ohio When It Comes to Controlling COVID-19*”. National Public Radio. July 15, 2020. <https://www.npr.org/sections/goatsandsoda/2020/07/15/889802561/a-covid-19-success-story-in-rwanda-free-testing-robot-caregivers>.
- Binagwaho A (2020). “*How Rwanda is managing its COVID-19 vaccination rollout plans*”. *The Conversation* (2021 April 19). <https://theconversation.com/how-rwanda-is-managing-its-covid-19-vaccination-rollout-plans-158987>
- Carmody, Pádraig, McCann G, Colleran C, and O’Halloran C (2020). “*COVID-19 in the Global South: Impacts and Responses*”. Bristol University Press.
- Hisham A (2020). “*Public trust, capacity and COVID-19: Early lessons from Africa*”. Policy Centre for the New South.
- International Monetary Fund. (2021). “*Rwanda: Third review under the policy coordination instrument*” Press release; staff report; and statements” by the Executive Director and Staff Representative for Rwanda (2021)”. <https://www.elibrary.imf.org/view/journals/002/2021/001/article-A001-en.xml>.
- Karim N, Jing L, Lee JA, Kharel R, Lubetkin D, Clancy DC, Uwamahoro D *et al.*, (2021). “Lessons learned from Rwanda: Innovative strategies for prevention and containment of COVID-19.” *Annals of Global Health* **87**(1).
- Korukire N, Rutayisire R, Rumagihwa L, Kayitesi I, Ineza M-C, Niyitegeka C, Mukangendo M *et al.*,(2020). “The implementation of the stay home measure and its effectiveness in containing the spread of 2019-nCoV in East African countries: Case of Rwanda, and Kenya.” *Rwanda Journal of Medicine and Health Sciences* **3**(3):362-71.
- Martín-Martín A, Orduna-Malea E, Thelwall M, and Delgado López-Cózar E (2018). “Google Scholar, Web of Science, and Scopus: A systematic comparison of citations in 252 subject categories.” *Journal of Intermetrics* **12**(4):1160-77.

- Muhayimana A, Mukamana D, Ndayisenga J-P, Tengera O, Murekezi J, Uwacu J, Mbabazi E, and Musabe J (2020). “Implications of COVID-19 lockdown on child Preparedness among Rwandan Ffamilies.” *Research Journal of Health Sciences* **8**(3):214-20.
- Mutesa L, Ndishimye P, Butera Y, Souopgui J, Uwineza A, Rutayisire R, Ndoricimpaye EL *et al.*,(2020). “A pooled testing strategy for identifying SARS-Cov-2 at low prevalence.” *Nature*: 1-5.
- Nachega JB, Atteh R, Ihekweazu C, Sam-Agudu NA, Adejumo P, Nsanzimana S, Rwagasore E *et al.*, (2021) “Contact tracing and the COVID-19 response in Africa: Best practices, key challenges, and lessons learned from Nigeria, Rwanda, South Africa, and Uganda.” *The American Journal of Tropical Medicine and Hygiene* **104** (4):1179.
- Ndiang’ui P and Darah PE (2020). “Africa in the time of COVID-19: Finding local solutions to combat a global pandemic.” *Electronic International Journal of Education, Arts, and Science (EIJEAS)* **5**(11).
- Ndishimye P, Nkeshimana M, Hitimana N, Turatsinze D, Nahayo E, Byiringiro F, Habinshuti M *et al.*, (2020). “Knowledge, attitudes and preventive practices towards COVID-19 among frontline healthcare workers in Rwanda”. *Rwanda Public Health Bulletin* **2**(1):16-21.
- New Times. Covid-19: (2021). “Schools step up vigilance”. (June 24). <https://www.newtimes.co.rw/news/covid-19-schools-step-up-vigilance>
- Nzaramba JP, Haguma F, and Rwibasira MJD (2020). “Safety and precautions of hotels, motels, restaurants and food markets in Rwanda for COVID-19.” *Emerging Environmental Technologies and Health Protection* **3**:35-41
- Ogbolosingha AJ and Singh A (2020). “COVID-19 pandemic: Review of impediments to public health measures in sub-Saharan Africa.” *American Journal of Preventative Medicine and Public Health* **6**(3):68-75.
- Raphael D and Komakech M (2020). “Conceptualizing and researching health equity in Africa through a political economy of health lens – Rwanda In perspective.” *World Development Perspectives* **19**:100207.
- Rutayisire E, Nkundimana G, Mitonga HK, Boye A, and Nikwigize S (2020). “What works and what does not work in response To COVID-19 prevention and control in Africa.” *International Journal of Infectious Diseases* **97**:267-9.
- Tengera O, Ndayisenga JP, Mukamana D, Muhayimana A, Murekezi J, Mukamusangwa M, Uwambajimana R, and Musabe J (2020). “The impact of the COVID-19 pandemic on maternal and child health services in Rwanda.” *Research Journal of Health Sciences* **8** (3):221-2.
- Uwiringiyimana C (2021). “Talks underway with investors to make COVID vaccines in Africa” Kagame. Reuter (June 21, 2021). <https://www.reuters.com/world/talks-underway-with-investors-make-covid-vaccines-africa-kagame-2021-06-21/>
- Wallace LJ, Nouvet E, Bortolussi R, Arthur JA, Amporfu E, Arthur E, Barimah KB *et al.* (2020). “COVID-19 In sub-Saharan Africa: Impacts on vulnerable populations and sustaining home-grown solutions.” *Canadian Journal of Public Health* **111**(5):649-53.
- Worldometer. COVID-19 Coronavirus Pandemic. (June 25, 2021). <https://www.worldometers.info/coronavirus/#countries>

World Health Organization (2021). “Responding to the COVID-19 pandemic: WHO’s action in countries, territories and areas, 2020”.

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Chapter Five

Strategies for control of the COVID-19 pandemic in African communities

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Abstract - Surveillance data from WHO indicates that most African countries already have local transmission of COVID-19 and the number of countries with widespread community transmission has also rapidly increased. Governments across Africa, for example, Botswana, Kenya, Rwanda, South Africa, and Uganda instituted simultaneously multiple public health measures, including enhanced surveillance to detect cases, contact tracing, quarantine, isolation, public engagement and sensitization, and case management to limit the spread and adverse outcomes of COVID-19 among their citizens. Most countries on the African continent also implemented stringent physical distancing measures, including movement restrictions to limit contacts among people. Although studies have shown that these interventions were very useful, they have become unsustainable and impractical in many African community settings. Sixteen simple strategies are proposed here for consideration by African governments in the struggle to limit and control the spread of COVID-19 in their communities. These include: vaccination, increased testing, public engagement and sensitization, decentralization of services, creation of task forces down to village levels, upgrading of health facilities, stockpiling personal protective equipment (PPE), strengthening referrals and active surveillance of cases, bolstering internal funding mechanisms, and supporting the global health security. In addition, the creation of a COVID-19 control program at the Ministry of Health and the support of state-regional collaboration in the control and prevention of COVID-19 are also advocated.

Keywords: SARS CoV-2, COVID-19 pandemic, Africa, public health measures, control strategies.

Abbreviations

ACDC:	African Center for Disease Control and Prevention
CDC:	(U.S.) Centers for Disease Control and Prevention
CoV-2:	Coronavirus-2
COVID-19:	Coronavirus Infectious Disease - 2019
GHSA:	Global Health and Security Agenda
NGO:	Non-Governmental Organization
PPE:	Personal Protective Equipment
SARS:	Severe Acute Respiratory Syndrome
WASH:	Water, Sanitation, and Hygiene
WHO:	World Health Organization

1. Introduction

Surveillance data from WHO indicates that most African countries already have local transmission of COVID-19 and the number of countries with widespread community transmission has also rapidly increased [1]. Governments across Africa, for example, Botswana, Kenya, Rwanda, South Africa, and Uganda instituted simultaneously multiple public health measures, including enhanced surveillance to detect cases, contact tracing, quarantine, isolation, public engagement and sensitization, and case management to limit the spread and adverse outcomes of COVID-19 among their citizens [2,3].

Most countries on the African continent have implemented stringent physical distancing measures, including movement restrictions to limit contacts among people [2]. Although studies have shown that these interventions were very successful in curbing down the spread of COVID-19 in many African communities, they have become unsustainable and impractical in the African community settings. These measures have also inadvertently hurt the social and economic life of individuals and their communities [2,3].

2. Strategies

Sixteen strategies have been proposed to African governments on how they could limit and control the spread of the COVID-19 pandemic in their countries but also allow other sections of the economy to run. The strategies are presented next:

Vaccinating the African population: The development of several potent COVID-19 vaccines has been dramatically fast and several viable and effective vaccines have been rolled- out in many countries, including some African countries, with good results so far. Since COVID-19 vaccines were rolled out in January 2021, reports from the U.S.A., for example, have shown a tremendous decline in the number of new cases, the number

of hospitalizations and deaths ever - a sign, perhaps, that these vaccines are safe and effective against the virus. The emergence of new, more infectious variants sends more worrying signals to the medical world. However, recent reports show that even these variants are susceptible to these vaccines - a relief that sends hope and good expectations for the control of COVID-19 pandemic the world over. Worrying is that many African countries have not had a fair share of the available vaccines for their citizens and there are already talks of 'apartheid' in vaccine distribution across poor nations. The role of the WHO in the equitable distribution of vaccines in poor countries is being carefully watched by many stakeholders.

Increasing protective procedures: The testing, isolation, and quarantining of suspected cases in homes must be increased where practically possible. This requires a well-established community surveillance system, a motivated health work force with personal protective equipment (PPEs), adequate test kits, and organized and coordinated referral systems of samples to designated test sites (preferably the hub system). These test sites should be decentralized to regional centers where reports from and to referral and source sites are timely delivered. In addition, community contact tracing of suspected and contact cases should be conducted holistically and efficiently, avoiding the spread of the virus but maintaining the human dignity of the infected persons [4].

Engaging, sensitizing, and mobilizing the population: The African population must be engaged, sensitized, and mobilized regarding preventive measures: This should be developed in a coordinated fashion from the COVID-19 National Task Force at the provincial, district, parish, and village task forces. Messages should be regular, factual, and provided in a manner that does not cause anxiety, panic, depression, and more uncertainties in the population. Communities should avoid stigmatization of those infected with COVID-19 because this creates undesirable effects such as emotional, psychological, and mental harm. More so, some of the affected may avoid seeking healthcare or may get discouraged from adopting healthy behaviors thereby creating more risks to the population [5].

Communicating regularly: Updates on the status of the country's situation: must be provided regularly. Relevant government authorities are to regularly inform and provide guidance on the situational analysis on COVID-19 internationally, nationally, and locally [6]. The fear and disorders on SARS-CoV2 pandemic which resulted from an inadequate amount of information conveyed to the public caused this emerging pathogen to be dreadfully received by many communities in Africa. Nevertheless, taking into consideration and inspired by the last 40 year old success story on HIV, African communities could successfully rise up to the challenge of this pandemic [7]. The initial steps in the control of the COVID-19 pandemic have been successfully undertaken by

the use of face masks [8], physical distancing, lockdowns, stay-home policies, regular use of sanitizers, and washing of hands with soap and water [5,8].

Creating COVID-19 task forces: Such task forces must be created at the national, provincial, district, parish, and village levels. Their charge would be to disseminate and follow-up cases in communities. The flow of information from task forces is recommended to be bi-directional, regular, and coordinated by the line government ministries. It is suggested that each task force should have subcommittees such as coordination & resource mobilization, case surveillance, action research, risk communications, case management and IPC, logistics, security & enforcement, and water, sanitation and hygiene (WASH). These task forces should meet regularly perhaps once every two weeks; updating members on progress in the fight against the virus internationally, nationally, and regionally. It is suggested that in the same meeting community reports through the subcommittees be escalated to the main Task force committee.

Upgrading of health facilities: Upgrading of health facilities is expected from national to rural facilities to stockpile the required tools, equipment, and sundries for the management of COVID-19. In cases where COVID-19 patients develop severe forms, the lowest health facility should be able to identify, isolate, and refer cases to regional centers. National, regional, provincial and district centers should be well prepared with the required human resources and equipment and be ready to handle COVID-19 cases received. Timely handling of cases and ensuring that there are no delays will prevent panic, anxiety, and uncertainties among health workers and the public [5]. A dedicated and well-motivated workforce at health facilities should be set aside to handle any COVID-19 emergencies, preferably 24 hours a day.

Procuring and stockpiling the correct PPEs for all health workers: Health facilities (governmental and non-governmental) should have the required medical sundries for the management of COVID-19. Health workers should be trained on standard operating procedures (SOPs) for the management of COVID-19 in their locations. In addition, trained health workers should be supervised on the use of PPEs all the time during work as studies have shown that nearly 50% of COVID-19 cases may be asymptomatic [9]. Many studies have shown infected health workers could become super spreaders of the virus to the population, especially when they continue to treat other patients [10].

Strengthening active surveillance of COVID-19: This should be done in high-risk areas, especially densely populated communities, border points, schools, markets, and among international drivers. It can be achieved by regular and mandatory testing of such groups to detect early asymptomatic cases and provide the necessary remedies including isolation, quarantine, and treatment as may be required [9].

Decentralizing the testing to Regional Centers: Efforts should be made to ensure quality tests and assurance in regional centers. One of the goals for successful management of COVID-19 cases would be to treat the cases at the nearest points of identification. Establishing regional test and treatment centers will help reduce costs of transportation of patients and samples and would also reduce the risk of spread of the virus along the referral systems. This is likely to reduce congestion of cases in a single treatment center, thus creating less spheres of risks of spread of the infection to the population.

Allocating research funding to stakeholders: In order for a country to respond appropriately to the COVID-19 pandemic, it is essential that it understands how the SARS CoV-2 virus spreads in its community, its dynamics, population characteristics, and other factors that determine spread [11]. This can best be determined by conducting research of high quality. Institutions such as universities, research centers, health facilities, non-governmental organizations (NGOs), and bilateral and multilateral organizations should put all efforts to support research on all aspects of human life including health, economy, education, trade, behaviors and social life. Evidence adduced by researches provides the blueprints which can feed into the National task force, technical working groups, and the Ministry of Health for policy formulation and implementation. African governments should identify, allocate, and fund studies on COVID-19 because there are so many unknowns about the virus and its effects on specific population groups.

Strengthening referral systems: Referrals from the lowest health units to National Referral Centers should be strengthened. In order for an African country to develop systems which are sustainable, it is essential that it strengthens its referral systems to efficiently handle all COVID-19 cases and any other emerging infectious diseases in the future. This demands that health facilities should have human resources, equipment, test kits, and ambulance ready to transfer COVID-19 cases from one unit to the other. Laboratory services and hub systems should be bolstered to transfer biological materials while keeping the recommended standard operating procedures in force.

Bolstering internal resource mobilization: Resources are scarce globally and African governments should begin to plan and organize self-funding interventions using their own resources. Internal funding mechanisms should be put in place to support an in-country COVID-19 strategic plan. The economic downturn as a result of the COVID-19 pandemic has devastated economies of many countries globally and most economies are heading to recession. It is time that African governments focus on self-funding of this pandemic program as a short, midterm and long-term measures. It is proposed that a special COVID-19 trust fund be set aside by each African government in respective line ministries to facilitate the implementation of these COVID-19 programs.

Creating a COVID-19 National Control Program in the Ministry of Health:

This program will be tasked to plan, execute, and handle health issues related to the SARS-CoV-2 virus. Several researchers have predicted that perhaps SARS-CoV2 will be around for many years to come unless eradicated by vaccination or other means. Several treatment protocols for COVID-19 are at different levels of trials and there is no certainty on the timelines of being approved. Now, with the advancement in technology, safe and viable vaccines have been rolled-out in most countries with very good results, it is proposed that COVID-19 National Control programs should be put in place to steer the program implementation in each country, and design policy frameworks for national prevention and control of the SARS-CoV2 virus.

Strengthening regional-state collaboration on prevention and control:

Policy approaches on how to handle the COVID-19 pandemic have varied across nations and continents [12,13]. In many African countries, for example, tribes and communities cut across borders and boundaries and they visit and share functions and activities together. Collective approach by regional governments would help a great deal in the control, prevention, and spread of COVID-19. A good example of this was seen in East Africa where the approach to the control of the COVID-19 pandemic were different (complete lockdowns versus no lockdowns) and only for the region to realize that, the main drivers of transmission were the international truck drivers who seemed disproportionately affected by the SARS-CoV2 virus [12]. Collaborative efforts among regional countries would recommend testing of truck drivers at the country of origin, border points, and destination. These collaborative actions would identify truck drivers with positive SARS-CoV2 virus and take appropriate measures to control their movements in the population [13].

Assessing the usefulness of curfews and night movement restrictions:

The function of curfews imposed on residents in some African countries have been described as controversial in many parts of the world. However, considering situations in some African countries, we recommend that restrictions by way of curfews continue to be in place in some circumstances. This is to regulate and inform the public that the SARS-CoV2 virus is still around and therefore utmost care must continue to take place in the population. In addition, continuing restrictions at some hotspots with indications of community transmission are recommended to limit further community spread of the SARS-CoV2 virus.

Supporting global health security:

A number of countries are investing in global health security, ensuring domestic preparedness, eliminating diseases, and ending epidemics as their top priorities [14]. Since the inception of global health security agenda (GHSA), the (U.S.) Centers for Disease Control and Prevention (CDC) have minimized public health threats by improving public health preparedness in the U.S.A. and internationally [14].

It is now known and commendable that the (U.S.) CDC invested in 12 partner African countries to strengthen and sustain public health readiness to contain outbreaks at their sources [14]. So, the areas that the (U.S.) CDC focusses on are the four fundamental areas that underlie all aspects of global health security. These include: surveillance system, laboratory systems, workforce development, and emergency management and response [14]. With the development of African Centers for Disease Control and Prevention (ACDC), headquartered in Addis Ababa, Ethiopia, it is high time that African countries unite to strengthen this Center to partner and collaborate with the (U.S.) CDC so that it can effectively scale-up to cover the whole continent. Furthermore, similar replicas of ACDC should be created among member states with the view of strengthening the four pillars of Global Health Security in African countries. Likewise, it is important to note that, the ACDC has accelerated its work to enhance diagnostic and surveillance capacity on the continent over the years [6]. Taking into consideration that pandemics know no borders, and success in controlling a pandemic in any one country will be limited if epidemics continue to rage elsewhere, it is important that collective efforts be put in place to control the pandemic [6].

3. Conclusions

In conclusion, sixteen simple strategic approaches have been proposed to African governments to help in the control of the COVID-19 pandemic in African communities based on evidence, disease dynamics, situational analysis, and the ability of national governments to handle any upsurges.

4. Recommendation

We recommend that African governments invest and focus on research, internal funding mechanisms, regional-state collaborations, and support global health security policies in the control of the COVID-19 pandemic. Pandemics are a great danger to humans and their livelihoods.

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References

- Eric Nzirakaindi Ikoona, David Lagoro Kitara (2021). “A proposed framework to limit post-lockdown community transmission of COVID-19 in Africa”, *Pan Afr Med J*, **38**:33.
- United Nations Economic Commission for Africa (2020). “COVID-19 lockdown exit strategies for Africa: Ideas for Prosperous Africa”, <https://www.uneca.org>.
- David Lagoro Kitara, Eric Nzirakaindi Ikoona. (2020). “Proposed strategies for easing COVID-19 lockdown measures in Africa”, *Pan Afr Med J* **36**(179):10.11604/pamj. 2020.36.179.24194.
- Lisa Rosenbaum (2020). “Harnessing our humanity - How Washington’s health care workers have risen to the pandemic challenge”, *The New Engl. J. Med*, 1-3. [doi: 10.1056/NEJMp2007466](https://doi.org/10.1056/NEJMp2007466).
- Betty Pfefferbaum, and Carol S. North (2020). “Mental health and the COVID-19 pandemic”, *The New Engl. J. Med*, 1-3. [doi: 10.1056/NEJMp2008017](https://doi.org/10.1056/NEJMp2008017).
- Wafaa M. El-Sadr, and Jessica Justman (2020). “Africa in the path of COVID-19”, *The New Engl. J. Med*, 1-3. [doi: 10.1056/NEJMp2008193](https://doi.org/10.1056/NEJMp2008193).
- Myron S Cohen and Lawrence Corey (2020). “Combination prevention of COVID-19”, *Science* **368**(6491):551. [doi:10.1126/science.abc5798](https://doi.org/10.1126/science.abc5798).
- Michael Klompas, Charles A. Morris, Julia Sinclair, Madelyn Pearson, and Erica S. Shenoy (2020). “Universal masking in hospitals in the COVID-19 era”, *The New Engl. J. Med*, 1-3. [doi: 10.1056/NEJMp2006372](https://doi.org/10.1056/NEJMp2006372).
- Qun Li, Xuhua Guan, Peng Wu, and Xiaye Wang (2020). “Early transmission dynamics in Wuhan, China of the novel coronavirus-infected pneumonia”, *The New Engl. J. Med*, **382**(2):1199-1207. [doi: 10.1056/NEMJoa2001316](https://doi.org/10.1056/NEMJoa2001316).
- Temet M. McMichael, Dustin W. Currie, Shauna Clark, Sargis Pogojans, Meagan Kay, Noah G. Schwartz, James Lewis, and Atar Baer (2020). “Epidemiology of COVID-19 in a long-term care facility in King County, Washington.”, 1-7. [doi: 10.1056/NEJMoa2005412](https://doi.org/10.1056/NEJMoa2005412).
- Wayne C. Koff, and Michelle A. Williams. (2020). “COVID-19 and immunity in aging populations-A new research agenda”. *The New Engl. J. Med*, 1-3. [doi: 10.1056/NEJMp2006761](https://doi.org/10.1056/NEJMp2006761).
- David Lagoro Kitara, Eric Nzirakaindi Ikoona (2020). “COVID-19 pandemic, Uganda’s Story”, *Pan Afr. Med J.* **35**(2):51. [doi:10.11604/pamj.suppl.2020.35.2.2343..3](https://doi.org/10.11604/pamj.suppl.2020.35.2.2343..3)
- Salman Rawaf, Harumi Quezada Yamamoto and David Rawaf (2020). “Unlocking towns and cities: COVID-19 exit strategy” *East Mediterr Health J.* <https://doi.org/10.26719/emhj.20.028>.
- (U.S.) Centers for Disease Control and Prevention (2020). “CDC and global health security agenda”, <https://www.cdc.gov/global health>.

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Chapter Six

The role of people as individual and collective agents in making a difference to societal outcomes, also in the COVID-19 era: African insights

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Abstract - This chapter elucidates how ten young adults (in their 20s to mid-30s) from various African countries have experienced their individual and collective agency as impacting social and ecological outcomes in their societies. The chapter also considers how their agency has been crucial during the COVID-19 pandemic. It details how they regard themselves as having developed through experiences starting in their early childhood, which led them to recognize the need to become proactive in helping others deal with challenges. It recounts how they chose to seek out exposure for their personal growth and capacitation, with a view to making a social contribution in various fields in which they could become influential. The chapter points to their accounts of some of these contributions. The participants' stories were elicited (September 2021)

through an open-ended set of questions which they were requested (by Romm and Laouris) to answer. The questions were intended to draw out what these participants consider their most outstanding contributions (individual or collaborative) to African society; what factors/assets/experiences enabled them to make such contribution(s); and what important learnings had “stayed” with them from what was called Re-Invent Democracy in the Digital Era project organized in 2015-2017 by the Future Worlds Center (of which the second author is the CEO), in which they participated. Further to their creating answers on the “questionnaire” form, we held a Zoom conversation (September 27th, 2021), in which they clarified their answers and lent more detail to them. The chapter focuses on some of the insights that we have harvested from these elucidations – which we argue are relevant to continued theorizing around the pertinence of social network theory in the digital era and its application/adaptation to African contexts and beyond.⁸

Key words: *African responses to COVID-19; digital age; feed it forward behavior; networking; social outcomes; social media; “weak ties” theory.*

Abbreviations

ACDEG:	African Charter on Democracy Elections and Governance in Ghana
ADH:	Adolescent Health
ADH-TWG:	Adolescent Health Technical Working Group
AGA:	(African Union’s) African Governance Architecture
AIESEC:	Association Internationale des Etudiants en Sciences Economiques et Commerciales
AMREF:	African Medical and Research Foundation
AU:	African Union
CBD:	Community-Based Organization
CRS:	Civil Registration Services
CSO:	Civil Society Organization
CYD:	Center for Youth and Development
DMPAK:	Disaster Mitigation Professional Association of Kenya
DoSWFCD:	Department of Social Welfare and Community Development
ECE:	Elgon Center for Education

⁸ In Chapter 2 in this volume by Laouris et al., (2022) entitled Rendering Africa more resilient, sustainable, and better prepared for COVID-analogous pandemics: Proposals from across seven African countries, the authors referred in the Introduction to this Re-Invent Democracy in the Digital Era project, which was coordinated by the Future Worlds Center. That chapter detailed six of the participants’ proposals for creating resilience in the COVID-19 era and beyond, as clarified and discussed together around a Triggering Question in August 2021. This chapter concentrates on ten of the participants’ stories (discussed and elaborated in September/October 2021) of their own individual and collective agency in making a difference to outcomes pre-and post COVID-19, and how the Re-Invent democracy project was influential in their various journeys. (See Laouris et al., 2017 for an indication of the whole project, of which Africa was one selected region.)

ECEC:	Elgon Center for Environmental Education
FASTER:	Faith-based Action for Scaling-up Testing and Treatment for Epidemic Response
GAWE	Global Action for Women Empowerment
GIMAC:	Gender Is My Agenda Campaign
GLOWA:	Global Action for Women Empowerment
IUNV:	International United National Volunteers
IW:	Intellectual Property
MAYO:	Marvel Act Youth Organization
MMUST:	Masinde Muliro University of Science and Technology
MNF:	Mwaka Namwila Foundation
MTW:	Move The World
NASF:	National HIV & AIDS Strategic Framework
NGO:	Non-Governmental Organization
NCI:	Nurture a Child Initiative
POWER:	Promoting Opportunities for Women Empowerment and Rights
RD:	Re-invent Democracy
SDD:	Structured Democratic Dialogue
SDG:	(WHO's) Sustainable Development Goals
SGBV:	Sexual and Gender-Based Violence
SLDF:	Sabaot Land Defense Forces
SRHR:	Sexual and Reproductive Health and Rights
SSA:	Sub-Saharan Africa
UN:	United Nations
UNECA:	United Nations Economic Commission for Africa
UNPF:	United Nations Population Fund
UNV:	United National Volunteers
WHO:	World Health Organization
WILDAF:	Women In Law and Development in Africa

1. Introduction

The starting point that sparked our (Laouris's and Romm's) decision to ask the ten young pioneer leaders to reflect upon their individual and collective agency was our recognition that discourses regarding the crisis of the COVID-19 pandemic tend to focus on how various governmental and non-governmental institutions have functioned to mitigate the effects of the pandemic. Yet, the role (and motivations) of the *people* who were/are at the heart of facilitating options to address community/societal challenges in the face of the pandemic tends to be sidelined in current discourses. Hence, for instance, reference might be made in common parlance to the importance of research institutions, academic institutions, government agencies, non-governmental organizations (NGOs), and (other) civil society organizations (CSOs). However, what we considered to be largely unanswered questions are: What leads people to decide to

use their roles in academia to good effect for the benefit of communities?; to do research that will have a broader impact on community wellbeing (and not just bring acclaim and/or profits to a group of researchers)?; to use government institutions or offices as service agencies to serve the most vulnerable; and/or to use civil society mechanisms to hold government officers accountable?; and, finally, to volunteer with relevant NGOs or CSOs, or indeed to set up and lead organizations that will be of service to collective wellbeing? ⁹

The chapter delves into this aspect of “social work” where our participants have been committed to doing “work” on a social level that is meaningful not only for themselves but primarily to the community/society. They have been doing so before and during the pandemic. Many of their contributions spanned the global arena as several of them consider themselves as global citizens. They consider that their work can draw on and feed into global agendas. They wish to fulfill globally relevant agendas such as encapsulated in the 2015 United Nations (UN) Sustainable Development Goals, (SDGs) now refined to address the COVID-19 and post-COVID-19 era. When answering the question in our questionnaire form and during the Zoom conversation as to “what factors/assets/experiences enabled them to make such contribution(s)?”, nearly all of the participants referred to their involvement in networking in seeking out opportunities for furthering their contributions in their societies. Hence, we have organized this chapter to shed light on social network theorizing as part of our discussion. ¹⁰

In considering the issue of “How do our social networks affect wellbeing?”, Delagran (2016) argues that “our social networks ... provide benefits, not only to ourselves, but to our community”. She indicates that much network theory has concentrated on the benefits accruing to individuals in, for instance, “finding a job, taking care of a loved one with cancer, or simply passing information quickly” – in that networks “offer resources we might not be able to access on our own”. But she notes that apart from network theory pointing to benefits to individuals in that they are able to access “social capital” (the potential to secure benefits and invent solutions to experienced challenges through the networks), the theory can also be used to delineate how

⁹ Civil society organizations (CSOs) by definition refers to a broader range of organizations than nongovernmental organizations (NGOs) and includes, for instance churches and other faith-based organizations; online groups and social media communities; NGOs and other nonprofits (e.g. Community-Based Organizations (CBOs) specific to a defined community; Unions and other collective-bargaining groups; social innovators, entrepreneurs, and activists as well as cooperatives and other collectives. Most of the participants in this cohort actually set up NGOs and/or CBOS in order to further their work in the society, while also being involved in certain other civil society organizations (such as social media communities in which they were also active in creating and encouraging participation).

¹⁰ Some of the participants have been liaising with each other across different African societies – hence, their activities are not confined to only one national context (for example, Abel Mavura, Apollo Murigi, and Abiba Abdallah have been liaising across Zimbabwe, Kenya, and Ghana); and some have had commitments across different societies in the region (e.g., Melvis Kimbi has been working and contributing in Cameroon as well as Madagascar, with her work for WHO during the pandemic having been undertaken in partnership with the Ministry of Health in Madagascar).

networks are of benefit to the community/broader society. She cites Christakis and Fowler (2009), who point to benefits such as:

1. Facilitating the flow of altruism and generosity.
2. Fostering trust and reciprocity.
3. Contributing to lower crime rates.
4. Promoting better public health.
5. Supporting reduced political corruption (Delagran, 2016).

Sadly, she points out that although “vibrant social networks are a vital part of a healthy community and individual wellbeing”, it appears that in the United States, “social connections ... are falling”. Here she cites Robert Putnam’s book *Bowling Alone* (2001), which documents this decrease. She refers to his statement that “over the last 30 years, our participation in public affairs and civic associations, as well membership in churches, unions, and the somewhat symbolic bowling league, has fallen by 25% to 30%. And, with that reduction, also comes a decrease in charitable giving, as well as a decrease in the number of people participating in the political process and an overall dwindling of trust in others” (Delagran, 2016). We would suggest that this can well be a result of the individualist-oriented culture that could be said to be dominant (and increasingly dominant?) in U.S.A. society (see also Romm and Lethole, 2021). Such individualism is at the expense of appreciating human beings as existing “in relation”, as in the African adage “I am because we are” – cf. Romm (2017); Basse (2019); Paulson (2019); Chowdhury *et al.*, (2021); Adyanga, Romm, and Ocan, 2022). Or, as Tutu expresses it: “A person is a person through other persons” (https://www.goodreads.com/author/quotes/5943.Desmond_Tutu).

As noted by Paulson (2019), “the Kenyan literary scholar, James Ogude, believes Ubuntu might serve as a counterweight to the rampant individualism that’s so pervasive in the contemporary world”. Chowdhury *et al.*, (2021) take the same position, suggesting that worldwide, during and post-COVID-19, “when we are nearing the new normal, we feel that the sense of individualism, consumerism, Eurocentric ‘self,’ and ‘making self’ should be replaced by a common principle of solidarity” – as in the “indigenous African faith Ubuntu” (pp. 361-2). They consider that the philosophy (and attendant practice) of Ubuntu can well be of relevance to other geographical contexts in (re)vitalizing people’s sense of solidarity with others.¹¹ In his discussion of “*Relational being*”, the well-known U.S.A.-based sociologist/psychologist/educationalist, Gergen, similarly

¹¹ Chowdhury *et al.* remark that “Ubuntuism become popular outside South Africa because Nelson Mandela led the transition to democracy in South Africa in 1994, mainly through Rev. Desmond Tutu In the meaning of Ubuntu, an individual’s existence is merged in ‘we’—based on a proper self-assurance that he or she belongs to a higher position. Tutu’s assertion gives a reduction when others are insulting or belittling others when they are mistreated” (Chowdhury *et al.*, 2021: p. 362).

refers favorably to the African concept of Ubuntu (2009: 388) as advocating compassion and care for others. He additionally argues (2020) that in the face of the COVID-19 pandemic, we need to be more aware of setting-up what he calls a “communiverse” where communications across boundaries (and transcending a sense of bounded self) are encouraged.

Our chapter does not attempt to comment on the relative absence of a sense of community in the U.S.A. or other more individualist-oriented societies (relative to different contexts). Rather, we concentrate on elucidating how social network theory as we interpret/utilize it helps show how the ten participants in this African cohort appreciate the importance of networking, which they understand as “exposure” and “developing connections”. They consciously hunted and continue to hunt-out opportunities for making connections to grow themselves with a view to also contributing to community/social welfare. The discussion of their practices exemplifies and, at the same time, casts new light on the relevance of social network theory.

This chapter is structured as follows: In the next section (Section 2), we offer some theoretical deliberations around the value of “weak ties” – in contrast to strong family or friendship ties where people are engaged in frequent, lasting interactions, and with emotional intensity. The discussion is based on Granovetter’s (1973) central insight that weak ties are more important to us than strong ones for finding new information, ideas, or even a job. A focus on weak ties offers a better theoretical basis to explain why diffused networks (in contrast to strong ones) are more responsible for advancing community and wider social welfare. We indicate how the participants chose to seek out (from various contexts, including attendance of in-person and online conferences and workshops -local, regional, and international) opportunities to network with those whom they surmised were interested in the issues with which they were concerned so that they could learn from them, share with them, and in turn make significant contributions to their societies.

Following this, in Section 3, we offer a discussion around what Christakis (2021), a social network theorist, refers to as the potentially wonderful human qualities of humans, which he believes to be genetically programmed in our human make-up in terms of a propensity for cooperative behavior towards the “public good” (along with other less wonderful qualities that people can exhibit). We indicate how the participants all chose, based on their response to their early childhood experiences, to act with a sense of commitment to community/societal wellbeing, which in nearly all cases was spurred by the suffering/challenges they had faced early in life. We indicate how the participants feel a sense of fulfillment to the extent that their activities have been socially impactful in making a difference in the lives of others. We refer, for example, to their involvement in providing educational opportunities for students (of various ages) and creating mentorship programs and forms of financial support; their involvement in gender issues (improving the plight of women and girls, including in the face of gender-based violence); their involvement in advocating for environmental protection of forests and “green” urban and rural spaces; and organizing ecological awareness campaigns for youth; their involvement in advancing democracy in Africa (for example, through advocating for

transparency of information); and their involvement in promoting the role of youth in the social and economic development of Africa, etc. (for example, via social entrepreneurship¹²).

In Sections 3.1-3.10 and subsections 3.1.1.1 to 3.1.1.10, we recount some of the (crucial) impacts that the participants indicate they have made, highlighting their contributions to their societies in the face of COVID-19 and its challenges. We concentrate on their responses to COVID-19 in their various capacities (e.g., while situated as academics, leaders of organizations, involvement in consulting to government and other organizations, working for international ones such as WHO, working as professionals such as lawyers or journalists advocating for rights during the COVID-era). In Section 4, we indicate how the participants suggest that their involvement in the Re-Invent Democracy (RD) project organized by the Future Worlds Center (2016-2017) was helpful for them in their continued ways of contributing to their societies. In Section 5, we conclude our overall story. We also indicate some implications for network theory in the digital age.

2. Weak ties in network theory

Granovetter's focus of analysis in network theory is on what he calls "weak ties". He intuitively defines the strength of a tie as referring to a "combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and the reciprocal services which characterize a tie" (1973: 1361). He suggests that this intuitive definition should suffice for most of us to agree (when speaking of ties) whether a given tie is strong(er) or weak(er). The main argument in his article is that if we focus on the weak ties that an individual has instead of being concerned only about the strong ones, we can locate the mechanisms by which "weak" interactions between people (in this case, carefully chosen by the African participants to get exposure beyond their small group contexts) can diffusely spread to create outcomes which affect social structure at a more macro level of the system.

Instead of using network theory to consider small-scale face-to-face groups of people, Granovetter advocates that network analysis can be used to link small-scale levels (and processes of interaction) with one another as well as with more "amorphous" wider social outcomes (1973: 1376). This means that instead of concentrating on questions (often asked by network theorists) asking people to point to whom they "like best" or "prefer to do something with", he focuses his attention on how people develop "*weak ties and the social consequences of this*". What is specifically relevant for our theoretical purposes is that these kinds of networking ties were the kinds that the African participants all sought out – and which became the basis for their growing

¹² As Urban and Gaffurini (2018: p.117) note, there has been a growing research interest in examining social enterprise as a "way to incorporate economic activities into providing solutions for social problems, while adding social value". Social entrepreneurs are not impelled by a single bottom line of maximizing profit, but are impelled more by what Arko-Achemfuor and Dzansi (2016) call doing good business by doing good. It is a way of "doing business" through a triple bottom line that takes into account social and environmental impacts as well as economic ones (Mair, Battilana, and Cardenas, 2012).

and learning, while inputting their learning into wider networks in the society, including through various organizations that many of them formed in order to make a social, economic, political and/or ecological difference with broad societal impact. In this way, the ties that they sought out became translated, as Granovetter states, into “large-scale patterns, which... in turn, could feed back into small groups”, making a difference to people’s everyday lives (1973: 1360).

We elaborate on some examples of social, economic, political, and ecological impacts that ensued from the participants’ agency during the chapter. In this way, we are (theoretically) connecting “agency” with “social structure” (where structure is defined as the recurrent patterned societal arrangements which affect the choices and opportunities available to people in their daily lives). We indicate how the participants deliberately used their agency to create what can be called structural changes, which would expand others’ sense of, and actual, life chances (and their agency in turn). This line of thinking is compatible with Sen’s capability approach (Sen, 1999, 2009), which proposes that social arrangements should be evaluated primarily according to the freedom/choices people have to take part in a life worth living in terms of quality of life.

Resonating with the African concept of Ubuntu, Sen offers a discussion of the interconnectedness of humans and our responsibility to recognize our shared humanity so that we take some responsibility for reducing “unfreedoms” such as poverty, famine, and lack of political rights to participate in decision-making, etc. (See also Sen and Nussbaum, 1993.) What our stories show up is how these participants take these responsibilities seriously. As Abdulkarim Taraja succinctly states in his questionnaire response: “The [word] I gives responsibilities to self and not depending on others to do it”. But we can add that when using the word “I”, clearly this is a *community-directed I* (rather than a narrow self-interested one). The suggestion is that it is up to us as agents to shape the societies in which we live to create (more) opportunities for others. In her email signature, Georgina likewise expresses her sense of agency combined with a sense of responsibility, where she states: “The world we want will not be handed to us; we have to create it”. Melvis indicated (on her questionnaire form) that her “exposure and experience as a journalist” have “opened me up to many realities and to how simple actions can effect tangible and long-lasting change for oneself and others”. As the participants act in the world in relation to many others, they experience themselves as agents making a difference in the lives of others. These participants all “create the world” as they connect with others across various contexts, learn from them (while sharing their ideas), and create opportunities for enhancing wellbeing/quality of life through their organizational activities and other networking activities. They also rely on communication media such as TV, radio, the internet, and other social media communications to forward life-changing opportunities for themselves and others.

In their discussion of network theory, Fowler and Christakis (2010), while not using the language of “weak ties”, refer to the spread of interpersonal effects across individuals via various pathways, such that co-operative/helping behavior can spread and persist over time. Fowler and Christakis refer to an example – taken from a “public goods” experiment undertaken in the USA –where participants had no prior knowledge of each other. With respect to this experiment, Fowler

and Christakis point to “an illustrative set of pathways” as follows: “If Eleni increases her contribution to the public good, it benefits Lucas (one degree), who gives more when paired with Erika ... in period 2, who gives more when paired with Jay ... in period 3, who gives more when paired with Brecken in period 4” (2010: 5337). Fowler and Christakis note that “other researchers have shown that giving behavior can spread from person to person in natural settings, whether in workplace donations to charity or their decision to donate organs [influenced by what they see others doing]”. Fowler and Christakis indicate that it is often supposed – in terms of a view of “rational” action which is deemed to be directed toward seeking individual payoff – that people would seek to maximize their gains. (This would, of course, be in terms of a conception of humans as non-relational beings, whose “rationality” would drive them to seek what they consider to be in their own interest, as isolated selves.) Fowler and Christakis try to explain why the participants in the cited public goods experiment chose not to act in this way. They argue that “One mechanism that may underlie such deviations from “rational” action appears to be mimicry: When subjects copy the cooperative behavior of others with whom they interact, their doing so causes them to deviate even more from rational self-interest and may help reinforce this behavior” (2010: 5337). Fowler and Christakis sound a note of caution that although this has been shown via specific experiments, “whether such ‘pay it forward’ behavior spreads more widely from person to person in natural human networks (i.e., non-experimental ones) remains an open question” (2010: 5338). However, they add, citing Cesarini *et al.*, (2008) that “cooperation itself ... appears to have a genetic basis” – that is, it appears to be built (as one of our capacities) into our array of capacities as humans (Fowler and Christakis, 2010: 5337).

We suggest that the stories presented in this chapter cast further light on this “open question,” as mooted by Fowler and Christakis. The stories which we share offer expressions of how the (African) participants sought out opportunities for interaction which they recognized would help them, in turn, to “pay it forward” (to use Fowler’s and Christakis’s terminology). These opportunities were created via in-person and online conferences and workshops that were organized with local, regional, and international bodies (often linked to UN agencies); via online courses, many of which were given for free by certain universities (such as various Open Universities and the Commonwealth of Learning); and via the UN-funded project called Re-Invent Democracy (RD), etc. (organized by the Future Worlds Center, FWC). Meanwhile, through the range of opportunities sought by the participants, sometimes mentors were found. These mentors in turn spurred them to assume mentoring roles for others, besides their other functions in transforming social, political, economic, and ecological outcomes for what can be called the public good – as in the public goods experiment described by Fowler and Christakis (2010).

Continuing his deliberations about the human capacity for cooperation, this time in relation to the “new normal” post-pandemic, Christakis (March 2021) made reference during an interview to our genetic capacity for co-operation (<https://www.youtube.com/watch?v=Lis1il9Pqyo>). He explained how this has manifested and can continue to manifest in the COVID-19 era and beyond (while recognizing that this is not our only human propensity). When asked by the

interviewer whether he felt that we have learned anything new about human interaction from the pandemic thus far, he indicated that he had not been surprised by responses, which ranged from people trying to blame others (just as in other pandemics which led to blaming) to showing up some “wonderful qualities” of people. He stated that such qualities include the capacity for cooperation, which has manifested as people have responded cooperatively to the “common enemy” (the virus). He suggested, for example, that doctors around the world have collaborated to develop vaccines – “they have worked together and shared knowledge”. He stated that: “We have evolved [as a species] to co-operate and work together, and we see these qualities in the times of plagues too. This quality is one of the more appealing of our species: we work together and share knowledge”. He pointed out that “we evolved to do these things. We also have awful qualities, but we have wonderful qualities too”.

This interview occurred in March 2021, and Christakis referred to the cooperation of certain doctors in sharing knowledge. Further to this, we know that not all doctors (or institutions) have been as co-operative – and that there has arguably been excessive profit-making through Intellectual Property (IP) associated with the development of vaccines by certain pharmaceutical companies (<https://www.nature.com/articles/d41586-021-01242-1>). This focus on IP became one of the reasons for the shortage of vaccines in Africa, where governments in developing countries could not afford the vaccines produced in developed countries and where vaccines have been sold in advance to those who can afford them.

However, Melvis Kimbi, one of the African participants who has worked for the World Health Organization (WHO) as communications officer (International UNV), indicated during our Zoom conversation in September 2021 that WHO has been designing tailor-made options for various African contexts. For example, she noted that in designing policies in partnership with Ministries of Health in multiple countries, WHO has supported efforts to promote research and the development of alternative solutions and help boost laboratories that can develop vaccines for the African continent. She referred to the example of South Africa. Indeed, in August 2021, South African President Cyril Ramaphosa announced that some vaccines had been partly manufactured on the continent, namely, with “fill-finish activities taking place in South Africa”. These vaccine doses are being produced at the Aspen Pharmacare facility in Gqeberha in South Africa. Vera Songwe, executive secretary for United Nations Economic Commission for Africa (UNECA), indicated that “this is a proud moment for the continent” – especially that the vaccines are partly manufactured in South Africa (<https://www.worldbank.org/en/news/press-release/2021/08/05/africa-announces-the-rollout-of-400m-vaccine-doses-to-the-african-union-member-states-and-the-caribbean>). Songwe suggests that Africa can create millions of jobs if health commodities are manufactured on the continent.

Meanwhile, Stephen Saad of the Aspen Group, referring to the facility at Gqeberha (in which Aspen invested 3 billion rand), has indicated the intention to provide quality and affordable vaccines while at the same time strengthening the competencies of the Aspen employees. According to Saad, the manufacturing thus far has already amounted to “enhancing a knowledge

base in South Africa” that can contribute to solving future public health challenges. In principle, it seems that the kinds of sharing by doctors as envisaged by Christakis (at least as far as the African continent is concerned) has reached some fruition in that the idea has been to cooperate to offer affordable medicines – rather than simply being produced out of a pure profit motive to make maximum profits (at the expense of saving lives).

It is worth noting that Melvis Kimbi, from her base in Cameroon at the time, met Vera Songwe in 2017 at a conference in Rwanda called Youth Connect Africa Summit. She was thrilled that Vera encouraged her to think about how she could achieve goals with her exposure and experience. This acquaintance we could call one of Melvis’s “weak ties” – but an influential one in encouraging her and spurring her in her career, to the point that she held the position at WHO as Communication Officer in Madagascar – IUNV. (See Section 3.6.1.)

3. The potentially “wonderful” qualities of humans: Using networks to spread wonderful influence

As indicated above, Christakis (2021) refers to the wonderful and awful qualities that humans might exhibit; he also suggests that social networks can form a basis for spreading (wonderful) actions that lead to the public good. In this section, we draw out how our participants in this African cohort all specifically sought to find opportunities for developing themselves via networks, intending to contribute at a social level to the patterning of outcomes for others. Of course, the participants themselves were all carefully chosen by the FWC team on the Re-Invent Democracy (RD) project in 2016 because of the “good” qualities and “good” work that the team gleaned from the participants’ applications, accompanied by their videos. And indeed, the participants’ decision to apply was also based on their using networking and social media to find opportunities (such as the RD project) from which they could grow and continue their good work. (The FWC team had advertised the project in various forums, including using social media.). So, it is expected that these participants exhibit the wonderful qualities to which Christakis refers as a human potential.

Interestingly, all the African participants seem to be manifesting these qualities as a response to their witnessing or experiencing in their formative years some of the “awful” qualities of humans – and their feeling “bad” about how this has caused human suffering. This effect is pertinently and perhaps most extremely manifest in the story of Abdulkarim Taraja. He remarked during the Zoom meeting that in the face of the conflicts and killings over land in Mount Elgon in Kenya to which he bore witness as a child (a legacy of the colonial era, which led to such deadly conflicts), he has “*seen the worst and the best of humans*”. We now expound on his story (arguably the most extreme) to start this section; further, we turn to the other participants’ stories in alphabetical order.

3.1 Abdulkarim Taraja

The “awful” battles over land to which Abdulkarim was exposed in his childhood occurred because of the effects during and after the colonial era that displaced indigenous families. Upon return, different ethnicity inherited the lands bringing what is called “Historical Land Injustice” (cf. <https://searchworks.stanford.edu/view/11941423>). The colonists drew borders in Mount Elgon unfavorable to the original inhabitants whose land and livelihood were encroached upon; these borders have never been changed, resulting in the wars that Abdulkarim experienced first-hand through the emergence of the Sabaot Land Defense Forces (SLDF) Human Rights Watch Report (2008). This traumatic experience spurred Abdulkarim’s commitment to, now as a young leader, try to create opportunities, *inter alia*, for children’s education, as he had seen so many children who dropped out of school due to the land conflicts and the consequent closure of schools. Besides losing friends due to the conflict, he also “felt bad” that his siblings did not get a chance to attend school; during the Zoom meeting, he recounted that this is why he has become so outspoken about the importance of providing educational opportunities. Abdulkarim founded the Elgon Center for Education (ECE) in 2018 and has used this as a platform to promote access to education through structured academic mentoring programs targeting teachers, learners, and parents. Before this, he was also promoting access to education in various communities. Through his initiatives, thousands of children have been prevented from dropping out. He believes that when a larger population has access to holistic education and opportunities, there can be long-lasting, sustainable development and peace – hence the SDG 4 on Quality education.

This example from Abdulkarim’s story is one example of how suffering as a child led him to decide to act to change the world (in various ways, with the Elgon Center for Education (ECE) being one of them). He indicated that besides attending to his character building (through networking), he also networks with fellow youth organizations to combine their initiatives. And his educational work in helping learners, teachers, and parents is not the only work he does – he is active in other ways. For instance, through establishing the Elgon Center for Environmental Education (ECEC) in 2019, an affiliate of ECE focusing on environmental conservation and climate change, combined with advocacy work as a journalist (and using social media “to create a ripple” in 2019 and 2020), the conversations led to some sections of Mount Elgon forest being handed over to the Kenya Defense Force. This occurred in September 2021, for protection to manage and oversee the recovery of tree cover after massive destruction. We can see here Abdulkarim’s allegiance to protecting the community and the more-than-human community in Elgon (mother nature) and his networking to this effect, to spread “good” influence.

3.1.1 Highlights of activities during COVID-19

Regarding activities directly linked to the challenges of COVID-19, Abdulkarim recounted (via the questionnaire, Zoom meeting, and further emailing to Norma) that he had worked, among other things, to spread stories of hope through using his journalist/communication skills and by making use of the social media in particular. He considers these stories, combined with

tangible interventions (and prayer, which he regards as important), crucial to developing people's sense of agency in making a difference in outcomes. He stated that due to his ability to use communication and social media as tools to tell stories of hope, he was given opportunities to consult on communication strategies of different upcoming organizations, for example, recently from a youth organization in Uganda. Again, this is evidence of the spread of "goodness" and helping behavior through what Granovetter calls "weak links". Another example was that in July 2021, the AMREF Coordinator in his Kenyan County invited Abdulkarim to cover and develop a report for their Sexual and Reproductive Health and Rights (SRHR) policy meeting on meaningful youth engagement. (AMREF Health Africa is supporting Ministries of Health in Africa in strengthening the response to the COVID-19 pandemic in Africa.) Abdulkarim mentioned that some organizations know him directly – such as Civil Registration Services (CRS Kenya), where he was retained as Public Communications Officer after his government Internship program ended in March 2021 – or recommended to him. He "always adjusts his schedules to offer assistance: any person who wants my service or advice sets up the meeting". Another initiative that he organized at the height of the pandemic was that he and his team "engaged in media advocacy on community learning and homeschooling as well as addressing matters of behavior change in tackling the rising cases of teenage pregnancies and early marriages through community Radio". He works with families, the government, and communities in this regard.

3.1.1.1 A note on spreading wellbeing

Many of the participants echoed Abdulkarim's story of being party to and witnessing childhood suffering. They referred to challenges they faced as children, which spurred them to build their character and their skills-base (including through making use of various networks to benefit themselves and others). Many of the stories are of dire poverty and/or facing intense hardships and challenges in childhood, and the participants expressed that this drives them to want to use their lives to help others. At this point, we would like to note that McKay (2015, 2018, 2020) made a similar finding in her research assessing the impact of the national Kha Ri Gude Campaign in South Africa. In doing this research during and after the campaign (2008-2016), she remarks that: "In the face of extreme poverty, there were cases where learners, who themselves were poor, set out to establish development projects to assist others who were less fortunate than themselves such as the aged or people with disabilities" (2020: 33). That is, they used their new-found literacy to assist not only themselves but others to take some control over their lives. This finding of McKay's indicates again the wonderful qualities exhibited by people in disadvantaged circumstances wishing to help others. And she suggests that on a broad scale, the Campaign led to the formation of massive interlinked social networks, which enabled formed groups (of learners and educators) to "collectively tackle many day-to-day problems and to co-operate for mutual benefit" (2020: 32). She explains this in terms of the "interactive ethic" of Ubuntu, in which people recognize their reciprocal responsibilities as agents (2020: 32). Like other network theorists, she suggests that these interactive processes brought about changes at many levels of the society, for example, also through political advocacy "by putting

pressure on local authorities to ... build a bridge where children needed to cross a river to go to school” (2020: 33). As noted earlier, we cannot comment on whether an Ubuntu-inspired way of appreciating “reciprocal responsibility” affects how networks “work” to spread wellbeing outcomes in societies. But McKay suggests that this ethic may indeed have been at play in the case of the impact of the Kha Ri Gude campaign in South Africa.

With this as background, we now refer to the stories of the various other participants in terms of the experiences and factors/assets which impelled their sense of responsibility to others and how this panned out in their practices. (The word responsibility was explicitly used by Abdulkarim but is also echoed in the stories of the other participants.) We turn to these stories only to give a glimpse of these, as space limitations do not permit more than a summary account. (We do not include Yiannis Laouris and Norma Romm in the storying below, as we played other roles – for example, setting up the questionnaire for participants to respond to, facilitating the Zoom meeting, organizing consequent correspondence with participants, and creating a synthesizing story for participants/authors, in turn, to write into.)

3.2 Abiba Abdallah

In response to the question on our questionnaire form concerning factors/assets/experiences that the participants considered to be life-shaping in enabling them to make their contributions, Abiba stated that “family background” was one of them. She also mentioned on the questionnaire that she escaped and rejected two attempts from her dad to force her into child marriage. It transpired in the Zoom meeting that this was indeed the reason for her deciding not only, as Yiannis Laouris put it during the Zoom meeting, to “care about herself” but care for others. She stated that she nearly became a victim of child marriages arranged by her father: Her dad had tried to “get rid of her” (one of the awful manifestations of a human being to use the terminology of Christakis), but she had been assertive. An organization in Ghana had come to her aid as a movement also operating in her community. Due to her experience of being helped (and in line with Christakis’s indication of “pay it forward” behavior), she developed a passion for defending other girls.

Her childhood was, of course, not an easy one. To pay for her higher education, she spent three years doing voluntary work for some organizations, being paid very little by some of them. Still, she managed to purchase a university voucher out of this money and applied for enrollment and further fund education. (She is now continuing her education in social work studies but is doing social work, *albeit* not as a professional social worker.) Her activist work, still mainly voluntary, includes working individually and collaboratively in educational, social, and environmental fields. She also mentioned in the Zoom meeting that a vital part of her journey bringing her to who she is today is her meeting Abel Mavura, another participant whose story we recount later (Section 6.3.8). He moved to Ghana for about two years to work for ActionAid Ghana to support the Young Urban Women’s Movement as an influencer, and he met Abiba. It was Abel who sent her the link for the RD project organized by the FWC, which was another formative

experience for her, as we discuss in Section 4. This experience led her after that to do research (with a friend) to write into the report by Ghana for the African Union’s African Governance Architecture (AGA) and the effective implementation of the African Charter on Democracy Elections and Governance in Ghana (ACDEG), for dissemination in Ethiopia.

All in all, to increase her contribution to society, she has sought various forms of exposure – e.g., traveling, training, workshops, public speaking, etc. She participated in voluntary work as rapporteur and facilitator for ActionAid Ghana for a Promoting Opportunities for Women Empowerment and Rights (POWER) project. She was nominated to participate in a Gender is My Agenda Campaign (GIMAC) summit to share experiences of women smallholder farmers in Ghana. She was recommended – by a community member who knows the work she does in her community – to Move the World (MTW) in 2017. After a few volunteer (not paid) activities with MTW, a new initiative called Get Global was inaugurated. She happened to be the first facilitator (paid voluntary work) who recommended other potential activists to serve as facilitators with MTW in her community. Currently, she works as an administrative assistant (part-time contract work) also for MTW Ghana. She is one of the lead facilitators in engaging youth on Sustainable Development Goals (SDGs), focusing on the first six goals.

Her leadership experience from the Young Urban Women’s Movement influenced her decision to contest and be elected as the Deputy Regional and Deputy National Coordinator for Activista Ghana, engaging girls, women, and men on human rights, SRHR, social rights, and economic rights. Apart from this, she has been working with smallholder women farmers developing their skills. She also assisted various State departments in Ghana, such as the Department of Social Welfare and Community Development (DoSWFCD), in designing responses to sexual and gender-based violence (SGBV) issues. Again, we see from this story how early childhood experiences (being a victim of child marriage, coupled with later seeking out “weak ties” through exposure and networking) created the ripple effect to make a difference to the patterning of social outcomes in an array of ways.

3.2.1 Highlights of activities during COVID-19

Continuing her involvement during COVID-19, she organized global citizenship education (in-house) for young people. This initiative included awareness creation on COVID-19, its effects and safety measures, and our roles as citizens to be active global citizens to minimize spread. It also served as a content curation for collaborative work with Move the World (MTW). Via MTW, she furthermore organized some home schooling for children in various communities. Overall, she worked with CSOs, NGOs, and State agencies such as the Department of Social Welfare, Activista Ghana, WiLDAF Ghana, etc., to make her contributions. For example, she successfully ended two early marriages and was active on SGBV and related issues and developing reporting mechanisms as children, women, and girls were trapped with perpetrators during lockdown. During the lockdown, violence was on the rise, so she stepped up her engagements with training women and men as well as boys and girls; and set up mechanisms for victims to report instances

of SGBV. She traveled within the country as a freelance trainer to run empowerment trainings for national NGOs such as Women In Law and Development in Africa (WiLDAF) on their Enough! project to end sexual and gender-based violence, ActionAid Ghana and Global Platform on their various projects. She volunteered for a year as Project Officer with Global Action for Women Empowerment (GLOWA) Ghana (Jan 2020 to Dec 2021). She is currently continuing her work as a freelance trainer, and she uses her social media skills in two organizations where she administers the platforms (one of them being MTW).

3.3 Bill Akomea

During the Zoom meeting, Bill recounted the factors/assets/experiences that impelled him to decide to use his lawyer's skills (and his law firm) to benefit clients that cannot pay for services and also to offer legal assistance in other ways – for example, using the radio, TV and social media in Ghana. He stated that his belief in God as a Christian has been influential. In his senior high school, he went to a missionary school, and they inculcated in him leadership and community service (a moral education). He stated that the Bible instructs people to do good; and this is also his personal belief. He had humble beginnings and struggled to get educated; there were times when the family could not afford his school fees due to the fact that he lost his dad at an early age. He, therefore, “knows what it means to go through challenges”.

As soon as he had the opportunity, he chose, apart from formal education, to expose himself to different experiences by traveling to different places and also exposing himself to city and rural life. He became involved in the Association Internationale des Etudiants en Sciences Economiques et Commerciales (AIESEC), which is a global platform for young people to develop their leadership potential through international internships and volunteer opportunities. It is a non-governmental and not-for-profit organization run by youth for youth; and he was their national President for a time. He found in his experience that “good people around him supported what he was doing,” and this was also encouraging. (When he did his first master's degree in Germany, he also indicated that he was attracted to people who have the same values.) As far as his contribution to Ghana is concerned, he indicated that through his nine years of legal practice, he had handled numerous cases for deprived and poor persons who otherwise would not be able to afford the services of a lawyer. These were primarily individuals whose rights had been abused or they were in need to enforce their rights. Besides his law firm in Ghana (where he regularly offers legal aid to those who cannot afford services), he appears once a week on television, offering practical solutions to those that need it – for example, women suffering from divorce, property rights, etc. He gives personal lectures in various venues and also teaches law at a university in Ghana.

Furthermore, he founded an NGO (Plight of the Child International) based in Ghana. The NGO has provided free medical care and education for over five thousand persons in rural communities. It has also built two libraries to date and provided a number of educational

materials to them, built children’s playgrounds, and sponsored the education of rural children (some to the university level).

3.3.1 Highlights of activities during COVID-19

Through his being a human rights activist, he continued these activities during COVID-19, including advocating the right to information (as a matter of government transparency) and teaching people their rights, for example, in relation to the police. Notably, he used his “academic” position at the University and his skills with the specific intention that his academic life becomes linked to *community engagement*, helping people in the community to deal with various practical issues facing them (through the multiple platforms that he uses, such as TV, radio, and social media).

3.4 Daniel Ehagi

Daniel Ehagi lectures at Masinde Muliro University of Science and Technology (MMUST) in Kenya, in a department of science and technology, with a specialization in disaster risk management. He indicated during the Zoom meeting that what impelled him to become interested in disaster management was that some of the family members are engineers in his family background. While he was a child, he sometimes joined them when they traveled to certain disaster-prone regions, such as digging wells for water due to water shortages or repairing roads due to flash floods that occurred. This led him to recognize the many hazards that can affect a country such as Kenya, so he chose to do his degree in Disaster Management at university. He also indicated that besides his formative experiences in witnessing the devastation caused by disasters, he learned spiritual values via his upbringing in Christianity inclined to Protestantism, which led to his Salvation invocation for people to “do good things”. These values continue to guide him.

Daniel indicated that he uses his academic position to teach the next generation disaster management so that future disasters can be better addressed and encourages his students to take part in youth-based initiatives/activities in slum areas – thus setting-up community-based projects for them. Furthermore, he is the chairperson of the Disaster Mitigation Professional Association of Kenya (DMPAK), and as such, he contributes to policy at the State, County, and public policy levels. When bills are at the draft stage at the national government, he (and the team members) read these keenly to offer critique to raise issues of concern. (The government sends feedback indicating how they have taken the comments into account. They demonstrate their appreciation of the input; thus, indicating that the critiques/suggestions have been taken seriously.)

3.4.1 Highlights of activities during COVID-19

During lockdowns in Kenya, his students at the university faced challenges as classes moved to online ones. The time frames for joining the online courses were not always amenable for the students, and also, the students may not have the necessary data bundles to join the classes. He helped adjust the schedules for teaching and to raise funds so that the students could participate in using, for example, Zoom and Instagram. He also organized webinars that were educative in society as a whole. So, he and his students were able to share a lot of information and create awareness, including understanding people's rights concerning government policies. He pointed out (during our Zoom meeting) that, for instance, sometimes police had been mishandling people because COVID-19 required them to enforce regulations; but he, together with his students, spread information through the various social media of what people's rights were. In addition, he prompted his students to fund-raise for workers who had been laid off from work due to COVID-19 and/or who were sick. Together with his students, he became involved in projects such as organizing food baskets for people in need. Furthermore, his involvement in disaster management planning as part of the professional association of Kenyan professionals also advised the government on finding avenues to mitigate the COVID-19-related disaster.

3.5 James Gondwe

James indicated during the Zoom meeting that he considers his main contribution to Malawian society is that he set up an organization (NGO) called Center for Youth and Development (CYD), which has managed to vastly increase access to ICT provision to youth in Malawi. He indicated that looking back on why he founded this organization, he would say that he set it up due to the challenges he faced when growing up. He came from "humble beginnings," and although his father and mother were supportive of him as a son, the family had challenges that shaped the way he now thinks, including the need to think outside the box. He first encountered using a computer when he was at the university. He became acutely aware of the opportunities that computers and digital literacy offer for accessing, for example, educational materials online, learning and growing, and linking with others. He has made use of many free courses (and some paid ones) online – the free ones being provided by various Open Universities and the Commonwealth of Learning. He learned a lot about project management via these courses and different educational videos, including how to manage his own NGO to, in turn, support others. The NGO was set up with the specific intent to provide computers to schools to enable learners to learn basic computing. James wanted to give them access to the kinds of learning opportunities that he himself was able to access only once he reached university. He recognized that in the light of these opportunities, it was "high time" that we provide opportunities for young people to learn about computers at a younger age. So, he started (via his organization) collecting computers from individuals and firms so as to teach basic computing to children.

He mentioned by way of example a program called Improving Access to ICT Program in Malawi (implemented via the NGO he leads), which enabled him and the organization under his

auspices to deliver computers to over 140 schools in Malawi. He regards this as an outstanding achievement because it “comes down to his vision when he founded that particular organization”. Each school to which the computers are provided gets a minimum of 20 computers and a maximum of 50 computers. Through this program, over 55,000 students annually have access to digital literacy and essential education resources that the organization has curated in this computer system. Overall, the NGO is now at a stage where it is sustainable and running and can secure resources to carry out its interventions. His key role in the organization is to create funding proposals as part of the business development of the NGO. He focuses on looking for funding opportunities (e.g., from local and international donors and the local private sector; thus far, he has not fully explored the latter option, although he does get some funding from them). He had begun to explore the possibility of involving the corporate sector further, but then COVID-19 set in – and this disturbed the process of seeking funding from people in terms of their corporate social responsibilities.

3.5.1 Highlights of activities during COVID-19

James mentioned that a key achievement during the COVID-19 period was his piloting a program to provide education to support students and young people during COVID-19 (when schools became closed). It is a model that can be used to enhance any remote learning. It is called the Remote Educational Support Model. For this pilot program – funded by Seagull in the USA – the NGO targeted 800 learners and developed handbooks designed for remote learning. They trained volunteer teachers who could coach young people over the phone. So they would send a text message providing assignments and then later follow up with a phone call to discuss the subject matter further over the phone. Besides the Seagull offering funding, the local government offered technical support for this too. The district education manager was involved; and the program included asking several professionals to go through the teaching material to contribute to the content that was created. The pilot program revealed that remote learning opportunities could be supported (as is crucial during COVID-19 and beyond) as “normal” forms of learning are inevitably going to change to post-COVID-19).

3.6 Melvis Kimbi

On the questionnaire form, in answer to our question concerning assets/factors/experiences that led the participants to make their contributions, Melvis mentioned “Family background” as first on her list. She clarified that this entailed “growing up as a girl/young woman in a typically (traditional) male-dominated environment with only a mother (widow) to look up to and somehow protect at the same time”. During the Zoom meeting, she elaborated that “she had lost her dad as a young girl and her mom never got married again and raised five children on her own”. She stated that “I am the last, and it was not ever easy because I remember the one thing that used to drive me was to tell my mom ‘I am going to take the place of my dad in your life. I have to do something to give you what dad was not able to give you because he left too early’”. She recounted that this was always at the back of her mind, so when she was

in school, she made sure that she had to stay in school; she knew she had to get grades that would “get me ahead and, when I started doing journalism, the issue of defending women and girls is something that already defined where I come from”. She mentioned that what impelled her was her background and how her mother raised the children in a condition where they had lost everything when her mother was widowed because “my tradition basically gives the man everything so my mom was left to struggle for us”. She expressed that “till now this is something that pushes me or that has driven me down the path of working for women’s issues. Besides my mainstream communication or journalism work, I am a committed activist when it comes to giving women the table”. Again, in Melvis’ story, as in that of the other participants, we see her motivations as springing from observing the struggles of her mom, which translated into her own struggles too, and which led her to become an activist for advancing, among other things, women’s issues.

Melvis noted on her questionnaire form that what was secondly important for her as a factor/asset/experience was “experience and education”, which included formal schooling and later seeking connectivity with people –seeking opportunities via the internet to connect with others in various forums. One of the many instances of Melvis seeking connections and exposure resulted in her being invited in 2015 to attend the Third International Conference on Financing for Development in Addis Ababa, Ethiopia, as a young gender activist in Central Africa. She was selected as a young gender activist by UN Women – the UN agency for Gender Equality and the Empowerment of Women. She was able to bring the issues relating to women and girls in Africa to this global platform and, at the same time, to return with ideas concerning ways of raising awareness of the issues at the local level. One of the outcomes of this was her choosing to set up a local initiative (the Wulwi initiative) to finance young girls in financial need and to empower girls with ICT skills for a better future. (Like many of the other participants, Melvis recognized the importance of ICT capacitation in the digital age – and chose consciously to contribute in this way.)

As stated earlier (Section 2), during the Zoom meeting, Melvis also indicated that she had, for example, met Vera Songwe at the first-ever Youth Connect conference that she attended in Rwanda in 2017 for young people with innovative ideas on entrepreneurship. She indicated that she “met this lady (Vera Songwe), a Cameroonian” who had “just been appointed by UN Secretary General as the executive director of UNECA”. As a journalist, Melvis spent a whole day trying to interview Vera, and she finally succeeded. Vera then told her, “You have a lot of drive in you, and you can get everything you want”. This Melvis considered a defining moment, which also spurred her further to continue her good work (including her recent work for WHO as their communications officer in Madagascar) while remaining a journalist at heart.

In concluding her story about where she is today, she mentioned that “I consciously tried to look for these opportunities, and this is the exposure I am talking about. If I am here today, it’s the drops of water. I have been able to share and learn from other people, and this has actually brought me to where I am today” (in terms of her various contributions to different African

societies). Melvis' analogy of "drops of water" also supports the "weak ties" argument that the weak ties in which people become involved where they learn and share and in turn influence others who in turn feed forward with a view to the common good, can create wide impact.

3.6.1 Highlights of activities during COVID-19

Currently (during COVID-19), Melvis mentioned in the Zoom meeting that she was a Communications Officer with WHO. She also stated that if she had not done some voluntary work with UN women on Women's Empowerment and Gender Equality, the way might not have been paved for her to work and or navigate through the UN agency system. As the communications officer for WHO in Madagascar, basically, the job entailed supporting the Ministry of Public Health to develop and implement strategies on public health and scale-up responses in crisis situations and everything around public health and the pandemic. She indicated (in response to a question from Norma) that "yes, I have really been in the heart of the pandemic in terms of the WHO response". Her answers on how WHO helps countries with policy strategies were referred to in Section 2 of this chapter, with reference to the support for South Africa, for example, in encouraging laboratories to develop locally manufactured vaccines.

As far as Melvis' additional personal response during the pandemic goes (and reaching out further via her communication skills not only as a communication officer for WHO), she mentioned that during the pandemic, besides her official work for WHO, she has made an effort to "share as much as possible all verified/verifiable information on the pandemic with family, friends, community and social networks to ensure that I am actively taking part in awareness-raising" – again she spreads influence by participating in creating ties with diffuse effects.

3.7 Georgina Mabereze

In responding to the question on influential assets/factors/experiences impelling her contribution (in this case to Zambian society), Georgina stated on the questionnaire form that she lost her parents at a tender age and had to survive some harsh conditions through life. Looking back now, she realizes that through these experiences, she never wants a child to go through what she did; hence she feels the need to "reach out where I can to help vulnerable children and adolescents". She also (like some of the other participants) refers to exposure to a key mentor whom she met at a conference for African youth (the African Youth and Governance Convergence) in 2013 in Ghana, who became a mentor friend around her business life and also giving back to society. This mentor strengthened her feeling of wishing to give back to society, but already her late mother's influence was paramount, and it "continues to be the reason I dedicate my life to serve others; her home was open to everyone, and that taught me a lot about helping people". As part of her (sought out) experiences, she stated that she belongs to various groups of networks where she has "met like-minded people that have inspired my work and decisions in life". Consistent with the network theorizing that we have been developing in this chapter, and emerging out of all the participants' stories, is the way in which they have been inspired by others "doing good"

– as also noted by Fowler and Christakis in their public goods experiment, which indicates how people can be prone to “mimic” the good behavior of others (2010: 5337).

Georgina’s “favorite greatest contribution,” which she highlighted in her questionnaire (and in the Zoom meeting), has been working with communities in Zambian provinces to ensure HIV prevention, testing, and treatment in children and adolescents. She noted that this is a context in which “about half of HIV-positive Zambian children and adolescents are unidentified and viral suppression is below 50%”. The program she is actively involved in has helped identify many children and adolescents to bring them to treatment and prevent mother-to-child transmission. She has been going into villages teaching women who are HIV-positive how to prevent their children from getting HIV. She has done this under the auspices of the Faith-Based Action for Scaling Up Testing and Treatment for Epidemic Response project (FASTER), which mobilizes partners in government, civil society, and faith-based organizations towards achieving viral suppression with children and adolescents. FASTER is a Catholic relief service funded by the U.S.A.’s Emergency Plan for AIDS Relief to accelerate the HIV response in four African countries: Nigeria, Uganda, Tanzania, and Zambia. She remarked that she gets great pleasure when she sees the smiles on the faces of mothers who are HIV-positive but get babies born HIV-negative. (Prior to her teaching them that this is possible, they were unaware they could prevent their children from being HIV-positive.) She also made the point that indeed the Church stopped preaching that holy water could function to cure HIV and AIDS – the church leaders began to realize that through this approach, many lives were lost; hence their allegiance is now to the medication that can help people live healthily. (Even the traditional healers in the community have been invited to, and attend, the meetings on this.)

Furthermore, she has also been providing vulnerable girls in Zambian community schools with sanitary wear and menstrual hygiene knowledge while also addressing issues of GBV in society and child marriage as a human rights activist. As far as sanitary wear is concerned, she stated that from her personal experience, it was difficult to get this during her youth; and it meant that she had to skip school when she was menstruating – hence her commitment to this cause too. Because she suffered, it hurts her to see others suffering, and hence she devotes much of her time to various social causes. Besides (paid) work in the insurance field, she is also currently a managing partner at Avier Consult and Avier Environmental Salve, which designs renewable energy solutions. The motto of the consulting company is that renewable energy technologies offer clean and sustainable options for generating energy and that when owned and managed in the right way, they can contribute to poverty reduction in communities.

3.7.1 Highlights of activities during COVID-19

During COVID-19, the health issues connected with HIV/AIDS and the saving of lives through anti-viral drugs for AIDS and preventing mother-to-child HIV transmission were as crucial as addressing the COVID-19 pandemic – hence the FASTER program, of course, has continued unabated, as has Georgina’s continued charity work for the organization Mwaka Namwila

Foundation (MNF) (as well as her other charity work and involvement in various organizations and bodies dealing with the plight of vulnerable people, especially youth). Her actual job is for an insurance agency business, but she can run her time there at her own pace. She has chosen to run it at a pace that allows her ample time for all the volunteer work that she does: she is a member of the National HIV & AIDS Strategic Framework (NASF) Consultative meeting with Young People, the Adolescent Health Technical Working Group (ADH-TWG), the Adolescent Health Advisory Committee and the HIV Prevention Coalition consultative teams, and is also a member of the District Health AIDS committee, at a national level. On the international level, she is a member of the Global Network for Young Women Leaders and a member of the African Youth Union Commission, a member of the Community Advisory Board on the FASTER project, contributing actively to these networks.

3.8 Abel Mavura

Abel attributes his family background to making him what he is now. He was raised in a rural setting as a child by his mom alone, as his father moved to the city for more than five years without sending anything to the family. It was challenging to pay for things – or even buy a school uniform. He had to go to school barefeet. He developed a “deep understanding of how life looks like when you are from a marginalized setting”. He came to realize that a lot of young people have similar challenges. At 16 years old, he formed an NGO in Zimbabwe called MAYO (Marvel Act Youth Organization) after leaving high school. It became registered in 2007 and focused on community development and development for social change initiatives that have benefitted many young people, including young women. Most of his projects and initiatives target those living in poverty to ensure a better life. For example, he realized that often after other youth finish their O-levels and have nothing to do, they start to use drugs. He began working with these youth in fundraising projects such as drama – talented youth could read poetry and act in theaters, and people would pay them to put up the dramas. This put his organization in the spotlight, and it started receiving support from international donor agencies for the good work they are doing. For International Youth Day and Women’s Rights Day, they also put up dramas. In 2008 he went to Kenya for the regional meeting of NGOs, and there also learned more on how to fundraise with other agencies. Generally, he indicated that continuous learning organizing skills, various forms of exposure, volunteering in multiple organizations, and networking at local and international platforms had been assets/factors/experiences that have enabled him to make his contributions.

Abel concentrated in the Zoom meeting on explaining how he played an important role via MAYO when the COVID-19 outbreak struck. COVID-19 exacerbated already existing problems connected, *inter alia*, with poverty and the rights of girls and women to sexual and reproductive health, issues which MAYO had already been addressing pre-COVID-19. COVID-19 also required responses to additional issues, which MAYO became active in pursuing, as indicated below.

3.8.1 Highlights of activities during COVID-19

Due to the COVID-19 outbreak, MAYO has been continuing its work in ensuring girls and women living in rural areas receive necessary health services, e.g., information on where to find the services, counseling, sanitary wear, and some services pertaining to their physical and mental health. During the lockdown period, he was also mandated by the government to reach people finding it difficult to access health services and sanitary wear. During the lockdown period, he initiated a Volunteers for Change program to respond to the needs of the most vulnerable groups, targeting young women and girls, orphans, and other vulnerable people, whom he, together with the MAYO team, thought were hard hit by COVID-19 effects. This initiative saw him and his organization fundraising and mobilizing resources and materials for food, clothing, and sanitary wear for girls living in rural areas and food for children's homes. This was an initiative that involved youths as volunteers with the tagline #Volunteers4Change. The contribution became visible and impacted the extent that national newspapers and radios captured the work being done.

He was furthermore involved (via his organization in which he plays an oversight role) in servicing classes to children at home so that they would not lose out on access to education because of being confined at home. This was especially the case in rural areas, which are hard to reach. He was one of the active youth organizations that did such work during the lockdown period. He also helped arrange for many young people who could not attend digital classes using digital media such as Whatsapp, Google Meet, Microsoft Teams, and Zoom. The MAYO team distributed books and organized online courses with children who could afford to buy data to join the lessons.

And about health education, the MAYO team created WhatsApp groups to raise awareness on mental health and drug abuse after realizing that many young people were committing suicide.

3.9 Apollo Murigi

In a Zoom conversation with Norma¹³, Apollo indicated that his parents had separated when he was six years old – and his mother moved her children to an urban informal settlement in Nairobi, Kenya. Before this, the family had been living in a relatively affluent community, with all the trappings of affluence, that is, cars; a big house; sanitary living conditions with a private bathroom in which he could bath and running water in the house, as well as proper drainage within the estate; and supermarkets from which to buy food, etc. It had been a cocoon, separated and shielded from people's way of life in the informal settlement he later moved to. This was a total shock to him and “opened me up to realities”. He now had to live in contrast to the living conditions that he previously had taken for granted. The family lived in dire poverty, and they often had to skip meals for an entire day; they had to borrow from shops on debt; there was no

¹³ During the Zoom meeting in the evening of 27th September, Apollo could not stay until the end as he had important work to do the next day, which required an early start.

running water, and water had to be fetched in cans, etc. Through this experience, he also realized that the family was at peace (instead of the parents arguing) – they were a happy family; and he realized that happiness and contentment are not to be found in (excessive) material goods. He also understood that it is unlikely that the middle classes will be the persons who will fight for – and devote their life to – helping others in unfortunate circumstances. But because he had lived in the informal settlement conditions, he is aware of the needs of the people there.

In his early career, he worked for the African Population and Health Research Center (an international NGO), being paid well and traveling to different countries across Sub-Saharan Africa. However, he soon realized that he was not doing enough to directly help poor and needy people in their plights. He felt inadequate, as if he was not achieving his goals. He was not content. Hence, while working at the research center, he did voluntary work with schools in the informal settlements, mobilizing resources to feed the children (for the Touch Life Education Center – a CBO). Later (in 2019), he became involved with Miss Koch Kenya – an NGO that serves informal settlements in Nairobi and metropolitan areas.¹⁴ His involvement began when one of the donors supporting Miss Koch approached him to help with mentorship in one of their mentorship programs; and now he is a full-time programs manager at Miss Koch. Miss Koch has been operating to empower young people to develop skills for sustained social and economic well-being and participation in leadership and governance. Apollo has used his skills to fundraise for these purposes – managing to secure funding from local governments, other NGOs, international organizations and agencies, and the private sector. (He mentioned to Norma in Zoom conversation that he surmises that business people “feel good” when they contribute; and this is their motivation for engaging in corporate social responsibility.)

Apart from his managerial work at Miss Koch, he regards as a crucial contribution his additional works with Peace First (a Boston-based organization) as their Sub-Saharan Africa (SSA) ambassador. He got to know about Peace First because of COVID-19. Miss Koch had conducted a rapid assessment of the status of learning in informal settlements and pastoral communities in Kenya, collecting data. It transpired that most children were more worried about increased GBV than the discontinued formal learning process occasioned by the closure of schools by the government as part of COVID-19 containment. It became evident that not enough research and intervention had been done on GBV. When looking for agencies that could support such interventions, he came across Peace First. He now mentors youth across SSA on developing projects that show courage, compassion, and collaboration within their communities and ensure that they are sustainable beyond the funding period.

¹⁴ The name is derived from the place where it was originally registered (in 2001) as a CBO, namely, in *Korogocho*; and it later became expanded into an NGO serving other communities.

3.9.1 Highlights of activities during COVID-19

During COVID-19, Apollo indicated that he had fundraised (via Miss Koch Kenya) to ensure the following activities were achieved:

- Supported over 5,000 households with food supplies during the COVID-19 pandemic and helped children with cerebral palsy get physiotherapy treatment.
- Organized capacity building for over 200 reformed youth in urban farming techniques such as vertical gardening, sack farming, and mushroom farming as alternative sources of income generation to better their livelihood instead of illegal works. (These initiatives were aimed at providing food security, yet without destroying the environment, and were not meant to be run for profit maximization, but for benefiting the community via providing nutritious food. In this sense, they were social enterprises – see also footnote 5.)
- Trained 80 teachers on interactive teaching techniques and the use of e-learning resources to better the learning experience of learners post COVID-19.
- Provided community radio sessions to reach parents in informal settlements on the need for parental engagement in bettering learning outcomes during COVID-19.
- Provided and maintained 18 community hand-washing water points to aid with the COVID-19 measures in reducing the spread of the deadly virus and providing face masks to reduce the scourge of COVID -19.
- Helped in reclaiming riparian land into the proper use of urban farming and recreation parks in Korogocho. This involved working with the local community in defining how to use the public land along the rivers. (Private developers who had wished to use it recognized that they had to leave the land due to the community’s strong commitment.)
- Reached out to 1000+ girls with sanitary towels during this COVID-19 pandemic and dignity packs from the United Nations Population Fund (UNPF).
- Mobilized resources for the construction of an Early Childhood Center in Korogocho.

3.10 Rahab Wairimu

Rahab Wairimu stated on the questionnaire form that: “Personal family background, religion, personal values, friends and financial capability” were all assets/factors/experiences that were formative for her. During the Zoom meeting, she elaborated that a single father brought her up as her mom had left the family. Hence, education was a struggle in terms of school fees not always being available. She would go to school at times and then be sent home at other times as the fees

had not been paid. Within the family as a whole, only she and one other sister of hers eventually made it through the schooling system. Her dad was a hard worker trying to make ends meet, but most of the time, he was absent. She realized that she wanted to study and become a career person, and eventually, this transpired. (She became a government-sponsored university student towards this end.) Once her career took off, she decided she could “give something and tell children and other youth that they can make it regardless of challenges”. Therefore, she founded an organization called Nurture a Child Initiative (NCI) – a community-based organization in Kenya. NCI runs mentorship, sponsorship, and support programs and seeks to impart youth with education opportunities. Through this organization, she has been consistently supporting a children’s home in Nairobi by providing teachers at the home and offering support in terms of foodstuffs too for the children.

Another one of her contributions that she highlighted has been through involvement with the African Leadership Forum. Her involvement here has been to mentor university students – the Forum arranges mentorship for university students, and she is part of this initiative. She mentioned that what stands out for her, along with her early formative struggles in herself getting educated, was a person she had met at an African Leadership Forum event that she attended. This person is based in Uganda, but she shared with him what she wanted to do (in terms of enabling educational opportunities for people). He confirmed with her that it is possible to “become something as a person and impact society”. She regards this experience (a “weak tie” formed) as a significant formative experience, which encouraged her continued contributions.

On her questionnaire form, she also had mentioned other experiences/assets – one of them being religion and her personal values. Like some other participants, she believes that her love of God (and her values that support this) have been motivating factors in deciding to empower people to act as agents to make a social impact. She considers that education is a tool for, as she puts it, “causing a change in the society, an individual at a time”. She now uses her own financial capability to contribute to the sponsoring of students. Meanwhile, she has a full-time career as Deputy Head of Human Resources and Administration at Eclectics International (a software development company in Nairobi operating in another 23 African countries). She considers this a social enterprise because it fulfills a social need – for example, supporting small businesses and small business development, along with other companies.

3.10.1 Activities during COVID-19

Rahab Wairimu did not elaborate in the Zoom meeting on how her activities were re-tuned in the COVID-era. Still, the schooling for children as arranged via the Nurture a Child Initiative (NCI) organization became redirected so that the children could participate in online learning. Likewise, the mentoring for university students was redirected accordingly.

3.11 A note on the influence of religion/spirituality

Many of the participants mentioned in the questionnaire and/or in the Zoom meeting that they considered their religious upbringing (along with their personal value system that they nurtured as persons) as an important experience for them. Various religions – including interfaith ones – were mentioned. (One of the participants said to Norma in another conversation that he regarded his official religious background as unhelpful – and that it was *despite* rather than *because* of this religion that he had become the person that he is today – dedicated to helping and empowering vulnerable people.) What we want to refer to at this point is Chowdhury *et al.*'s (2021) citing of an Indigenous healer in Bangladesh in the context of their discussion of Ubuntu as an ethic prompting human solidarity (p. 362): The healer urges us to recognize that all religions can in principle become binding forces for humans as long as they are not experienced as separating us from others. Hence, the healer suggests that: “I am not [defined by being] Jewish, and I am not [defined by being] Catholic, I am not [defined by being] Muslim; I do not know what I am. I am a part of peace as *I know I belong to the community* (a Rakhain Indigenous healer of Bangladesh, *our italics*)”. We could argue, as do Chowdhury *et al.*, that the code of ethics of Ubuntu perhaps supplies a commonality across different religions/spiritual values, as also expressed in the 14th Dalai Lama's and Bishop Tutu's *The Book of Joy* (2016) – put together by interviewer Douglas Abrams as interviewer and collator. As the Dalai Lama and Tutu express in their Preface to the book: “No dark fate determines the future. We do. Each day, and each moment, we are able to create and re-create our lives and the very quality of human life on our planet. This is the power we wield”. This encapsulates the messages portrayed by the participants – whether or not they mentioned religion or religious upbringing as being formative for them in their sense of wishing to contribute to a wider community in which they feel enmeshed (with the community spanning national boundaries and including a sense of global citizenship too).

In Section 4, we turn to what the participants said about their experience of being involved in the RD project. (In the Introduction to the other chapter by Laouris *et al.*, in this volume, some detail is offered on setting up this project for youth in different regions – with Africa being one of them – to participate in structured democratic dialogue sessions aided by some technological tools to support the dialogues.)

4. What stood out for participants from the Reinvent Democracy experience

In this section, we turn attention to how the agency of Laouris, and his team at the FWC too, became socially impactful – in this case, in influencing these ten participants (who agreed to participate in this chapter writing on individual and collective agency). All the participants referred to the value of their being exposed to the RD project. Below we locate three recurrent themes identified by the various participants as learnings that they appreciated and “paid forward” in their various fields of influence.

4.1 Recognition/confirmation that one can indeed “do” things as actors to make a difference in outcomes

Nearly all of the participants indicated that one of their learnings from the RD project was that they realized/confirmed that they could act and become more involved in social processes to make a difference in outcomes. Melvis Kimbi summarized this as “The need to be part of ‘the process’ in order to bring change and to take concrete action”. (As we indicated in Section 3, she is currently involved in societal processes via her involvement, *inter alia*, with WHO, and as an active journalist.) Abdulkarim Taraja stated one of his learnings is that he learned “The use of “I” and not “we/you” while developing and implementing actions” (that is, he learned to take responsibility and thus to be active in co-arranging implementations with others). Again, in Section 3, how Abdulkarim has been active, for instance, in his Elgon educational NGO and the environmental wing of it, not least in arranging (via his advocacy and use of the internet too) for the Elgon forest to become protected. Abel Mavura indicated that he took away the importance of “involvement and commitment” from the RD project. He stated that the RD project was also empowering as it confirmed to him his capacity to mobilize (with a view to achieving desired outcomes). For example, during COVID-19, he mobilized various youths via an initiative involving youths as volunteers with the tagline #Volunteers4Change” to supply food, clothing, and sanitary wear for girls living in rural areas and food for children’s homes. Daniel Ehagi stated that the RD project reminded him of his rights as a person – which implies the right to participate in decision-making and not be a passive recipient of others’ decisions in society. (He applies this in the field of disaster management).

Abiba Abdallah stated strongly that the RD project taught her that she can and should participate in governance at various levels of society. As she put it: “My ‘reinventing democracy’ experience influenced my decision to participate in meaningful governance and to inspire other youth”. Abiba gave an example of how, together with her friend (Margaret Osei), she became a consultant to lead/engage in diverse research and assessments of the Status and Extent of Upholds on Democratic Principles on governance systems in Ghana in terms of the African Union’s (AU) African Governance Architecture (AGA) and the effective implementation of the African Charter on Democracy Elections and Governance in Ghana (ACDEG), for dissemination at an AU conference. And she inspires other youth to participate in other arenas by encouraging them via social media networks. To this effect, she uses what she calls her “social media marketer” skill, which she stated became enhanced as a result of participation in the RD project. She uses this skill in her involvements with, among others, the Move the World (MTW) organization. (She is MTW’s social media marketer as well as lead facilitator and trainer.)

The other participants mentioned collaboration and networking as learnings gleaned from the RD project, which can be considered a recognition/confirmation of capacity for collaborative agency. The feature of collaboration and networking towards the democratic development of shared goals is discussed in Section 4.2.

4.2 Practicing democratic processes

The SDD process in which the participants partook in 2016 was a way of “doing democracy” to advance a style of deliberative democracy, where the focus is on generating a large number of ideas from a broad range of participants/stakeholders as a forerunner to deliberating together around socially impactful action options for addressing issues of concern (cf. Ani, 2013; Dryzek, 2000, 2018). SDD processes (aided by specialized digital technologies) provide a practical way of achieving this.¹⁵

All the participants referred to how the RD experience inspired them to engage people (those with whom they are involved in their activities) in democratic processes. As James Gondwe put it, he “learned a way of engaging people in democratic decision-making”. James considered this an enlightening moment for him in that it showed him “practical ways of engaging our constituencies [implementers and beneficiaries of programs] so they participate in the design of programs”. He also referred to learning the need to “accommodate multiple views and come to an agreement on concrete solutions by considering what actions will impact most”. Or, as Apollo Murigi mentioned, he learned that one must firstly “openly collect all views from as many beneficiaries, as this makes them feel involved”. One must furthermore “allow beneficiaries to come up with solutions to address challenges identified” and do so in a way that enables the beneficiaries to consider which solutions, when implemented, “would impact most on the challenges”. Abdulkarim Taraja stated that further to participating in the RD project, “almost every activity I do is guided by the SDD practice of getting to the bottom/root of an issue.” He enthused that, “the SDD process is the most ideal model I use in my structured academic mentorship programs and it does wonders”. Bill Akomea stated that what he learned was “the SDD process and how it works”. Melvis Kimbi’s way of expressing this was “forging and engaging in meaningful dialogue with target groups in the quest for (any) solutions and innovative ways of doing things in a community”. Abel Mavura mentioned that the experience of RD taught him “community mapping”. Abiba Abdallah stated that she does not necessarily use map-making with the grassroots participants with whom she works. Still, she does use some of the SDD processes, such as multiple idea generation and clarification of the range of ideas. Bill Akomea stated this aspect as recognition that “all opinions matter”, while Rahab pointed to “idea generation and identifying the most important issues is key”.

Georgina Mabezere mentioned that she learned about the use of IdeaPrism to collect a wide range of ideas. As she stated: “The use of digital technologies and IdeaPrism in ways that

¹⁵ For a sample of elucidations of the SDD methodology see Christakis, Dye and Shearer (1999); Christakis (2004); Laouris and Christakis (2008); Laouris (2012); Cisneros and Hisijara (2013); Laouris and Michaelides (2018); and Flanagan (2021). (Notably, the works of Christakis mentioned here refer to *Alexander* Christakis, the father of *Nicholas* Christakis who is referred to in Section 2 as a network theorist). For peace-related applications see, for example: Broome, 1997; Laouris *et al.*, 2009a,b; 2015. For specialized applications, such as, for example, sponsored by the European Commission to discover obstacles preventing the wider use of broadband technologies, see: Laouris and Michaelides 2007, and Laouris *et al.*, 2008.

benefit others”. Georgina’s explicit reference to learning about the use of technology as part of the democratic process *to benefit others* is crucial. This was indeed what the 2016 RD sessions were meant to inspire, that is, using any democratic deliberative process focusing on “benefiting others” – improving the overall quality of life. From Section 3, we can detect how the participants all took seriously this manner of “doing democracy” no matter at what level(s) of society they were operating to be influential (local, national, regional, or international). They practiced processes for generating a wide range of views/ideas and encouraging dialogue around them to define a way forward for action. This was in terms of, for instance, visions of social justice (empowering the vulnerable), a consideration of the need to redistribute “wellbeing stocks” (access to wellbeing), and a focus on economic and environmental sustainability – where economic activity is coupled with considerations of social and environmental quality. In this regard, we could refer to the relevance of Stiglitz, Sen, and Fitoussi’s (2010: 15) conception of wellbeing stocks to appreciate various dimensions of the quality of life, as also cited by McIntyre-Mills (2020: 830).

4.3 Role of digital technology to enhance democracy in the digital age

The RD project in which they participated in 2016 was entitled “Re-Invent democracy in the digital age” and triggered participants to consider challenges and opportunities for Re-Invent Democracy in this era. Not surprisingly, therefore, many participants considered the critical role that technology could play in Re-Inventing our democratic processes. Rahab Wairimu stated that one of her RD project learning was “the role of technology and its applicability to solve today’s challenges”. Rahab clarified that the RD project was an eye-opener for her in terms of its potential helpfulness in solving problems in today’s society, including its role on the African continent. Georgina Mabezere gave an example (in the Zoom meeting) of what had been tried during the COVID pandemic in a project in which she was involved: they had designed an App to help girls abused at home to report (as during lockdown cases of this had increased). The idea was that teachers in different schools would also be given gadgets to report to a portal. And children could, if necessary, be relocated from their homes where they were experiencing abuse. Due to financial constraints, this project has not yet taken off as planned, but it is now being revamped. This is just an example of how technology can be used to a good effect.

Many participants mentioned that they learned via the RD project how digital technology and the digital age could increase networking possibilities – including their own use of digital and media platforms. For example, Abdulkarim Taraja referred to the “strategic use of integrated digital and social media platforms” as something he learned via his RD exposure. He elaborated that he has been “able to advocate for education, environment, and equality over the social media while sitting in my office and actions being taken”. Daniel Ehagi also referred to his better “appreciating digital frameworks” following on from participation in the RD project (such that during COVID-19, he organized webinars with his disaster management students to share and discuss information). Melvis Kimbi spoke of “the responsible and profitable use of social media as a tool to enhance change” (clearly currently profitable/beneficial for her as Communication

Officer for WHO and as a journalist). Bill Akomea gave credit to the particular network created among all the RD participants in the African cohort and the value of this in itself.

Abiba Adbdallah indicated that participation in the RD sessions taught her how to use digital technology in workshops and facilitate educational sessions. As she stated: “Participating in SDDs helped me embrace and appreciate the new normal or trend which is a digital way of conducting trainings, workshops, and participating actively in class. Its pedagogy or process shaped my skills to inculcate digital methods rather than just using traditional ways”. She indicated that she can now “assist individuals and organizations with digital skills especially on using digital platforms for workshops, meetings, etc.”. She handles several organizations’ social media platforms (as social media marketer). We can say that the various social media platforms have become vehicles for her to act as what Grabowicz *et al.*, (2012: 1) name as “a broker” (or intermediary), stemming from involvement in various organizational/group involvements – acting to spread information and ideas from different sources into a variety of discussion platforms. (Grabowicz’s discussion is based on a sample of interactions in a particular Twitter group that they investigated over a time period in 2008 (2012: 2).) Grabowicz *et al.*, refer to the “advantage of connecting different groups [online] to access novel information due to the diversity of sources” (2012: 1). This is what they call developing “intermediate ties” alongside “weak” and “strong” ties, as named by Granovetter (1973).

In terms of Grabowicz *et al.*,’s conceptualization, many of the participants, in their work within and across communities, can be said to have partaken in weak as well as intermediary ties by acting as mediators across networks. Georgina Mabezere stated, for example, that by her belonging to “various groups of networks,” she has met like-minded people [in terms of their value systems]. These have inspired her work and decisions in life. She also mentioned that cognizance of the IdeaPrism App led her to appreciate the importance of listening actively to and considering a wider range of ideas. This is instead of people simply reinforcing their original viewpoints (as might become the case in the “strong” ties where groups become isolated from others). This would be consistent with the notion that weak and intermediary ties can function “strongly” in the digital age to make social impacts based on the principle of deliberative democracy.

5. Conclusion

In this chapter, we offered an indication of how people have used/interpreted their childhood experiences (more or less traumatic, but all with challenges) as levers to push them into “reaching out to people”. We indicated how they consciously sought and continue to seek forums for exposure to develop themselves and their skills/ideas/visions, which leads to feeding forward some “good” into wider communities. We also pointed out how, in recognition of the digital era, many participants were insistent that more people in the society should become capacitated to participate in digital networks to enhance themselves and the inputs that they can make to their society and the global society.

The question that we have left somewhat in abeyance is the extent to which the “weak tie” theorizing (introduced by Granovetter, 1973) is specifically relevant in the digital age. In this regard, Grabowicz *et al.*, (2012) give credit to Granovetter’s theory (1973), which points, ironically, to the weakness of “strong ties” (where interactions are intense and localized in small groups) in creating wide social impacts. They suggest that his theorizing, though clearly not designed for the digital age, holds as much for online communications and is possibly even more relevant in the current era. They suggest, with Granovetter (1973), that *weak ties* become “strong” through the links connecting different users who share and learn from one another (2012: 1). Furthermore, as indicated in Section 4.3, Grabowicz *et al.*, add that we should not ignore the strength/value of “intermediate ties” through users who belong to different online groups acting as brokers by introducing ideas/stories from different sources due to their participation in a number of groupings (2012: 1).

In terms of the theory of weak ties, combined with a recognition of intermediate ones, Grabowicz *et al.*, point to the social value of online interactions. This is consistent with the ten participants as co-authors of this chapter. Each of them referred to their own networking (via in-person and digital methods) and deliberate use of various media as a route to generating solidarity with a wide range of others while appreciating the importance of accommodating a diversity of ideas (as in SDD) as a forerunner to people’s finding relevant solutions to issues of concern. All the participants referred to how democracy in the specific projects in which they are engaged or indeed lead, and democratic governance in the society as a whole, requires advancing the capacity of people to participate in defining and discussing issues towards seeking agreed-upon solutions. They referred to the RD project as influential in alerting them to this as a way of life which they practice and encourage others to practice. This spirit also prevailed in all of their ways of acting as individual and collective agents to respond to the crises created when COVID-19 struck, which exacerbated the inequalities and challenges faced by the vulnerable people to whom the participants feel committed.

Grabowicz *et al.*, do not discuss cultural variation in how people in different cultural milieu might use “weak ties” (or intermediate ones) to good effect; and we too do not attempt this in this chapter. But we have indicated that the social value of online interactions, along with in-person ones, may be tinged with cultural variation across more individualist- or community-oriented ways of living that may be permeating in different societies (as ethical codes). We also pointed out that interactions across cultural milieu can enable us to recognize our human solidarity as global citizens and feel a sense of belonging to the global community and a commitment to try to “make a difference” to the patterning of society at local, national, regional, and international levels.

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References

- Adyanga FA, Romm NRA, and Ocan J (2022). “Economic development for holistic wellbeing in the (post) COVID-19 era”. In Alain L. Fymat and Joachim Kapalanga (Eds.), *COVID-19: Perspectives across Africa* (this volume Chapter 16).
- Ani EI (2013). “Africa and the prospects of deliberative democracy”. *South African Journal of Philosophy*, **32**(3):207-19.
- Arko-Achemfuor A and Dzansi DY (2015). “Business doing well by doing good in the community”. *The Journal of Commerce* **7**(2):53-68.
- Bassey N (2019). “Breaking the chain of development”. In A Khotari, A Salleh, A Escobar, F Demaria, and A Acosta (Eds.), *Pluriverse: A Post-Development Dictionary* (pp. 3-6). Chennai: Tulika books.
- Blauvelt J (2010). “Summary of Granovetter’s ‘The strength of weak ties’”. Accessed 1 October 2021 at: chrome-extension://efaidnbnmnibpcajpcglefindmkaj/viewer.html?pdfurl=https%3A%2F%2Fwww.albany.edu%2Ffaculty%2Fkretheme%2FPA%2FD637%2FClassNotes%2FSpring%25202010%2FWeek2_Summary.pdf&clen=447208&chunk=true
- Broome BJ (1997). “Designing a collective approach to peace: Interactive design and problem-solving workshops with Greek-Cypriot and Turkish-Cypriot communities in Cyprus”. *International Negotiation* **2**(3):381-407.
- Cesarini D, Dawes CT, Fowler JH, Johannesson M, Lichtenstein P, and Wallace B (2008). “Heritability of cooperative behavior in the trust game”. *Proceedings of the National Academy of Sciences*, **105**(10): 3721-6.
- Chowdhury JS, Wahab, HA, Saad MRM, Roy PK, Hamidi M, and Ahmad MM (2021). “Ubuntu Philosophy: ‘I Am Because We Are’ –A Road to ‘Individualism’ to Global Solidarity”. In HA Wahab, JS Chowdhury, SHB Abu Bakar, and M Rashid (Eds.), *Handbook of Research on the Impact of COVID-19 on Marginalized Populations and Support for the Future* (pp. 361-81). Hershey, PA: IGI Global.
- Christakis AN (2004). “Wisdom of the people”. *Systems Research and Behavioral Science* **21**(5):479- 88.

- Christakis AN, Dye KMC, and Shearer WL (1999). “Collaboration through communicative action: Resolving the systems dilemma through the Cogniscope.” *Journal of Transdisciplinary Systems Science* 4(1-2):9-32.
- Christakis N and Fowler J (2009). “Connected”. New York: Little, Brown, and Company.
- Christakis N (2021). “What new normal looks like post-pandemic”. Interview Accessed on 2 October at: <https://www.youtube.com/watch?v=Lis1il9Pqyo>
- Cisneros RT and Hisijara BA (2013). “A social systems approach to global problems”. Cincinnati, OH: Institute for 21st Century Agoras.
- Dalai Lama (14th), Tutu D, and Abrams D (2016). “The Book of Joy”: New York: Random House.
- Delagran L (2016). “How do our social networks affect wellbeing?” Accessed 2 October at: <https://www.takingcharge.csh.umn.edu/how-do-our-social-networks-affect-wellbeing>.
- Dryzek JS (2000). “Deliberative Democracy and Beyond”. Oxford: Oxford University Press.
- Dryzek JS (2018). “Deliberative democracy: An introduction”. In A Bächtiger, JS Dryzek, J Mansbridge, and M Warren (Eds.), *The Oxford Handbook of Deliberative Democracy* (pp. 1- 36). Oxford: Oxford University Press.
- Flanagan TR (2021). “Structured dialogic design for mobilizing collective action in highly complex systems”. In GS Metcalf, K Kijima and H Deguchi (Eds.), *Handbook of Systems Sciences* (pp. 765-85). New York: Springer.
- Floridi L (2015). “The Onlife Manifesto: Being human in a hyperconnected era”. Springer Nature. Available on line: <https://link.springer.com/book/10.1007/978-3-319-04093-6>.
- Fowler JH and Christakis NA (2010). “Cooperative behavior cascades in human social networks”. *Proceedings of the National Academy of Sciences* 107(12):5334-8.
- Gergen KJ (2009). “Relational being: Beyond self and community”. New York: Oxford University Press.
- Gergen KJ (2020). “A conversation with Taos Associates hosted by Ken Gergen – Constructing communiverse”. Accessed 5 April 2020 at: <https://www.youtube.com/watch?v=68NnCaKKtn8>.
- Grabowicz PA, Ramasco JJ, Moro E, Pujol JM, and Eguiluz VM (2012). “Social features of online networks: The strength of intermediary ties in online social media”. *PloS Digital Health*, 7(1):e29358. Accessed 8 October 2021 at <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0029358>.
- Granovetter MS (1973). “The strength of weak ties”. *American Journal of Sociology* 78(6):1360-80.
- Laouris Y and Michaelides M (2007). “What obstacles prevent practical broadband applications from being produced and exploited?”. In R Patrick (Ed.), *Towards an Inclusive Future Impact and Wider Potential of Information and Communication Technologies* (pp. 281-99). European Cooperation in Science and Technology. Available on-line at: <https://op.europa.eu/en/publication-detail/-/publication/c8297d4c-4f84-4651-8832-04ba3511a575>
- Laouris Y, Michaelides M, and Sapio B (2008). “A systemic evaluation of obstacles preventing the wider public benefiting from and participating in the Broadband Society”. *Observatorio (OBS*)* 2(2).
- Laouris Y, Michaelides M, Damdelen M, Laouri R, Beyatli D, and Christakis A (2009a). “A systemic evaluation of the state of affairs following the negative outcome of the

- Referendum in Cyprus using the structured dialogic design process”. *Systemic Practice and Action Research* **22**(1):45- 75.
- Laouris Y, Erel A, Michaelides M, Damdelen M, Taraszow T, Dagli I, and Christakis A (2009b). “Exploring options for enhancement of social dialogue between the Turkish and Greek communities in Cyprus using the structured dialogic design process”. *Systemic Practice and Action Research* **22**(5): 361-381.
- Laouris Y (2012). “The ABCs of the science of structured dialogic design”. *International Journal of Applied Systemic Studies* **4**(4):239-57.
- Laouris Y (2015). “Reengineering and reinventing both democracy and the concept of life in the digital era”. In: *The Onlife Manifesto* (pp. 125-42). Cham: Springer.
- Laouris Y, Laouri R, and Christakis A (2008). “Communication praxis for ethical accountability: The ethics of the tree of action”. *Systems Research and Behavioral Science*, **25**(2):331–48.
- Laouris Y, Taraszow T, Damdelen M, Daglı I, Beyatli D, Karayiannis A, and Christakis AN (2015). “Application of the structured dialogic design process to examining economic integration and free trade in Cyprus”. *ALAR: Action Learning and Action Research Journal* **21**(1):11-52.
- Laouris Y and Michaelides M (2018). “Structured democratic dialog: An application of a mathematical problem structuring method to facilitate reforms with local authorities in Cyprus”. *European Journal of Operational Research* **268**(3):918-31.
- Laouris Y *et al.*, (2017). “Democracy in the digital age: Manifesto”. Nicosia, Cyprus: Future Worlds Center. Available on line at: https://www.futureworlds.eu/wiki/Manifesto:_Democracy_in_the_Digital_Era.
- Laouris *et al.*, (2022). “Rendering Africa more resilient, sustainable and better prepared for COVID- analogous pandemics: Proposals from across seven African countries”. In Alain L. Fymat and Joachim Kapalanga (Eds.), *COVID-19: Perspectives across Africa* (this volume, Chapter 2).
- Lethole VP and Romm NRA (2021). “Prospects for sustainable living with focus on interrelatedness, interdependence, and mutuality: Some African perspectives”. In JJ McIntyre-Mills and Y Corcoran-Nantes (Eds.), *From Polarization to Multispecies Relationships* (pp. 87-114). Cham: Springer.
- Mair J, Battilana, J, and Cardenas J (2012). “Organizing for society: A typology of social entrepreneuring models”. *Journal of Business Ethics* **111**:353–73.
- McIntyre-Mills JJ (2014). *Transformation from Wall Street to wellbeing*. New York: Springer.
- McIntyre-Mills JJ (2017). *Planetary Passport*. New York: Springer.
- McIntyre-Mills JJ and Romm NRA (2019, eds.). *Democracy and governance for resourcing the commons*. Cham: Springer.
- McIntyre-Mills JJ (2020). “The COVID-19 era: No longer business as usual”. *Systems Research and Behavioral Science* **37**(5):827-38.
- McKay V (2015). “Measuring and monitoring in the South African Kha Ri Gude Mass Literacy Campaign”. *International Review of Education* **61**(3):365-97.
- McKay V (2018). “Through the eye of a fly: Action research as a support for the South African National Literacy Campaign”. *Systemic Practice and Action Research* **31**(4):375-93.

- McKay V (2019). “Communities in action: The participation of communities in two South African Literacy Campaigns”. In I Eloff (Ed.), *Handbook of Quality of Life in African Societies* (pp. 23- 44). Cham: Springer.
- Nature Editorial (2021). “A patent waiver on COVID vaccines is right and fair” (25 May 2021). Accessed 4 October 2021 at: <https://www.nature.com/articles/d41586-021-01242-1>.
- Nussbaum M and Sen A (1993, ed.). *Quality of Life*. Oxford: Clarendon Press.
- Paulson S (2019). “I am because we are: The African philosophy of Ubuntu”. Accessed 4 October 2021 at: <https://www.tfbook.org/interview/i-am-because-we-are-african-philosophy-ubuntu>.
- Romm NRA (2017). “Researching indigenous ways of knowing-and-being: Revitalizing relational quality of living”. In P. Ngulube (Ed.), *Handbook of Research on Theoretical Perspectives on Indigenous Knowledge Systems in Developing Countries* (pp. 22-48). Pennsylvania: IGI Global publications.
- Sen A (1999). *Development as Freedom*. New York: Alfred A. Knopf.
- Sen A (2009). *The Idea of Justice*. Harvard: Harvard University Press.
- Stiglitz J, Sen A, and Fitoussi JP (2010). “Mis-measuring our lives: Why the GDP doesn’t add up”. New York: The New Press.
- Urban B and Gaffurini E (2018). “Social enterprises and organizational learning in South Africa”. *Journal of Entrepreneurship in Emerging Economies* **10**(1):117-33.
- World Bank (2021, August). “Africa announces the rollout of 400m vaccine doses to the African Union Member States and the Caribbean”. Accessed 15 September at: <https://www.worldbank.org/en/news/press-release/2021/08/05/africa-announces-the-rollout-of-400m-vaccine-doses-to-the-african-union-member-states-and-the-caribbean>

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¹⁶ The Digital Futures Task Force of the European Commission commissioned 12 philosophers to produce the ONLIFE Manifesto (Floridi, 2015; Laouris, 2015) aiming to explore the extent to which the digital transition impacts societal expectations towards policy making.

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Chapter Seven

Understanding perception and experience of fear during mandatory quarantine: Lessons from the COVID-19 pandemic in Ghana

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Abstract - The coronavirus disease 2019 (COVID-19) pandemic has manifested differently across the globe in terms of its sociocultural and economic impacts. The World Health Organization (WHO) developed guidelines for the effective implementation of local or national quarantine protocols to quickly detect people who have been exposed to COVID-19 and separate them from others during the disease's incubation period. This chapter examines how Ghanaians perceive and experience fear under quarantine in the various designated quarantine centers (Pentecost Community Center and Pram-pram Convention Center). Drawing on the interpretive inquiry lens, data were collected through phone/Skype interviews with six individuals who had been quarantined with experience to share. Interpretative Phenomenology Approach (IPA) for data analysis was used to interpret the views and experiences of participants under quarantine and how that affected their well-being. Using the WHO quarantine guidelines, our analyses focused on individual's experience of fear under quarantine, offering an insight into what characterizes their fear as well as exploring events, coping strategies, and the implementation of standard quarantine protocols in the country. The results showed that the quarantine protocols used by the officials in Ghana aligned with the WHO guidelines, *albeit* with some exceptions; these omissions partly compounded the fear experienced by those who were quarantined in the various centers. This chapter contributes to issues of distinct emotions and individual viewpoints under mandatory quarantine during the COVID-19 pandemic in a specific country context.

Keywords: *COVID-19 fear; distinct emotions; quarantine centers; interpretive review; Ghana.*

Abbreviations

COVID-19:	Coronavirus Disease – 2019
IHR:	International Health Regulations
IPA:	Interpretative Phenomenology Approach
WHO:	World Health Organization

1. Introduction

1.1 What is quarantine?

Quarantine is used to prevent the movement of individuals who have been exposed to a disease or to ascertain if an infectious individual will become unwell and to reduce the risk of spreading the infection (Brooks *et al.*, 2020; Barbisch *et al.*, 2015). Again, quarantine is used to monitor the symptoms of the quarantined so that cases can be noticed at the earliest possible opportunity (Brooks *et al.*, 2020, Desclaux *et al.*, 2017]. The importance of quarantine in reducing the transmission of infectious disease should not be underestimated (Wang *et al.*, 2020], yet the likelihood of quarantine producing other sources of infection or other emotional antecedents is high if the implementation is not grounded in the principles of risk evaluation and local context consideration (Lombardi *et al.*, 2020]. The use of quarantine more recently for persons affected by the COVID-19 pandemic has become an important public health tool for countries globally. It became popular during the Ebola and SARS outbreaks. Indeed, the literature outlines several public health measures scientifically proven to break the chain of disease transmission, and quarantine is one of those measures (Nussbaumer-Streit *et al.*, 2020).

A review of 3,166 papers on the psychological impact of quarantine found that most individuals under quarantine are stressed, angry and confused, and subsequently experience negative post-traumatic stress (Barbisch *et al.*, 2015). Unpleasant experiences, such as constant fear, boredom, uncertainty, loss of freedom, and suicidal thoughts have been reported by individuals under quarantine (Maqbool, 2021). Under Article 3 of the International Health Regulations (IHR), countries can enforce quarantine (WHO, 2005) but this must be legitimized within the confines of human rights and individual freedom (Meier *et al.*, 2020). Countries have, therefore, enacted laws and policies in line with the IHR to support the quarantine measures, and those who refuse are either arrested, fined or both. Hence, on 28th March 2020, when Ghana detected its first COVID-19 case, the authorities announced measures to quarantine COVID-19 contacts at designated centers in Accra (Pentecost Community Center and Pram-pram Convention Center) and across all the regional capitals, in line with the WHO directives and global health policy initiatives (Nussbaumer-Streit *et al.*, 2020). To some extent, the implementation of quarantine in Ghana was met with resistance in some circles (i.e. Ghanaians arriving in Ghana from abroad and community leaders in the designated quarantine centers) due to the fear of the unknown, compounded by poorly communicated messages on quarantine.

1.2 International guidelines on quarantine

In March 2020, the World Health Organization (WHO) formally declared the coronavirus disease 2019 (COVID-19) a pandemic, with the global mortality rate estimated to be 3.4% (WHO, 2020a). Governments' efforts have geared towards the implementation of wide-ranging public health protocols, such as lockdowns, social distancing, and mandatory quarantine to control the spread of the disease. The WHO therefore developed guidelines for countries to effectively implement local or national quarantine protocols to fight the COVID-19 pandemic (WHO, 2020b; Desclaux *et al.*, 2017). The aim is to prevent the transmission of the virus while minimizing the psychological impact on those affected by the virus and placed under quarantine. The guidelines require member countries to adhere to a set of protocols (WHO, 2020b), including adequate preparation before the implementation of local quarantine protocols and the provision of clear communication to the citizenry regarding the need for the quarantine. Furthermore, authorities are expected to make provision for healthcare, financial support, physical protection, and social and psychological support to those affected. Also, during the implementation of quarantine protocols, authorities should provide basic amenities, such as food, water, locations for infection prevention and control, and the health of those quarantined should be continuously monitored (WHO, 2020c; Desclaux *et al.*, 2017). Despite these measures to support people under quarantine, the COVID -19 pandemic exposed many quarantined people to a number of psychological and emotional challenges, one of them being fear.

1.3 Individual perception and attitude towards fear

The psychologist sees fear as an intense emotion experienced in the presence of a perceived threat associated with the presence of an object (Mobbs *et al.*, 2019). Fear is a natural and powerful human emotion that involves a universal biochemical response together with a high individual emotional response (Schofield *et al.*, 2000). It alerts us to the presence of danger or the threat of harm, whether that danger is psychological or physical (Stearns, 2012). Thus, an assessment or judgement that there is a clear source of danger is essential to the experience of fear. Social constructivists position fear as a social construct through an expression of feelings (Barbalet, 2001; Drazen *et al.*, 2014). A recent conceptualization of fear categorized it as a social variable of emotions, often infectious, that may affect the behavior of individuals or a group during wars, public demonstrations, terrorist attacks and nationwide threats (Holton *et al.*, 2014). Again, fear is an emotion that disseminates differently across society due to individuals' lack of power and confidence to make decisions or act quickly because of their weakness (Carleton, 2016).

We explore the individual's perception and attitude towards fear while in quarantine to understand the distinct emotions of the first cohort of people quarantined in Ghana during the COVID-19 pandemic, using the WHO protocols on quarantine as a framework. It hereby uses an interpretative phenomenology approach to analyze their stories of fear under quarantine. We draw on the WHO guidelines on quarantine to assess the measures implemented by Ghana in

quarantining COVID-19 contacts and analyze how effective the use of the guidelines connected to the stories of the affected individuals. The aim is to help reveal some of the difficult meanings associated with an individual's emotions when they are under quarantine. This paper argues that a good understanding of the individual's views regarding fear when under quarantine is important for positive outcomes, such as early recoveries and post-recovery support programs to minimize stigma. The benefits of quarantine, therefore, need to be considered against the psychological constructs such as fear and its negative impacts on individuals, their families and the general public (Rubin *et al.*, 2020).

2. Methodology

2.1 Study design and sampling

We used an innovative research design, combining media interviews of participants on the topic with semi-structured interviews designed by the research team – providing an interplay between media interview and the participants' views and first-hand experience of the issues (Heffner *et al.*, 2021). A qualitative research method together with a purposive sampling technique was used. We contacted our potential participants through an intermediary (a radio presenter in a known media house), who interviewed the first individuals who tested positive for COVID-19 and were placed under quarantine. Interviews were arranged through phone and Skype calls. The interviews lasted between sixty and ninety minutes per participant. We informed the participants about the study approach and objectives, and they had the chance to ask questions. They were also assured of anonymity during and after the interview.

2.2 Demography of participants

The six individuals who were quarantined and released after twice testing negative for COVID-19 results were contacted for the interview. The participants were four females and two males aged between 40 and 55 years. All six participants consider themselves middle class and are married with children. Four of the participants were Ghanaian who had travelled abroad and returned to Ghana. These four participants were taken straight from the airport to the designated quarantine centers after testing positive for COVID-19. The fifth person was picked up at home by health professionals through contact tracing, and the sixth person voluntarily went for a COVID-19 test and received a positive result.

2.3 Data collection method

We used a referral method (a presenter at a radio station), drawing on their interview and online commentaries on the issues to reach our selected participants to record their experience. This helped us to gain a broader view of the issues the participants faced under quarantine. The participants' experiences were important in this study, and they were encouraged to share them during and after the quarantine. This was supported by the media coverage of how the

participants dealt with their fears under quarantine. This approach helped to give credibility to what the media published and what the participants said. The following questions were asked: Can you tell us what you were most fearful about when told you would be quarantined? Tell it as if you were reliving it again. Whom did you share your experience with and how did that feel? How did you deal with the experience?

2.4 Qualitative analysis

The interpretive phenomenology technique (IPA) was used to analyze the interview data. The reason being the participants have lived experience of quarantine due to the COVID-19 pandemic to share. IPA is also useful to explore topics that are complex and emotionally laden (Luft *et al.*, 2012). We analyzed the media stories published using the inductive content approach. This process helped us to move from specific to general issues to create a bigger picture. The method was chosen to enable the identification of themes surrounding the key issues that the participants experienced. First, we examined the content of the media publication on the issues to identify the key voices. Three important themes were identified, namely causes of fear, the physical and social aspects of fear, and approaches to cope with fear. Second, we analyzed the initial themes identified from the media publication and compared them to the participants' interviews to identify similarities and differences. This approach helped us to find consistency in their stories and to explain and demonstrate meaning. Third, we reread the participants' interviews relating to each theme and reorganized them into new ones (i.e. expressive ways of fear). Fourth, an interpretation of the themes that disclosed the meaning of the participants' fearful experiences was consistently demonstrated in both the media publications and the conducted interviews and presented logically. Finally, we compared the themes with the WHO guidelines on quarantine under the COVID-19 pandemic to give meaning to the complex nature of fear during quarantine.

3. Results and analysis

Based on the participants' interviews and the media publications, three key themes were identified and presented. Each theme is discussed and presented in turn with its distinct understanding of the participants' experience of fear under quarantine.

3.1 Causes of fear under quarantine

The central message that came through the participants' accounts of fear is that they did not know what to expect, the unknown duration of the quarantine, and the fear of being infected by others at the quarantine centers. They were concerned about their health and recognized the pressure on the health professionals to decide on their COVID-19-related symptoms. Fear was linked to the potential loss of lives and the uncertainty of recovery. From the participants' stories, it was clear that both the health professionals and government officials experienced some level of uncertainty in terms of treatment plan and support. This led to a fear of uncertainty:

In a first-person account, a 40-year-old woman, Ann, described how she was taken away like a criminal when she arrived at the airport and brought to a quarantine center without talking to family members who came to meet her because she had tested positive for COVID-19.

“I was scared, I felt like a criminal and did not know what will happen to me. Many things were going through my mind. I asked myself if I had the virus, will they tell me? How will the center look like and if I will return. At the quarantine center, it felt like a “special prison”, doors were locked and food placed in front of the door with no interaction with others” (Ann).

Another participant who returned from Europe, Nana, said:

“I was told, I will be taken to a particular center. However, I could not speak to any family member who came to meet me at the airport. I was confused and worried. The health professionals at the airport could have explained the process to me and my family a bit more. I got to the center before calling my family. Again, I was worried that the wrong test results could be given to me because of the number of people being tested at the same time” (Nana, 45 years).

Not knowing what to expect at the quarantine centers contributed to the participants’ feelings of doubt about their health and lives (Ratcliffe *et al.*, 2020). For the participants, being quarantined was seen as a damaging experience that negatively influenced their lives, social relations with others, and mental health. Repeated doubt about the conditions of a particular setting (e.g., the quarantine center) and the support system available can lead to fear with harmful consequences for a person’s well-being. In contrast to feeling uncertain, fear refers to the anticipation of this worrying event for the participants under quarantine, such that their continuous stay at the centers put their health and lives at risk (Barbisch *et al.*, 2015). As demonstrated by both Ann and Nana above, the way they were taken away made them feel like criminals, which compounded their fears. Nana called for clearer communication on the process of quarantine to both individuals and their families to reduce the uncertainties causing quarantine fear among suspected COVID-19 participants in Ghana.

3.2 The physical and social aspects of fear and their disruptions

Another theme that emerged from the participants’ stories was that the fear came with physical and emotional disruption, which represented worry about some social event with unwanted consequences. The participants described their fear as an unpleasant experience and emphasized the impact of their behavior on others and the health professionals at the quarantine centers. Their fear manifested in physical changes, such as sweaty hands and an unsteady voice when speaking. Psychological changes were also expressed, such as a sense of uncertainty, nervousness, and a burning sensation in their feet. Feelings of weakness and anxiety were accompanied by tiredness, feeling helpless, and the pain of not knowing what will happen next. Some participants

remembered experiencing fear on the bus to the quarantine centers, making them think they may not return home to see their families. For example, Maame, Alex and Kate, who returned from Europe and the U.S.A., recounted their experience:

“It was a very emotional and anxious moment for me on the bus to the quarantine center. I heard the number of people testing positive is going up and I’m going to stay in the same environment with them. I was wondering what is going to happen to me” (Maame, 45 years female).

“It was a very traumatic and emotional experience. I felt unwell and weak at my knees. I nearly got into a depression mode. I was worried because the information on testing was insufficient. Luckily, I met another Ghanaian man who came from the U.S.A. and we consoled each other through our conversation” (Alex, 50 years, male).

“My friends and family members who came to the airport to meet me were sent home. I started to feel nervous from there. My sample was taken when I arrived at the center but no information was provided on when I will get the result. I met others at the center who were waiting for their results as well” (Kate, 40 years, female).

These participants called for effective communication and a support plan to help them return home safely. Fear created an emotional disruption, loss of confidence in the process of testing, and nervousness. Having conversations with others in a similar situation appears to be part of the experience and helped to calm fears, with some participants talking and encouraging themselves. Fear, in this sense, is accompanied by emotions that need the involvement of others to calm the situation.

3.3 Approaches to coping with fear

The participants’ descriptions of how they coped with their fears at the quarantine centers were diverse. Their strategies were linked to emotion, problem, and appraisal-focused coping. The participants stated that they withdrew from the health professionals whenever they heard more people had tested positive at the quarantine center. Their withdrawal was in the form of not physically interacting with others and locking themselves in their rooms. Psychologically, they moved away from all the events in the center. Again, the participants reported coming together every morning to pray, share the word of God and engage in jokes to cope with tension and fear. They did this because they found it difficult to relax in a tensed and “toxic” atmosphere like the quarantine center. Attempts to distance themselves from activities at the quarantine center involved listening to non-COVID-related news, listening to religious music and reading religious books. These activities helped them to relax and to create a positive mindset. This time of relaxation and reflection appeared helpful to the participants and allowed them to distance

themselves from fearful emotional events. Emotion-focused coping dominated the participants' stories. This involved changing their emotional reactions and socially demonstrating a positive attitude. The participants said that at some point they had to suppress their emotions to show that they were on top of events in the centre. The suppression of fear was important to show that they were adults and had accepted events at the quarantine center. For example, one participant, Paul said:

“I had to be strong mentally. I had to show maturity and walk about feeling positive. The whole situation was overwhelming but I have to show I am a man by demonstrating bravery. I read books and stopped watching television to avoid hearing news about COVID-19” (Paul, 30 years, male).

The participants said that they used techniques, such as taking deep breaths and wringing fingers as a way to suppress their fears before their test results were read to them. This helped them to show that they were strong and could adopt the culturally accepted emotional behavior, especially the men, who are not supposed to show signs of weakness in a difficult situation. Again, this helped to reassure them that they would be fine and should show self-confidence rather than express fear. In the participants' stories and descriptions, they demonstrated deep acting techniques. This was seen as important when dealing with the difficulties they encountered under quarantine. For example, Janet said:

“When the health professional called me, I said to myself, “calm down you are going to be fine”. I prayed in my head a lot for a negative test result. I did not know what illness will accompany those results. I took a deep breath but was sweating and I said to myself I can handle this” (Janet, 53 years, female).

4. Discussion

This chapter explored the participants' experiences under mandatory quarantine during the COVID-19 pandemic in Ghana through storylines (Bai *et al.*, 2004). The focus was on issues that gave rise to fear and how the participants dealt with their fear. The findings provide an understanding of what fear means to Ghanaians who were in quarantine due to COVID-19 and how they expressed their fears in the quarantine centers. Fear manifested in different forms, such as uncertainty about test results, unclear communication from health professionals and government officials, delay in receiving test results and experiencing death thoughts. Fear was described by the participants as existential feelings (Wilken *et al.*, 2017) because the threat of the pandemic embodied everything around them and their existence as humans. It was a feeling that involved reflecting on one's life and health alongside thoughts of death. The participants' description of fear constituted both a physiological and a psychological disturbance of their lives, with different impacts on the individuals, such as lack of sleep and anxiety, despair, uncertainty about test results, and worrying about their families, friends and own health. The participants described their experience and the environment they lived in at the quarantine centers using

phrases such as ‘doors were locked’ and ‘food placed in front of the door with no interaction’; all of these experiences appear to support what researchers describe as fear (Mobbs *et al.*, 2019; Schofield *et al.*, 2000).

In the participants’ stories, important areas of threat were the uncertainty of the test results, ineffective communication from the health professionals, the government officials leading the process, and delays in receiving second test results. This made the participants doubt the process of quarantine in Ghana, describing it as a failure. The participants described their experience of fear as a silent inner struggle, although they appeared physically strong and confident (Wilken *et al.*, 2017). Interestingly, the participants’ experiences were similar to previous studies during the Ebola and SARS outbreaks (Zhuang *et al.*, 2016; Pittman and Karle, 2015; Lee *et al.*, 2016). The participants saw their fear as a primary emotion of the quarantine. A common form of emotional distress was anxiety, which was influenced by the lack of effective information on the test results. Fear under quarantine and its emotions were previously mentioned as being related to worry (Paek *et al.*, 2016; Hoffmann, 2016). Fear was high when blood samples were taken from the participants and sent to the laboratories for the COVID-19 test, and there were delays in receiving the results. Fear was apparent on the first day at the quarantine center when the participants did not know from whom to get information (i.e. either the health or government officials). Both the male and female participants reflected on how fearful their first night at the quarantine center was and the fear they felt when meeting the health professionals the next morning to answer questions on their health.

Participants attributed their fear to not only the lack of information on their test results but also other health conditions that may appear through their screening that they were unaware of. Also, they feared their existing health conditions could worsen if they tested positive for COVID-19. This study contributes to research that the earlier stages of a person’s life under quarantine are associated with fear and worry due to the unknown nature of the COVID-19 virus and the environment in which the individuals are housed. What was interesting about the participants’ stories was that they said much information was not provided on what to expect at the quarantine centers, which is contrary to what the government put out through the media houses in Ghana. It was clear from the media publications and the interviews that the participants were unhappy with the way things were organized and how they were received by the official at the quarantine centers. This unhappiness gave rise to worry, which resulted in a fear of dying. Studies have found that individuals often remain silent and refuse to speak about the issue when they are entwined with fearful situations that they believe could lead to death (Barbisch *et al.*, 2015; Ratcliffe, 2020). The reason is that they fear they may say things that may scare their friends and families, with repercussions for their community (Faye and Hooper, 2018; Altena *et al.*, 2020).

Both the media publications (stories) and the interviews indicate that the participants coped well using different fear strategies. However, emotion-focused coping strategies were dominant. The participants shared their practical and emotional strategies to deal with their fear without showing that they were nervous, and to show maturity. As a dominant evolutionary base

emotion, fear also inspires withdrawal from others, isolating oneself and avoidance behavior. This made the participants focus on the perceived threat and its future consequences on their health and lives. The participants highlighted their need to seek different ways to overcome their fear by engaging in non-COVID-19 related activities to feel more relaxed. Again, the participants understood that feeling afraid was part of human life and stated the need to suppress their emotional display to be seen as emotionally-resilient and mature. This, in turn, affected their emotional experience of fear. They shared the impact of having to control their emotions and display false emotions to others to meet the social and cultural norms as adults Ghanaians.

However, controlling their fears to show that they are strong and mature to the health and government officials supporting them at the quarantine center was both emotionally difficult and stressful. The participants demonstrated deep surface and deep acting emotions (Brooks *et al.*, 2020) as a way of changing their emotional experience. They also felt that there were no guidelines at the quarantine center to support their emotions, and therefore made a conscious effort to demonstrate socially accepted images to show their emotional strength (Maqbool, 2021). This implies that the participants relied on their “know-how” of emotional skills to stay at the quarantine center and deal with their health issues. Strength, maturity, and confidence were purposefully used by the participants to gain control of their fears and anxiety.

The participants’ acting to hide their emotions from the health professionals and the government officials (emotion control techniques) was evident in their stories, as they showed their social beliefs about fear and what the society will expect from them as adult Ghanaians in quarantine (Rubin and Wessely, 2020). They also demonstrated surface acting emotions, meaning compliance with an acceptable display of their maturity when receiving their test results or interacting with health professionals on COVID-19-related issues. Additionally, and most importantly, the participants referred to fearful events they had experienced in the past and tried to remember strategies that had helped them in such situations. This enabled them to demonstrate a positive attitude in front of the health professionals, an act attributed to high emotional intelligence (Schofield *et al.*, 2020; Lindebaum *et al.*, 2016).

The findings show that the WHO guidelines on quarantine were partly met. For example, quarantine was a priority policy for the government of Ghana during the COVID-19 pandemic, attracting all the necessary technical and financial resources. Authorities also provided the basic amenities, such as food, water, and settings for infection prevention and control. However, using the framework to synthesize the information from the interviews provides sufficient room to suggest that some of the protocols were not adequately adhered to. For example, it appears that there was no adequate preparation before the implementation of the quarantine protocols, while there was ineffective communication on the need for the quarantine in the initial stages. Doors were locked and food was not properly served to the participants. These constituted environmental challenges that affected them. From the analysis, it could be concluded that health professionals failed to provide physical protection or social and psychological support to those affected, and the health of those quarantined was not adequately monitored.

5. Conclusion and implications

Evidence from this study on fear under quarantine due to suspected COVID-19 in today's Ghana is also globally relevant. More attention needs to be paid to individual fear under quarantine and its impact on health and well-being. Fear of uncertainty about test results, unclear communication and experiencing death thoughts were all seen as etiological factors for fears under quarantine, leading to harmful physiological and psychological consequences. However, when the participants adopted a strategy of resilience, maturity, and self-assurance under quarantine, their fear was reduced. Health professionals' practical demonstration of clear communication processes is important as this will help to reduce the fear of individuals under quarantine due to COVID-19. Also, the government officials together with the health professionals leading the COVID-19 communication need to develop clear and robust monitoring systems considering the fearful nature of the COVID-19 pandemic and its impact on individual lives.

In terms of the individual experience during the outbreak of disease (pandemics), studies have focused on SARS and Ebola as the most recent pandemics. This study contributes to the literature on individual emotions during pandemics by adding to the research on the nature of distinct emotions. The implications of this study propose that the use of IPA as a way of learning about individuals' fear emotions when under quarantine due to COVID-19 can provide insight into the main concerns of people's emotions and their nature, especially in global crises such as the COVID-19 pandemic. We argue that a detailed understanding of COVID-19 quarantine-specific emotions will help create a mirror image of emotions in other emergencies and under different circumstances.

5.1 Limitations

The findings in this study provide an insight into the process of COVID-19 quarantine in Ghana and its implications for policy and practice. However, it is not without limitations, and some of these must be recognized. The most obvious limitation is the number of participants. Participants were not willing to take part in the study due to the fear of being stigmatized. Furthermore, the research was conducted with participants from Ghana, which made it country-specific. Thus, caution must be taken when trying to generalize to other contexts and countries, although the participants' experiences and stories may be transferable.

5.2 Ethics and consent

The issues of ethics and participant consent were adhered to in this study. Researchers also adhered to high moral and ethical values, thus ensuring the protection and promotion of the rights of all the individuals involved. The aspect of confidentiality was also given the highest attention. In this case, the identities of the participants were not disclosed to other people, and their names were also anonymized.

References

- Bai Y, Lin CC, Lin CY, Chen JY, Chue CM, and Chou P (2004). "Survey of stress reactions among health care workers involved with the SARS outbreak". *Psychiatric Services* **55**(9):1055-7.
- Bandera A, and Gori A (2020). "Duration of quarantine in hospitalized patients with severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection: A question needing an answer". *Journal of Hospital Infection*. **105**(3):404-5.
- Barbalet JM (2001). "Emotion, Social Theory, and Social Structure: A Macrosociological Approach". Cambridge University Press; 2001 Sep 6.
- Barbisch D, Koenig KL, and Shih FY (2015). "Is there a case for quarantine? Perspectives from SARS to Ebola". *Disaster medicine and public health preparedness* **9**(5):547-53.
- Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, and Rubin GJ (2020). "The psychological impact of quarantine and how to reduce it: Rapid review of the evidence". *The Lancet* 2020 Mar 14; **395**(10227):912-20.
- Carleton RN (2016). "Fear of the unknown: One fear to rule them all?" *Journal of anxiety disorders* **41**:5-21.
- Desclaux A, Badji D, Ndione AG, and Sow K (2017). "Accepted monitoring or endured quarantine? Ebola contacts' perceptions in Senegal". *Social Science & medicine* **178**:38-45.
- Drazen JM, Rupa K, Edward WC, Eric JR, Scott M, Hammer SM, and Lindsey RB (2014). "Ebola and quarantine" 2014:2029-30.
- Faye S and Hooper J (2018). "Emotional strength: A response type, response disposition, and organizing principle for emotion experience". *New Ideas in Psychology* **50**:6-20.
- Heffner J, Vives ML, and Feldman Hall O (2021). "Emotional responses to prosocial messages increase willingness to self-isolate during the COVID-19 pandemic". *Personality and Individual Differences* **170**:110420.
- Hoffmann EA (2016). "Emotions and emotional labor at worker-owned businesses: Deep acting, surface acting, and genuine emotions". *The Sociological Quarterly* **57**(1):152-73.
- Holton A, Lee N, and Coleman R (2014). "Commenting on health: A framing analysis of user comments in response to health articles online". *Journal of health communication* **19**(7):825-37.
- Ledinger D, Zachariah C, and Gartlehner G (2020). "Quarantine alone or in combination with other public health measures to control COVID-19: A rapid review. *Cochrane Database of Systematic Reviews*. 2020(9).
- Lee H, Fawcett J, Kim D, and Yang JH (2016). "Correlates of hepatitis B virus-related stigmatization experienced by Asians: A scoping review of literature". *Asia-Pacific Journal of Oncology Nursing* **3**(4):324.
- Lindebaum D, Jordan PJ, and Morris L (2016). "Symmetrical and asymmetrical outcomes of leader anger expression: A qualitative study of army personnel. human relations". **69**(2):277-300.
- Lombardi A, Alagna L, Bozzi G, Mangioni D, Muscatello A, Peri AM, Taramasso L, Ungaro R,

- Luft S and Overgaard S (2012). "The Routledge Companion to Phenomenology". London.
- Maqbool Z (2021). "Experiences of quarantine for individuals during the COVID-19 outbreak in Kashmir: A qualitative study". *Indian Journal of Social Psychiatry* **37**(1):71.
- Meier BM, Evans DP, and Phelan A (2020). "Rights-based approaches to preventing, detecting, and responding to infectious disease". *Infectious Diseases in the New Millennium 2020* (pp. 217- 53). Springer, Cham.
- Mobbs D, Adolphs R, Fanselow MS, Barrett LF, LeDoux JE, Ressler K, and Tye KM (2019). "Viewpoints: Approaches to defining and investigating fear". *Nature neuroscience* **22**(8):1205-16.
- Nussbaumer-Streit B, Mayr V, Dobrescu AI, Chapman A, Persad E, Klerings I, Wagner G, Siebert U,
- Paek HJ, Oh SH, and Hove T (2016). "How fear-arousing news messages affect risk perceptions and intention to talk about risk". *Health communication* **31**(9):1051-62.
- Pittman CM and Karle EM (2015). "Rewire your anxious brain: How to use the neuroscience of fear to end anxiety, panic, and worry". *New Harbinger Publications*; 2015 Jan 2.
- Ratcliffe M (2020). "Existential feelings. In The Routledge Handbook of Phenomenology of Emotion" 2020 Apr 22 (pp. 250-261).
- Rubin GJ and Wessely S (2020). "The psychological effects of quarantining a city". *BMJ* Jan 28;368.
- Schofield TP, Youssef H, and Denson TF (2017). "No experimental evidence for visual prior entry of angry faces, even when feeling afraid". *Emotion* **17**(1):78.
- Stearns PN (2012). "American fear: The causes and consequences of high anxiety. *Routledge* 2012 Sep 10.
- Turner J (2000). "On the Origins of Human Emotions: A Sociological Inquiry into the Evolution of Human Affect". Stanford University Press; 2000 Jun 1.
- Wang Z, He T, Zhu L, Sheng H, Huang S, and Hu J (2020). "Active quarantine measures are the primary means to reduce the fatality rate of COVID-19". *Bull World Health Organ.* 2020:1-2.
- Wilken JA, Pordell P, Goode B, Jarteh R, Miller Z, Saygar Sr BG, Maximore L, Borbor WM, Carmue M, Walker GW, and Yeiah A (2017). "Knowledge, attitudes, and practices among members of households actively monitored or quarantined to prevent transmission of Ebola virus disease--Margibi County, Liberia: February-March 2015". *Prehospital and disaster medicine* **32**(6):673.
- World Health Organization (2008). "International Health Regulations" (2005).
- World Health Organization (2020a). "Considerations for quarantine of individuals in the context of containment for coronavirus disease (¶ COVID-19)¶: Interim guidance, 29 February 2020 (No. WHO/2019-nCov/IHR_Quarantine/2020.1).
- World Health Organization (2020b). "Considerations for quarantine of individuals in the context of containment for coronavirus disease (¶ COVID-19)¶: Interim guidance, 19 March 2020".
- World Health Organization (2020c). "Considerations for quarantine of contacts of COVID-19 cases: Interim guidance, 19 August 2020".

Zhuang Q, Wang L, Tang Y, and Chen A (2016). “Translation of fear reflex into impaired cognitive function mediated by worry”. *Science Bulletin* **61**(24):1841-3.

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Chapter Eight

Migrant workers in the COVID-19 era: Is it worth the risks?

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Abstract - This chapter examines the migration of workers across the globe and whether it is worthy to leave ones' countries of birth. International migration has been steadily increasing in every region of the globe since the end of the Second World War. Migration from the developing countries to the developed ones has increasingly become a major challenge for European and American governments and is often referred to as a new security challenge (Tsoukala, 2011; Tallmeister, 2013, Hellwig, and Sinno, 2017). Within the context of Africa, migration to the Middle Eastern countries (such as Oman, Saudi Arabia, Qatar, Jordan, United Arab Emirates, and Lebanon) have resulted into undesirable consequences to the migrants. Many of these often end up being poorly remunerated, enslaved, sexually abused, killed, and subjected to other forms of dehumanization (Jureidini, 2010; Wickramage, De Silva and Peiris 2017). Migrants represent a cheaper option to deal with existing labour/skills shortages and few countries have developed measures to assist migrants with integration. This paper is based on documentary review. In the era of the COVID-19 pandemic, which naturally should restrain people from traveling, our discussion seeks to answer the questions why is migration on the increase? and what are the associated health risks? We will also discuss the possible influence of migration on the health care sector of the recipient countries. We conclude by calling for social re-engineering in the protection of migrants by concerned recipient countries and relevant labour and human rights organizations to address the problems of inequality and job insecurity for those who find themselves in such a situation across the globe.

Keywords: *Migrant workers; challenges; survival; migration; COVID-19.*

Abbreviations

ASEAN:	<i>Association of South-East Asian Nations</i>
COVID-19:	Coronavirus Disease-2019
EU:	European Union
GCC:	<i>Gulf Cooperation Council</i>
ILO:	International Labor Organization
MENA:	Middle East and North Africa
OECD:	Organization for Economic Co-operation and Development
UN:	United Nations

1. Introduction

According to the United Nations (UN) International Labour Organization (ILO), migrant workers - defined as people who migrate with a view to being employed - stood at roughly [164 million worldwide in 2017](#) and represented nearly two thirds of international migrants. Almost 70% were found in high-income countries, 18.6% in upper middle-income countries, 10.1% in lower middle-income countries and 3.4% in low-income countries (European Parliament News, 2020). The outbreak of COVID-19 however has greatly affected this statistic. The pandemic pushed the entire globe almost in a flash into closed businesses, empty city streets and airports. It is surprising though that in spite of the fact that the world was shocked by the pandemic, migrant workers still exist.

2. Why migrant workers in this time of COVID-19?

Much as the COVID-19 is ravaging developing countries, the poor conditions prevailing in them such as unemployment, low salaries, political instability, war, human rights violations, disaster, violence and educational opportunities still compel migrants to leave their mother countries for others in Europe and Asia where they hope that they will find better living conditions (United Nations Policy Brief COVID-19, 2020). If economic conditions are not favorable and appear to be at risk of declining further, a greater number of individuals will probably migrate to countries with a better outlook (European Parliament News, 2020).

3. The situation of migrant workers in Europe and the Middle East

The migrant workers from Africa to Europe, the Middle Eastern countries such as Oman, Saudi Arabia, Qatar, Jordan, United Arab Emirates and Lebanon have suffered undesirable consequences to the migrants as many often end up being poorly remunerated, enslaved, sexually abused, killed and subjected to other forms of dehumanization (Jureidini, 2010; Wickramage, De Silva and Peiris, 2017). With 1.2 million migrant domestic workers employed in Saudi Arabia

(Human Rights Watch, 2008) and 600,000 in the United Arab Emirates (IRIN, 2006) alone, it can be estimated that there are well over 2 million migrant domestic workers in the Middle East (Jureidini, 2010).

Many migrants in other countries have been caught in a similar dilemma between unemployment, starvation, or becoming undocumented, working in the informal economy with all the risks that entails. Migrant workers typically do not enjoy the same rights as citizens of the host country. This leaves them in precarious situations during a crisis such as this. They are among those most impacted by the coronavirus outbreak – where disruption of work has severely affected many who have limited access to adequate health care services, meals, clean water and sanitation, and now may find they have had to vacate the premises where they lived. Their problems are compounded by the fact that many lack adequate health coverage or other benefits, including unemployment insurance, should they lose work (*Subramaniam, 2010*).

4. Theories underpinning migration

Several theories have been developed to treat international patterns of migration on their terms, but these too are variants of Push-Pull Theory. First, Neoclassical Economic Theory (Sjaastad, 1962; Todaro, 1969) suggests that international migration is related to the global supply and demand for labor. Nations with scarce labour supply and high demand will have high wages that pull immigrants in from nations with a surplus of labour. Secondly, Segmented Labour-Market Theory (Piore, 1979) argues that First World economies are structured to require a certain level of immigration. This theory suggests that developed economies are dualistic: they have a primary market of secure, well-remunerated work and a secondary market of low-wage work. The Segmented Labour-Market Theory argues that immigrants are recruited to fill these jobs that are necessary for the overall economy to function but are avoided by the native-born population because of the poor working conditions associated with the secondary labour market. Thirdly, World-Systems Theory (Sassen, 1988) argues that international migration is a by-product of global capitalism. Contemporary patterns of international migration tend to be from the periphery (poor nations) to the core (rich nations) because factors associated with industrial development in the First World generated structural economic problems and thus push factors in the Third World.

5. Methodology

This was basically a review of literature concerning migration and COVID-19 pandemic. Secondary data was obtained from books, journals, papers, academic reports and other documents. Desk research findings were used to establish why migrants amidst the COVID-19, the effect of migrant workers on the health care sector of recipient countries in COVID-19 era and the role of recipient governments and relevant labour and human rights organizations the migrant worker situation.

6. Is it worth the risk during the COVID-19 pandemic?

Worldwide, the coronavirus crisis has revealed existing inequalities in an unfamiliar way. In the era of COVID-19 pandemic which naturally should restrain people from traveling. It is worth considering what would make migrants take the risk. This discussion seeks to answer the questions why migration is on the increase and the health risks of migration in the age of COVID-19. COVID-19 has hit the Middle East and North Africa (MENA) at a time when oil prices, coping capacities, and the legitimacy of regional regimes were already weak. The economic impact of COVID-19 threatens to undermine social contracts and political stability, since it will affect domestic spending and is already exacerbating pre-existing crises and inequalities (GIGA, 2019). Migrant workers are forced to thwart curfews in order to make a living – indeed, a huge number have even had to return their home countries or move to rural regions or even conflict areas to find shelter and survive. In other cases, migrants have been either imprisoned in degrading conditions or forcibly deported, the health risks inherent in both having been ignored by the respective governments. Border closures and mobility restrictions have substantially increased their vulnerability (*ibid*). *Most of the over 35million migrant workers estimated to live and work in the Gulf Cooperation Council (GCC) countries are from Africa or South and South-East Asia. Across the Association of South-East Asian Nations (ASEAN) states, an estimated 10 million migrant workers live and work in major destinations such as Malaysia, Singapore, and Thailand. During the COVID-19 pandemic, countries in the GCC and Singapore were ranked in the top ten for infection rates per million, and almost all cases were from migrant workers living in dormitories (Subramaniam, 2010).*

Many migrant workers have been confined to poor living conditions in cramped dormitories, experienced job loss or non-payment of wages, been forced by employers to take unpaid leave or reduced wages, or repatriated back home with few to no alternative work options. Many struggle with the dilemma of exercising their right to return in these circumstances, while others remain stranded in cities without access to services or support, or in border areas, living in “quarantine facilities” with precarious conditions. They face discrimination in their destination countries, and sometimes when they return home, as suspected virus carriers. Migrant workers have been repatriated without consideration to their predicament. Many have been repatriated to situations of debt, as they will continue to pay off the recruitment fees and costs they took on to get their overseas jobs, despite returning home empty handed (*ibid*). The World Brief COVID-19, 2020 considers the issue of migrant workers in a threefold perspective as follows:

1. In terms of health, immigrants move find themselves exposed to infections with limited tools to protect themselves. They live and work in poor conditions which are crowded and have compromised access to health due to legal, language, cultural and other barriers.
2. In socio-economic terms, immigrants experience fragile livelihoods particularly those working in the informal economy with no or limited access to social protection measures.

3. In protection terms, immigrants face border closures and other movement restrictions to curb the spread of COVID-19 and this has a severe impact on their human rights exposing them to deeply dangerous situations.

7. Effect of migrant workers on the health care sector of recipient countries in the COVID-19 era

In a number of host countries across Southeast Asia and the Gulf states, migrant workers are entitled to COVID-19 screening and treatment. Local civil society organizations working with migrant workers, however, have raised concerns that many are unaware of their entitlement to healthcare, or reluctant to seek medical assistance due to fears of having their work permits revoked, deportation, or forced repatriation. Migrant workers much as they may appear as an unnecessary intrusion to the recipient countries however have a great contribution to make in some instances. For example, they take part in combating the COVID-19 pandemic though at the risk of contracting the virus. Research indicates that among the 20 countries most affected by the pandemic as of 4th September 2020, 7 of them namely the United States, Italy, Spain, Germany, United Kingdom, France, Belgium, the Netherlands, Canada and Switzerland depend on foreign born workers in the critical sector of health care services (ILO, 2018).

The shortage of health workers at the global level has been exacerbated by the pandemic. Even before the pandemic struck in 2016, research reveals that the United States of America and the United Kingdom relied heavily on foreign trained doctors who were trained in Pakistan and India (OECD, 2020). The same findings indicate that many doctors who are practicing in the United Kingdom studied in and are immigrants from Nigeria, Egypt, Ireland and Greece and South Africa (OECD, 2019). It is also worth noting that migrants constitute a significant share among the players in critical sectors and those worst hit by the COVID-19 pandemic. An illustration to this point is that 13% of all sales and service workers in 6 of the 20 countries with the highest statistics of COVID-19 cases were foreign born. Further data revelations indicate that 9% of all skilled agricultural, forestry and fisheries workers in 5 of these countries were foreign immigrants and on average 13% of all key workers in the European Union (EU) were immigrants from non-EU countries (Faza and Massa, 2020). Much as the immigrants are a crucial source of labour to the recipient countries, during the COVID-19 pandemic they are a conduit for the transmission of the deadly virus since they can pass it on to their employers which may culminate into them perishing with the worker or the worker losing their income if the employer dies without paying them their entitlements. The work permits are always tied to the employers and when this happens the immigrants end up being locked up in their destination countries without sources of livelihood due to border closures (OECD, 2019b).

8. Role of recipient governments and relevant labour and human rights organizations

The recipient governments should ideally be able to address the problem of inequality and job insecurity for those who find themselves in such a situation across the globe. This however, is not the case in many cases since COVID-19 has sent shocks into the socio-economic fabric of the countries. The human rights organizations too are grappling to come to terms with the effects of the pandemic. Their attempts to request recipient governments to ensure fair treatment of migrant workers has not received the attention it deserves. The world saw a scenario in May 2020 where immigrants from Libya were denied to land to Malta and 160 men were detained on the Captain Morgan Ships some for more than three weeks! This denies them basic human rights, dignity and voice. The young men were exposed to so much trauma and psychological distress that their physical and mental well-being deteriorated so fast (ADITUS Foundation, Joint Press Release (2020)).

In Malaysia, the Immigration and Labour Departments had their services limited to very minimal levels in the wake of the pandemic. This raised many challenges for migrant workers already stigmatized and subject to discrimination and xenophobia, especially on issues of health, security, labour, and housing. By May 2020, more than one thousand undocumented migrants were [detained](#) after a series of raids – despite fears the crackdown could push vulnerable people into hiding and increase the infection risks in overcrowded detention centers (*Subramaniam, 2010*). As many migrant workers also lack access to technology, such as high-speed internet, civil society organizations have stressed the need to ensure updated and accurate information disseminated, through relevant and effective channels, to migrant worker communities in their own language (*ibid*). Many organizations have been working tirelessly, providing assistance and food vouchers for laid-off or daily waged migrant workers, and other vulnerable migrants during the crisis. The International Organization for Migration (IOM), the UN's migration agency, has also been issuing guidance for [employers and recruiters](#) to uphold migrant worker protection during the health crisis.

In Lebanon, a survey involving 610 Sri Lankan, Filipina and Ethiopian female migrant domestic workers revealed that there were serious human rights abuses. Of these, 31% were not allowed to leave home and 34% did not have regular time off, 65% reported working for more than 11 hours per day, 42% worked for more than 13 hours a day, 31% worked for more than 15 hours a day, and many added that they were “on call” and worked 24 hours a day (Jureidin. 2010). This and other scenarios prompted the Lebanese government to close 15 placement agencies in 2006/2007 on account of gross human rights violations including physical abuse (TIP Report, 2007). Other Middle East countries should emulate the Lebanese example of taking stern measures against mistreatment of migrant workers.

9. Conclusion

It is still a reality that unemployment, low pay, political instability, limited access to education, poor health facilities and other misfortunes dog the African continent to a large extent. It is also still in the minds of all migrant workers that crossing the Mediterranean or Red Sea to Europe and Asia respectively will salvage their predicament thus forcing them to confront all odds to get to those destinations for refuge in terms of a better life. Ordinarily, one would imagine that the COVID-19 pandemic would deter the exodus of migrant workers but it has not. It should occur to the migrant workers that their move to those countries is not of much benefit to them though it may be to the recipient countries; a situation which pertained even before the pandemic. Now that the recipient countries have been hit hard by the pandemic, they migrant workers should not expect any better conditions to be meted out to them. Moreover, the countries look at them as a risk of furthering the COVID-19 infections that they are already battling with. The governments where the migrant workers originate and international organizations-especially those that concern themselves with human rights and dignity should intervene in sensitizing the workers about the prevailing situation. Their plan to migrate in search of work could be shelved for a post-COVID-19 era.

References

- ADITUS Foundation Joint Press Release (2020). “*The Ill-treatment Aboard the Captain Morgan Ships must be stopped at once!*” <https://aditus.org/mt/the-ill-treatment-aboard-the-captain-morgan-ships-must-be-stopped-at-once/#.X5vcGe5RXIU>
- European Parliament News (2020). “*Exploring Migration Causes-Why People Migrate*”.
- Fasani F and Mazza J (2020). “A Vulnerable Workforce: Migrant Workers in the COVID-19 Pandemic”.JRC Technical Report.
- Hellwig T and Sinno A (2017). “Different groups, different threats: Public attitudes towards immigrants. *Journal of Ethnic and Migration Studies* **43**(3):339-58.
- International Labour Organization,(2018).
- Jureidini R (2010). “Trafficking and contract migrant workers in the Middle East”. *International Migration* **48**(4):142-63.
- Piore MJ (1979). “*Birds of Passage: Migrant Labour and Industrial Societies*”. Cambridge University Press,; <https://doi.org/10.1017/CBO9780511572210>.
- Sassen S (1988). “*The Mobility of Labor and Capital: A Study in International Investment and Labour Flow*”. Cambridge University Press.<https://doi.org/10.1017/CBO9780511598296>
- Sjaastad LA (1962). “The costs and returns of human migration”, *Journal of Political Economy*. **70**(5,2):,80-93. *Investment in Human Beings (Oct., 1962)*, The University of Chicago Press. <https://www.jstor.org/stable/1829105>.
- Subramaniam G (2020). “The Compounding Impacts of COVID-19 on Migrant Workers Across Asia (Pt 1)”. Institute of Human Rights and Business.
- Tallmeister J (2013).” Is immigration a threat to security?” Retrieved from <https://www.e-ir.info/2013/08/24/is-immigration-a-threat-to-security/>.

- The German Institute for Global and Area Studies (GIGA) (2019). “COVID-19 in the Middle East and North Africa and Its Impact on Migration”. <https://www.giga-hamburg.de/en/news/covid-19-in-the-middle-east-and-north-africa-and-its-impact-on-migration>.
- The Organization for Economic Co-operation and Development (OECD), 2019.
- The Organization for Economic Co-operation and Development (OECD), 2019b.
- The Organization for Economic Co-operation and Development (OECD), 2020.
- Todaro MP (1969). “A model of labor migration and urban unemployment in less developed countries”. *The American Economic Review* 59(1):138-48. American Economic Association. <https://www.jstor.org/stable/1811100>.
- “*Trafficking in Persons*” Report (TIP), 2017.
- Tsoukala A (2011). “Turning immigrants into security threats: A multi-faceted process. Security, insecurity and migration in Europe”, 179-200.
- United Nations Policy Brief (2020). “*COVID-19 and People on the Move*”.
- Wickramage K, De Silva M, and Peiris S (2017). “Patterns of abuse amongst Sri Lankan women returning home after working as domestic maids in the Middle East: An exploratory study of medico-legal referrals”. *Journal of forensic and legal medicine* 45:1-6.

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Chapter Nine

COVID-19 diagnosis: Advantages of imaging over laboratory tests

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Abstract - In December 2019, in Wuhan City, China, many patients with unknown cause for acute respiratory disease were diagnosed as infected with a viral disease caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS CoV-2). Even though the relationship between the causative organism and the disease had not yet been confirmed (as per the Koch's Postulates, 2021), the disease had been reported to be caused by SARS CoV-2. This chapter looks into the role of imaging (high-resolution computed tomography) in the diagnosis and management of the disease and its advantages over laboratory testing (particularly, real-time polymerase chain reaction, RT-PCR). Other tests reviewed include antigen tests, serological tests, immunological tests, and antibodies detection. The many limitations of these and other tests are reviewed and the value of imaging is highlighted in clinically suspected COVID-19 patients. RT-PCR is the main laboratory test to identify the causative pathogen. A single test has less than 60% accuracy to prove the association between the disease and the causative pathogen. Its reliability to detect recent and mutant variations is still less so that multi-gene sequencing may be needed. The accuracy of RT-PCR to assess the progression of the disease, morbidity, and mortality is almost nil. High-resolution computed tomography (HR-CT) of the chest is used for involvement of the lungs due to the viral disease. It provides fairly reliable but indirect evidence on the causative pathogen in a particular clinical set-up and is highly reliable to assess lung involvement and disease progression. With uncertainties about the causative pathogen and the non-availability

of definitive antiviral medicine, the management of structural changes in the body by imaging seems to be more promising than laboratory tests.

Keywords: *HR-CT; RT-PCR; COVID-19; CoV-2.*

Abbreviations

ACE:	Angiotensin-Converting Enzyme
AI:	Artificial Intelligence
CDC:	(U.S.) Centers for Disease Control & Prevention (CDC)
CoV:	Coronavirus
COVID-19:	Corona Virus Disease-2019
CXR:	Chest X-Ray
FDA:	(U.S.) Food & Drug Administration
HR-CT:	High-Resolution Computed Tomography
Ig:	Immunoglobulin
NPR:	National Public Radio
RNA:	Ribonucleic Acid
RT-PCR:	Real-time polymerase chain reaction
SARS:	Severe Acute Respiratory Syndrome
WHO:	World Health Organization

1. Introduction

Many patients with unknown cause for acute respiratory disease were reported in Wuhan City, Hubei Province, China in December 2019. It was diagnosed as a contagious viral disease caused by severe acute respiratory syndrome coronavirus-2 (SARS CoV-2). This was categorized as a global pandemic by the World Health Organization (WHO). As of 14 November 2021, globally confirmed infected cases were 253,949,459 with 5,114,422 deaths.

Multiple sporadic waves of the disease have been identified in almost all countries. In the absence of definitive drugs against the virus, antivirals used for other viral diseases such as influenza, hepatitis, and Ebola (*Remdesivir*) were used for treatment. Hence testing, tracing, and tracking of suspected patients, sanitization, masking, and lockdowns (local as well as global) were the methods employed to restrict the disease.

Real-time polymerase chain reaction (RT-PCR) is the main laboratory test to identify the causative pathogen. On the other hand, imaging of the lungs by high-resolution computed tomography (HR-CT) is the test used for involvement of the lungs.

This chapter emphasizes the role of imaging in the diagnosis and management of the disease and its advantages over laboratory testing.

2. What is the pathologic basis of the COVID-19 infection?

Within a few months following the onset of severe acute respiratory syndrome suggestive of coronavirus disease in 2019 (COVID-19), the causative organism was identified as corona virus 2 (CoV-2). Within no time, multiple viral diagnostic measures were deployed (1).

The virus generally spreads through droplet infection and close contact. When the virus is outside the human body (termed as the 'external phase'), there are no specific tests to identify it. Once it enters the human body, generally through the nose, mouth, and eyes ('T-zone'), it multiplies in the nasal cavity, the nasopharynx ('nasopharyngeal phase') and is identified in nasal or throat swabs. During this phase, the persons may be symptomatic or asymptomatic. The usual symptoms are fever, sore throat, cough, headache, and muscle pain. All these symptoms are also seen during seasonal upper respiratory tract infections (2).

Laboratory tests to detect viral nucleic acids (RT-PCR) were considered mandatory for the diagnosis of this infection. Other laboratory tests, which detect the presence of viral components such as viral antigens, serological tests, antibodies were also considered as alternate tests to affirm COVID-19 infection (3).

The nasopharyngeal phase may last for a few days or a couple of weeks, depending on host's immunity. With strong immunity, the infection may subside just like any other upper respiratory viral infection. If the virus multiplies further, basically because of weak defense mechanisms, it will enter the lower respiratory tract, infect the lungs, and initiate an inflammatory reaction. The inflammatory reaction is generally the host's defense mechanism to kill the virus. This results in increased capillary permeability or leaky capillaries in the lungs. There will be leakage of fluids and other cellular components from the pulmonary blood into the air spaces (alveoli) or spaces between the airspaces known as interstitial spaces. The imaging tests will detect the amount of fluid in the lung spaces. The intensity or amount of fluid in the lungs again depends on host immunity and medical intervention. With increasing fluid in the air spaces of the lungs, oxygen exchange gets hampered, oxygen saturation decreases, and patients will have more serious symptoms such as dyspnea, breathlessness, confusion, and symptoms related to multiple organ failure. Florid Inflammatory reaction, endothelialitis and micro thrombosis, all are responsible for patient deterioration (4).

3. What is the difference between COVID-19 and other respiratory viral infections?

The initial symptoms of COVID-19 are similar to those of other upper respiratory tract infections such as influenza. But, the virus can multiply rapidly and involve the lungs. Lung inflammation causes reduced oxygen saturation, which can be life-threatening. Initially, the infection was described as a purely respiratory disease. Later, it became known to progress rapidly, involve

multiple organs, and cause a multi-organ dysfunction syndrome. The virus can affect the vital organs of the human body (heart, kidneys, liver, and nervous systems). These vital organ failures are generally not due to viral multiplication but are rather due to florid inflammatory response and immune reactions. Involvement of other organs by the virus depends on the presence of receptors known as ACE2. All these cells are susceptible to CoV-2 infection (5).

3.1 Why was it necessary to distinguish COVID-19 from other viral infections?

Even though the symptoms of SARS-CoV2 infection are often similar to those of influenza and seasonal upper respiratory tract viral infections, higher mortality and morbidity rates created panic in patients. The nature of the spread within the family created lots of anxiety in people. The intensity of the rapid spread across various nations resulted in huge concerns for many nations. The WHO declared a pandemic on the 11th of March 2020, leading to some form of lockdown across almost all countries of the world. Testing, tracing, and tracking as well as social distancing, masking, and sanitizing were made compulsory in many countries.

Global lockdown was initiated to stem the spread of the virus and ‘flatten the curve’ of the pandemic. Even though global lockdown had some effect on flattening the curve, it had a significant impact on people, including food security, global economy, education, tourism, hospitality, sports and leisure, gender relation, domestic violence/abuse, mental health, social activities, and environmental air pollution. This resulted in various measures to distinguish COVID-19 from other upper respiratory tract infections.

Many tests are used to detect infected persons, contain them, and prevent the spread of infections between persons and communities. The infected patients who cannot move around due to weakness and other symptoms will contain themselves within their residences. However asymptomatic persons will harbor the virus within themselves and start shredding it when they move around. They are potentially dangerous for the community health. Hence, testing of asymptomatic infected persons was of vital importance because, moving around, their viral shredding can inadvertently spread the infection to the elderly and those with disease comorbidities (6).

4. What are the laboratory tests and their advantages

Accurate viral detection is a starting point to contain the COVID-19 pandemic. The causal coronavirus consists of nucleic acids (RNA) surrounded by a protein coat. The laboratory tests are etiologic detection to confirm the presence of the virus. They generally include RT-PCR, which detects SARS CoV-2 nucleic acids in the nasopharyngeal fluids obtained as nasal or throat swabs (7).

Other tests include antigen tests, serological tests, immunological tests, and detection of antibodies. Serological testing complements virus detection, indicating past infection, which could be used for better management. Antibodies are detected by enzyme-linked immunosorbent assay using a qualitative detection of immunoglobulin antibodies (IgG or IgM). These tests determine an immune response against the viral spike (S) protein and may be helpful to assess protection against subsequent viral exposure and/or for contact tracing purposes. The test findings are useful for diagnosis but also for epidemiological evaluations and broad global therapeutic needs (8).

4.1 What are the limitations of the laboratory tests?

Patients with negative RT-PCR tests for SARS CoV-2 can present with abnormal HR-CT scans and later be diagnosed with COVID-19 (9). Studies have shown the positive rate of RT-PCR assay for throat swab around 50-59% (10), apart from the many more drawbacks and limitations of the laboratory testing described below.

Lapses affect public safety, enabling infection spread aided by false-negative test results. Laboratory tests comprise the vast majority of surveillance testing done in the workplace, schools, and for travelers for identifying the causative pathogen.

These tests have many limitations which include technical, reagent performance, detection rate, test sensitivity and specificity, immune status of the body, specificity of the pathogen target organs, and disease progression (11-14). Some of these limitations are explained below:

Poorly-timed specimen collection: Nucleic acid amplification tests may be problematic with poorly-timed specimen collection. There may not be enough virions in nasopharyngeal swabs in initial stages and the test will be negative. The disease progression and time of sampling are very crucial for proper testing.

Test repetition: There are many instances in which these tests are repeated several times, usually after 14 days in the vast majority of patients. The crucial time spent on identifying the causative pathogen is one of the important factors for mortality and morbidity.

Non-acceptance of the reports: Often these test reports are not valid in different countries and are repeated several times, especially in patients on long international travel.

Generation of fake reports: Fake reports from non-licensed laboratories and reports without strict security features to escape public scrutiny are very easy to obtain.

Trained laboratory technician requirements and their apprehensions: The requirement for trained laboratory technicians and the technique of obtaining samples have many limitations, especially due to the apprehension of the health care workers to obtain proper swabs.

Poor quality sample collection, storage, and transport of swab material.

Long wait times to generate results: Transport time of the specimens to the laboratory can take hours (4-6 hours) to days, depending on the availability of testing facilities.

Variable positive sampling rates: Positive sampling rates can vary widely between oropharyngeal swabs (32%–48%), nasopharyngeal swabs (63%), bronchoalveolar lavage fluid (79%–93%), sputum (72%–76%), and stools (29%).

Reagent availability and performance: There are other inherent drawbacks, including shortages of the primers and other reagents required to run the tests.

Limitations in detection rate, test sensitivity and specificity.

Dependence on immune status: The test results also depend on the immune status of the body.

Infodemic: COVID-19–related infodemic and its impact on public health are one of the greatest drawbacks of the test results.

According to current diagnostic criteria, viral nucleic acid tests by means of RT-PCR assays play a vital role in determining hospitalization and isolation for individual patients. However, their lack of sensitivity, insufficient stability, and relatively long processing time were detrimental to the control of the disease epidemic.

5. How to test patients with lung involvement or structural changes in body organs? Imaging studies

From the nasopharynx, the virus extends into the lower respiratory tracts or lungs. Patients develop more symptoms and start deteriorating clinically. Inflammatory response, antigen – antibody reaction, and accumulation of fluid in the lungs and other organs will result in structural changes. These fluids with cellular components have more density compared to the air density in the lungs and are seen as subtle white patches known as ‘ground glass densities’. With disease progression, they are seen as dense white patches known as ‘consolidations’. The presence of fluid in alveolar sacs will reduce the oxygen saturation in the blood, which can be measured by oximeters. Host defense mechanisms will try to drive this fluid from alveolar spaces into the interstitial spaces and this fluid is visualized as linear opacities and subpleural bands. In later stage it gives rise to fibrotic bands (15).

Figure 1 – Mobile van with digital chest X-ray device and AI for community screening



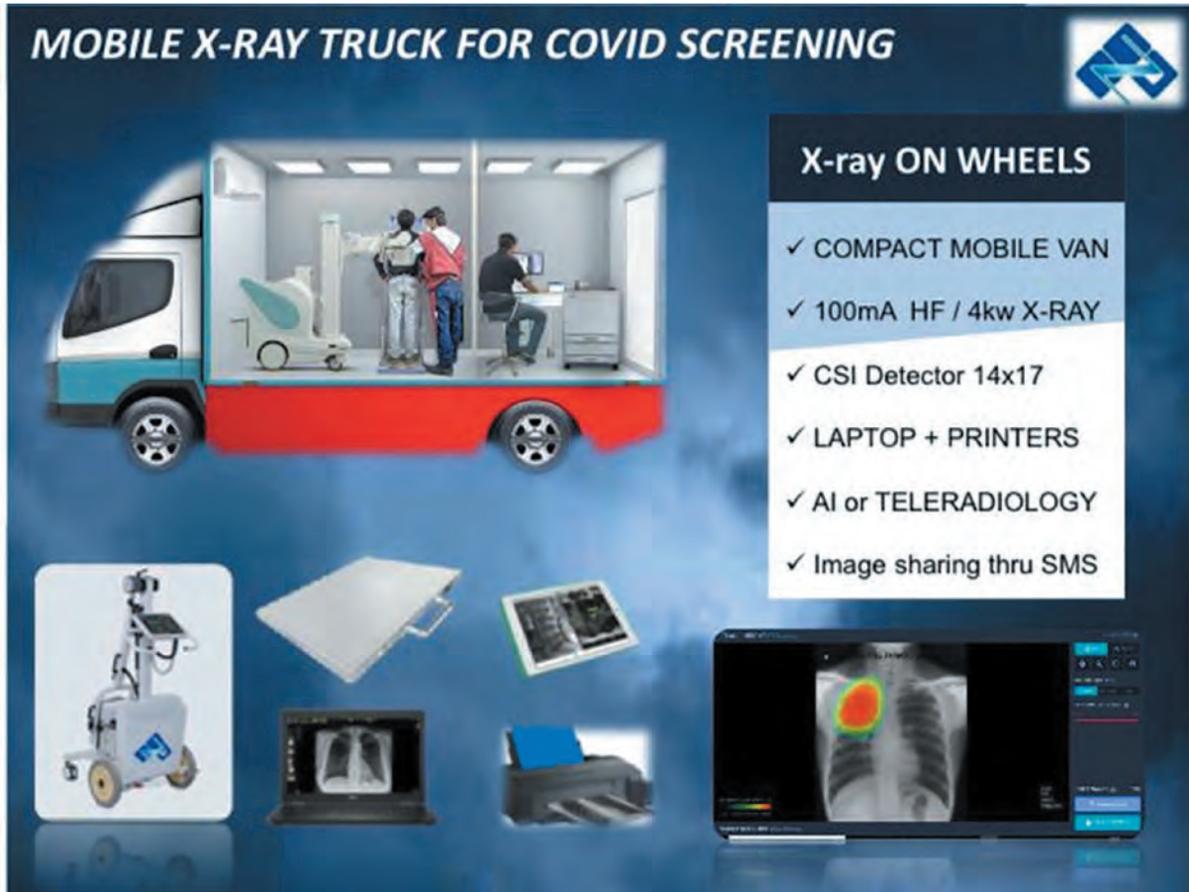
Figure 1 shows a mobile van with digital chest X-ray device and AI for community screening. Figure 2 details the “X-ray on wheels” concept, including a compact mobile van, an X-ray machine, X-ray devices and accessories, and the AI-obtained chest X-ray for sharing images through teleradiology.

For better management, it is necessary to image the lungs through chest X-ray (CXR) and/or high-resolution computerized tomography (HR-CT) (16). To this end, our intent in this chapter is to highlight the value of imaging in clinically suspected COVID-19 patients, and how it will help in patient management. Proper management of these patients will facilitate the containment of the virus’ global spread (8).

5.1 Chest X-ray

A simple CXR, which is widely available, is often sufficient in a patient with moderate and severe infections. A dense patch in the X-ray image is enough for diagnosis. Even though imaging features in a standard CXR are useful to confirm the disease, they can be often non-specific. Abnormalities such as pulmonary edema, bacterial infections, allergic reactions, trauma, and cardiac diseases are other possibilities. In the context of presenting COVID-19 signs and symptoms, CXR findings can be considered confirmatory (17,18). Similarly, a negative CXR alone cannot rule out lung involvement.

Figure 2 – The “X-ray on wheels” concept



A new Artificial Intelligence (AI)-driven CXR platform can help in early detection and further intervention through rapid screening of COVID-19. A digital CXR image obtained through digital radiography, can be instantly transferred to patients' smart phone through blue tooth technology. This can be transferred to the concerned physician immediately for further intervention. In India, an extremely useful solution called XraySetu (<http://www.xraysetu.com>) can work with low-resolution images sent via mobile phones. It is quick, easy to use, and can facilitate mass detection for management in rural areas. Figures 3 - 5 are representative digital chest X-rays. Figure 3 is that of a 42-year old male with COVID infection; the left side (a) shows ill-defined opacity suggestive of ground of consolidation in the lower left zone, whereas the right side (b) shows the same chest X-rays of the same patient with artificial intelligence highlighting lung infiltration.

Figure 3 – Digital chest X-ray of 42-year old male with COVID infection

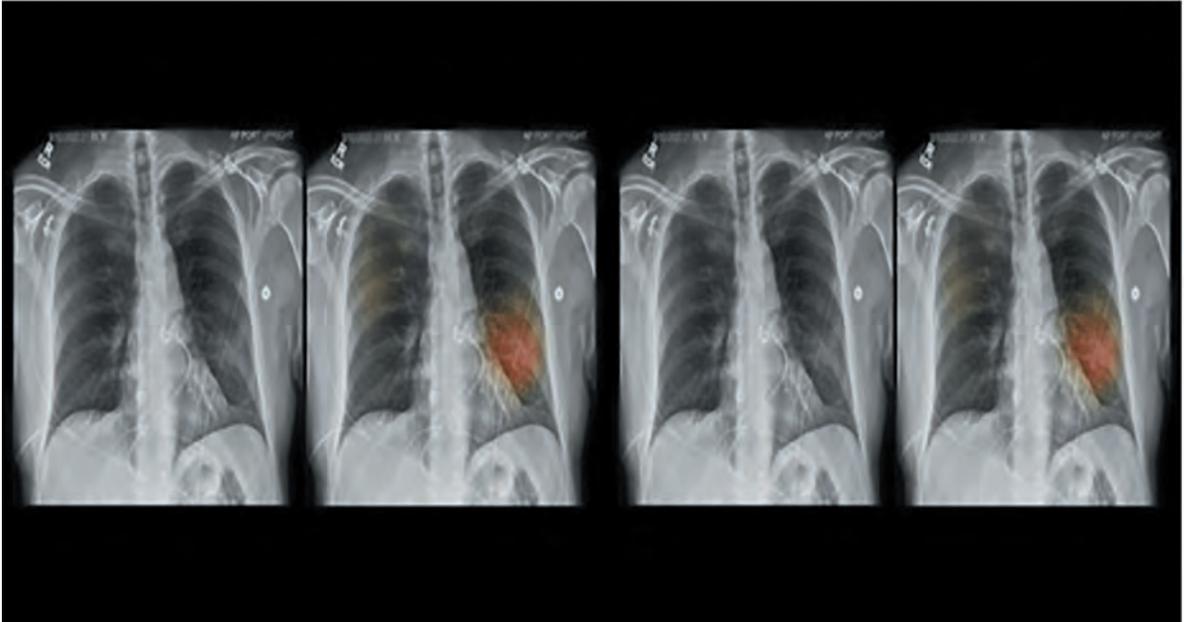


Figure 4 – Chest X-ray of 73-year old male with positive RT-PCR test

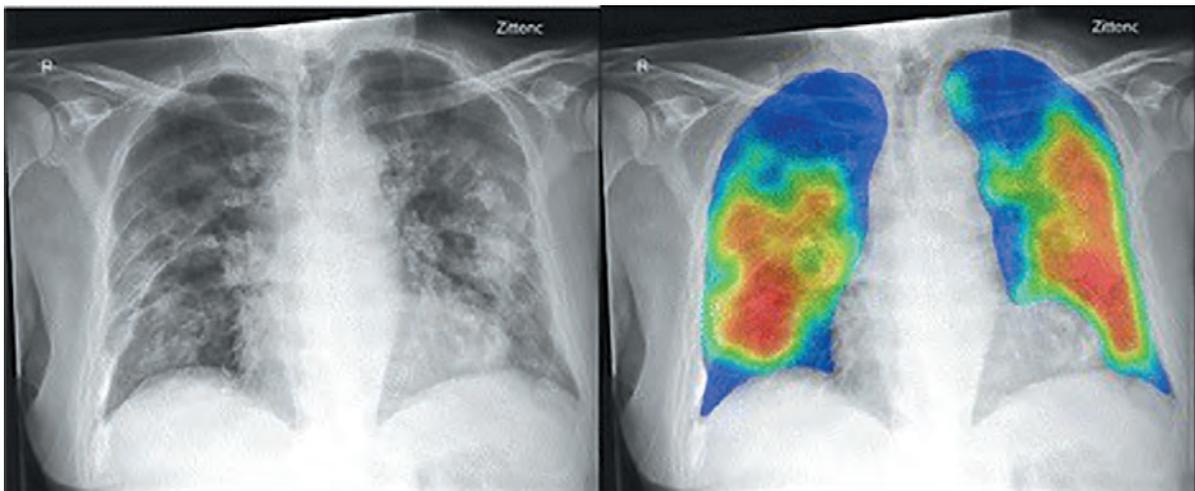
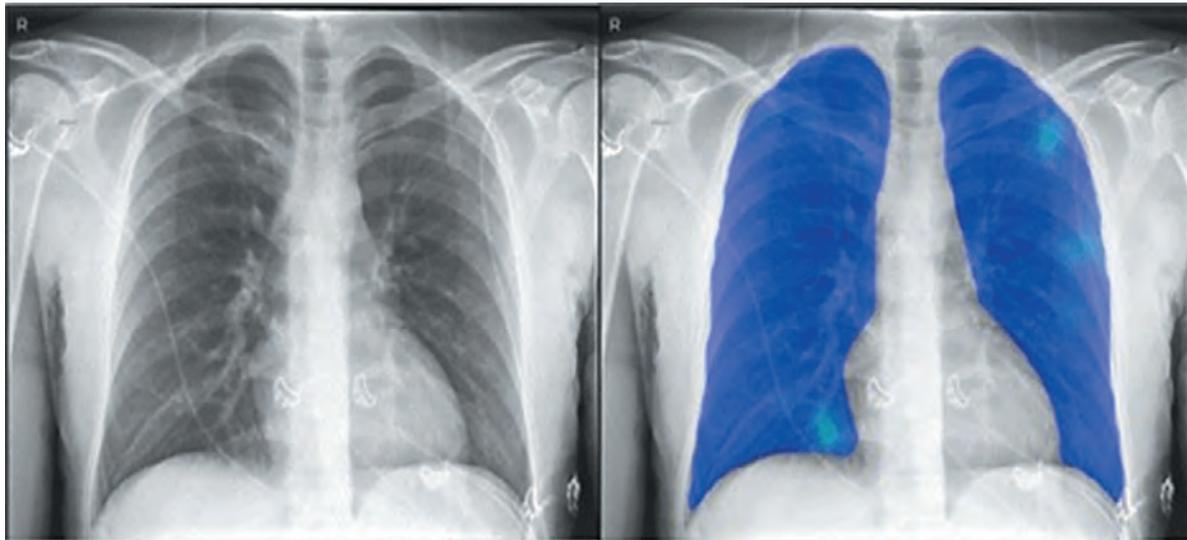


Figure 4 is of a 73-year old male with a positive RT-PCR COVID test in which the left- side (a) of the Figure shows multiple patches of consolidation in both lungs; the right-side (b) obtained with artificial intelligence (AI) of the same patient quantifies the pneumonia score at 99.8%, and Figure 5 is that of a 34-year old male with COVI, RT-PCR positive.

Figure 5 – Chest X-ray of a 34-year old male with positive RT-PCR test



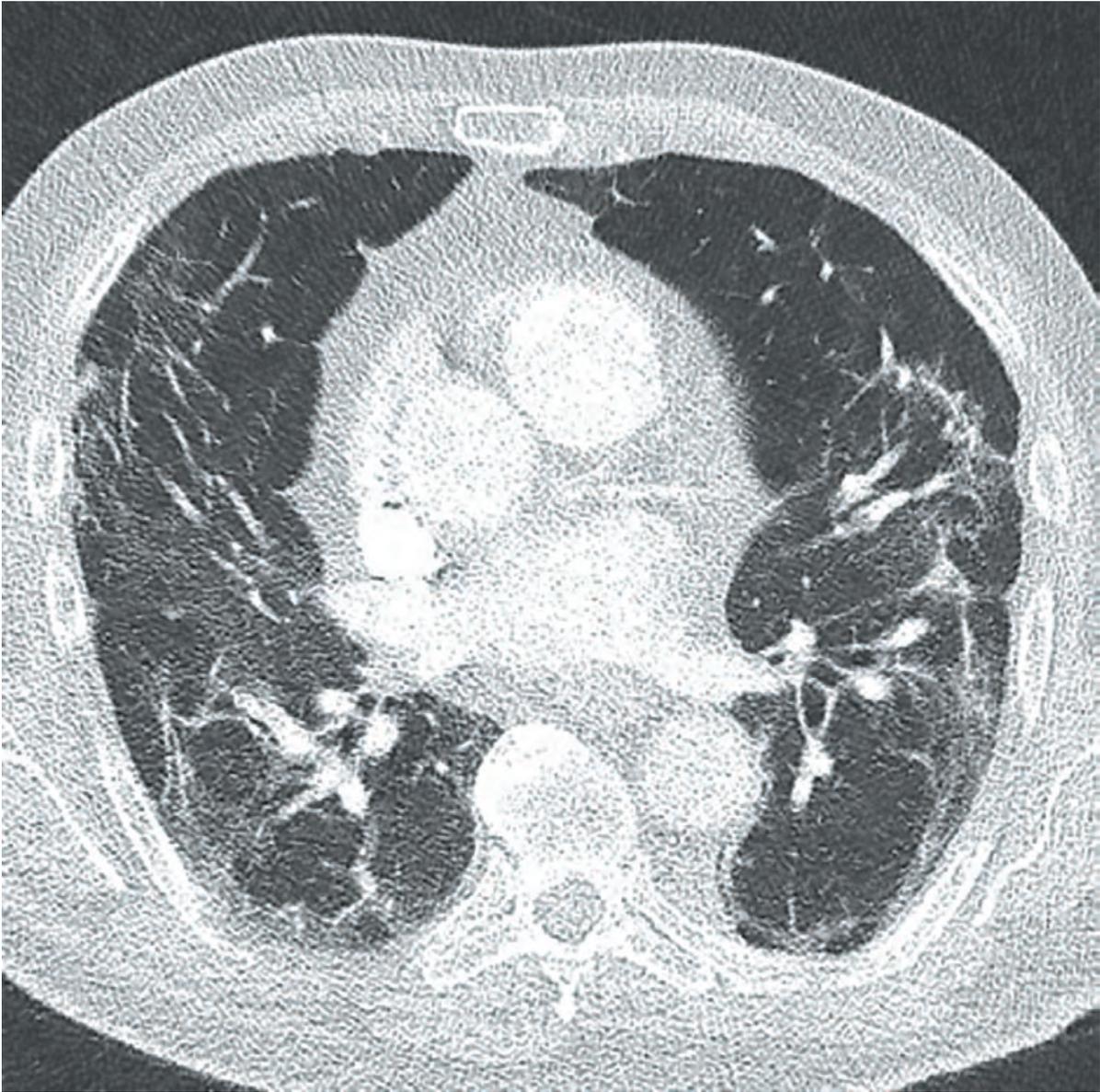
There are other easily and readily available commercial platforms for fairly accurate diagnosis of COVID-19 pneumonia on CXR images through AI. This can be used extensively for screening, triage, initial diagnosis, monitoring disease progression, and identifying patients at increased risk of morbidity and mortality. Based on this data, a website can be created, and the findings can be shared and distributed to others including public health departments for further management (19).

CXR possesses sensitivity of nearly 60% for initial detection of COVID-19-related pulmonary disease. These CXR abnormalities include bilateral lower zone and peripherally predominant consolidation and hazy opacities.

5.2 High-resolution computerized tomography

HR-CT is a conventional, noninvasive imaging modality with high accuracy and speed. On the basis of available data published in recent literature, almost all patients with COVID-19 had characteristic CT features in the disease process (21, 22, 23), such as different degrees of ground-glass opacities with and/or without crazy-paving sign, multifocal organizing pneumonia, and architectural distortion in a peripheral distribution. HR-CT is a thin (1-2 mm) axial sections of the chest from apex to the base of the lungs. Because of the negative density of the air in the lungs, early infections which manifest as inflammatory fluid collection in the alveolar as well as in the interstitial spaces of the lungs are identified with high sensitivity and specificity.

Figure 6 – HR-CT of asymptomatic patient recovered from COVID infection



HR-CT of the chest is the ideal imaging investigation in a patient suspected of COVID-19 infection. Hence the comparative discussion on imaging vs. laboratory tests is more on HR-CT and not on chest radiography. Chest radiography is generally used for mass detection and public health. Figure 6 illustrates the case of an asymptomatic patient recovered from COVID infection with an RT-PCR negative who showed classical subpleural fibrosis secondary to COVID infection.

The fluid collection in the alveolar spaces are again nonspecific in nature and need not be only due to COVID-infection. It can be due to various other factors like trauma, allergy,

infection, cardiac failure, and also non-COVID viral infections. However, the distribution and appearance of these fluid accumulations has gotten **specific** disease patterns for COVID diagnosis. HR-CT has a sensitivity and specificity of 90% and 91%, respectively, in diagnosing COVID-19 pneumonia (20).

Figure 7 – Digital chest X-ray and HR-CT of an actually sick patient with negative RT-PCR test

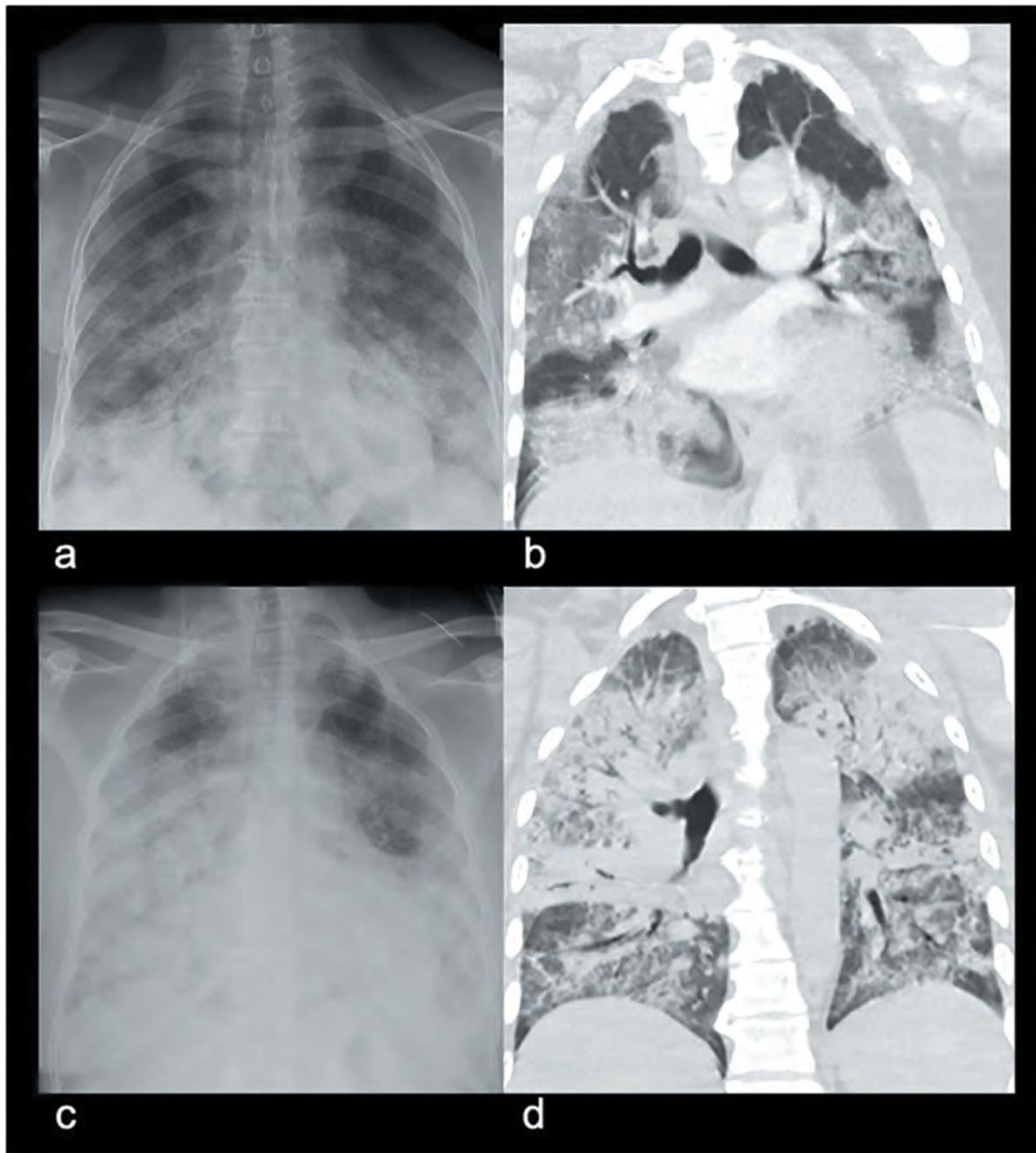


Figure 7 shows the digital chest X-ray and HR-CT images of the interesting case of an actually sick patient with negative RT-PCR test evidencing extensive lung infiltration. A repeat test on the 8th day came positive and the patient died on the 12th day.

5.3 Limitations of imaging

In low-prevalence areas or asymptomatic infected persons, imaging tests will face false-positive and missed detection problems and only viral detection can be relied on. Imaging examinations are quick tools to categorize patients into “probably positive” and “probably negative”. Epidemiological history, clinical symptoms, nonpathogenic laboratory tests, and chest imaging have various advantages for COVID-19 screening under certain conditions. Yet the final diagnosis of causative pathogen for COVID-19 infection must be made in combination with viral nucleic acid detection (20). However, it is important to evaluate whether it is necessary to identify the causative pathogen in a patient with inflammatory changes in the lungs due to viral infection.

Figure 8 – Standard flow for a symptomatic COVID suspect

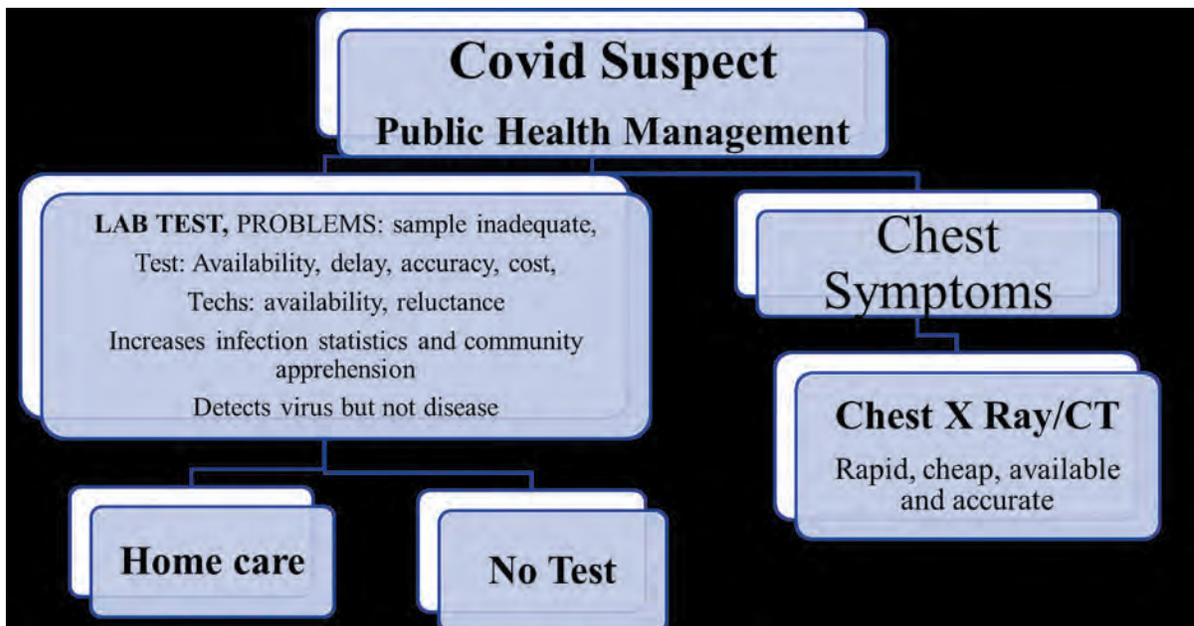


Figure 8 provides the standard flow for a symptomatic COVID suspect in which HR-CT is the initial test to detect early lung infiltration; if negative, the patient should be managed as usual for a respiratory viral disease.

6. Is SARS CoV-2 virus the real causative agent for the COVID-19 pandemic? Does it satisfy the Koch's postulates as the real pathogen?

The clinical performance has not been established in all circulating variants but is anticipated to be reflective of the prevailing variants in circulation at the time and location of the clinical evaluation. Performance at the time of testing may vary depending on the variants circulating, including newly emerging strains of SARS CoV-2 and their prevalence, which change over time (24).

Determining the accuracy and reliability of a test for a pathogen requires the presence of a gold standard. According to Trevethan, a gold standard provides, “authoritative, and presumably indisputable, evidence that a condition does or does not exist” (25).

Koch's postulates: In 1890, the German physician Robert Koch described four conditions which should be met before a microorganism could be deemed a human pathogen. With the discovery and improved understanding of viruses, it was realized that the postulates were not applicable to them since, as intracellular parasitic bodies, they were not easily purified nor cultured. Over the years, Koch's postulates have been adapted and modified such that there are eight criteria that preferably should be satisfied before a causal relationship can be said to exist between a virus and an infection(26).

The first paper on the new coronavirus warned that existing laboratory tests did not satisfy the modern version of Koch postulates (27). This was emphasized in a later article in the *Journal of Medical Virology*, which stated, “*The data collected so far is not enough to confirm the causal relationship between the new type of coronavirus and the respiratory diseases based on classical Koch's postulates or modified ones as suggested by Fredricks and Relman*”(28).

The many problems associated with the COVID-19 test have been identified by the (U.S.) Centers for Disease Control & Prevention (CDC), which noted in a recent publication that:

1. The presence of viral RNA in the sample might not indicate the presence of infectious virus;
2. The presence of viral RNA does not necessarily imply that SARS CoV-2 is the causative agent of COVID-19;
3. The test cannot rule out diseases caused by other bacterial or viral pathogens;
4. The test is not suitable for screening blood and blood products for the presence of SARS CoV-2;

5. If the virus mutates in the predetermined target region, the test is invalid; and
6. The optimum time to detect peak viral levels during an infection has not been established (29).

Hence, none of these tests are gold standard and 100% accurate. The failure to satisfy Koch's modified viral postulates and the inability to satisfactorily isolate SARS CoV-2 should cast doubts on the efficacy of any test that purports to identify the causative agent of COVID-19. Until all of the above are corrected, Bustin is of the opinion that testing programs for SARS CoV-2 are "*wholly inadequate, poorly organized, and surrounded by confusion and misinformation*" (30).

7. Laboratory tests, public health issues, and advantage of rapid antigen tests

With the COVID infection spreading across many regions of the world borders, schools and workplaces are partially or fully closed. Social functions and mass physical interactions are restricted. Laboratory testing which was limited for clinical confirmation and care, became a public health issue and many countries are now implementing widespread testing for public health use and risk management. However, there is little guidance available to policy makers on how to translate the scientific information on SARS CoV-2 diagnostic tests into practical policies for widespread testing in non-clinical settings (31).

Rapid antigen tests are simple, can be done in nasal and salivary samples, need not be nasopharyngeal swabs which are difficult to obtain. These tests are fast, do not need state-of-the-art laboratories, detect infection with 97% sensitivity, and have made widespread testing feasible (32). Frequency of testing and speed of reporting have a greater influence than test sensitivity on the effectiveness of SARS CoV-2 infection surveillance (33).

These core principles (i.e., the importance of fast test turnaround times, the relationship between test positivity and infectivity, and the ease of use for sample collection) are applicable to all SARS CoV-2 testing policies for public health use, along with cost considerations relating to high-volume testing.

7.1 What are the issues with laboratory tests for public health measures?

Strict public health measures to contain the disease have resulted in few problems:

1. ***Infodemics***: Often including rumours, stigma, and conspiracy theories have been common during the COVID-19 pandemic. The impact on public health is one of the greatest drawbacks of the test results. People started contacting international health agencies' websites and ministries of health's websites for credible information. This can result *in* more severe health problems and difficulties controlling a disease outbreak (14).

Imaging tests are evidence-based results, show structural changes, difficult to be forged and there is less scope for infodemics and rumours.

2. ***COVID-19 and public health measures:*** They have resulted in multiple attacks on cyber security. Also, they have generated a significantly changing dynamics in the context of cybersecurity due to the displacing of activities of organisations in the city to home in telework mode. The COVID-19 pandemic generated a rethinking of the approach to security strategies. It is necessary to take advantage of the opportunities of data-based decision-making and predictive projection techniques to be brought home at a low cost (34).
3. ***Fake reports:*** Imaging tests are evidence-based results that show structural changes that are difficult to be forged.
4. ***Morphed statistics by Governments' agencies:*** To avoid being notified as COVID-hot spot, there are numerous examples of modified test reports/statistics by State/National agencies for political stability and international reputation. In one of the detailed CDC data set, about 1 in 5 known cases — or 7 million people — are completely missing, a National Public Radio (NPR) analysis found. On top of that, about two-thirds of the data present are not usable, as health care providers marked fields as “Unknown” or simply left them blank. As of September 2021, many states in the U.S. have not sent the data to CDC and many have underscored the statistics. Texas, Missouri, Louisiana, West Virginia, and Wyoming have each submitted less than one-tenth of their total cases. Florida, Michigan, and Kentucky have smaller but still significant gaps in their data, each completely missing over 30% of their known cases. Over 3 million Texans have had COVID-19, but just 81,000 are in the data set. That is not even 3% (35). To compare the countries based on the number of seropositives for SARS CoV-2 infection is misleading, as there may not be enough tests being carried out to properly monitor the outbreak. The true number of infections might be still far higher than the reported values (36). It is quite justifiable because legitimation capacity of democratic systems is for maintaining functional, credible policy capacity, providing personal health care, and protecting citizens. Publishing test results and further statistics may be for global issues. Personal health care depends more on imaging results and not laboratory results.
5. ***Lack of stringent public health measures in low socio-economic countries:*** Thickly populated areas in many Asian countries such as slums, where there are no stringent public health measures, have not reported high incidence rates of COVID infection. In India, one of the densely populated slums (called Dharavi in Mumbai) has about 6,000,000 people living in 2 square kilometers. The morbidity and mortality there are very low, even after almost 2 years. The COVID-19 outburst was at its peak in May and the curve got flattened within the next two months. This model is also known as the Dharavi Model (37).

8. Is there any medication for COVID-19?

Extensive research is going on across the world to identify an ideal antiviral medicine. Universities, pharma companies, laboratories, and many countries are funding millions of dollars to develop medicines. There are many clinical ongoing trials. The virus basically has nucleic acid surrounded by a protein coat and it multiplies within the human cell. Viruses multiply fast and also mutate fast for survival. This makes it difficult to identify an ideal antiviral medicine. Many compounds which are used for treating other viral diseases, drugs used for malaria (*Hydroxychloroquine*), drugs used for parasitic diseases (*Ivermectin*), and many more have been used hoping for some or other benefit. None have been proved useful beyond any doubt.

An ideal anti-viral medication:

- ***Must be able to stop the viral multiplication:*** by deactivating the specific part of a virus (may be the nucleic acid or the protective coat).
- ***Must kill the virus:*** without killing the human cell it occupies.
- ***Must prevent mutation or have action on the mutant:*** (genetic transformation).
- ***Should not result in resistance to whatever drugs.***

8.1 Are there any specific drugs against viruses?

In many ways, the narrow activity of existing antivirals boils down to the nature of viruses themselves. Cellular pathogens like bacteria, fungi, parasites have many targets for drug action primarily because of their cellular properties. For example, penicillin blocks cell membrane synthesis in bacteria, sulfa drugs act on cephalosporins, and azole antifungals disrupt the cell membrane.

Aside from one qualified success in *Remdesivir*, a therapy originally developed to treat hepatitis C and Ebola, there were practically no strong antiviral drug candidates to quickly test and deploy against SARS CoV-2. In a large, placebo-controlled trial run over three months in early 2020, clinicians demonstrated that the drug accelerated recovery among people hospitalized with COVID-19 (38).

Some clinical studies have failed to confirm that it offers patients any benefit. Further, the drug is expensive, difficult to manufacture, and must be given intravenously in a hospital — all undesirable attributes in the middle of a pandemic (39).

Another antiviral drug making lot of promises is *Molnupiravir*. This is an easier-to-synthesize, oral drug option that has been found to shorten the duration of infectiousness among people with symptomatic COVID-19. Late-stage clinical testing is under way. But it has proven inefficient in terms of rapidly addressing epidemics or pandemics.

The health, humanitarian, social, and economic policies adopted by countries can influence the speed and strength of the recovery. Currently, no medication is usually recommended to treat COVID-19, and no cure is accessible. The (U.S.) Food & Drug Administration (FDA) has authorized medicines previously approved for other disorders to be used now as recommended therapy for COVID-19.

8.2 Why it is difficult to develop anti-viral drugs?

Viruses, with their compact genomes and lack of cellular anatomy, offer many fewer druggable targets. Add in a high rate of replication — a typical SARS CoV-2 infection, for instance, is thought to produce more than one million virions per person per day (6) — coupled with an inherent genetic mutability, and it is no wonder that most existing antivirals proved useless for COVID-19 (40).

Effective anti-viral treatments can shorten the duration of the illness and lessen complications in some people. Since the coronavirus that causes COVID-19 is new, there is limited evidence regarding specific anti-virals that may work against it. Doctors and scientists are looking at experimental anti-virals to find effective treatments for the new disease. (“Is the coronavirus treatable?”, Johns Hopkins update 21 October 2021).

Some scientists fear that tampering with human molecular pathways could cause unwanted side effects. There were extensive efforts to develop anti-viral drugs when severe acute respiratory syndromes emerged, like SARS (2003) and MERS (2012). Nothing happened and even now, in 2021, after devastating SARS CoV-2 we do not have a specific viral disease. We are using *Remdesivir*, which showed some benefit in hepatitis/ Ebola as an antiviral, hoping for the best!!!

8.3 If there are no specific antivirals, what are the drugs used to treat the COVID-19 infection?

The basic management of COVID infection is nothing but the management of inflammatory flux or changes in the human body secondary to inflammatory/immune response and thrombosis of blood vessels. Apart from clinical care, the commonest management principles are:

1. **Oxygen therapy:** The virus invades the lungs and alveolar spaces are filled with fluid. This results in altered oxygen exchange in the lungs and reduced oxygen concentration in the blood, which is treated by exogenous oxygen.
2. **Steroids:** The inflammatory response is treated by strong anti-inflammatory drugs like steroids and patients are treated with steroids (*Dexamethasone*).
3. **Anticoagulation drugs** (“blood thinners”): To prevent blood clots within small vessels of the lungs and other organs. Low dose heparin is generally used.

4. **Monoclonal antibodies:** They are used against the viruses.

However, host immunity is considered as the most important defense mechanism against the virus. Mortality is high in patients with co-morbidities or decreased immunity.

COVID-19 vaccines also provide strong protection from viral infections.

8.4 Advantages of HR-CT over laboratory testing

With all the uncertainties of laboratory tests, HR-CT imaging studies seem to be better investigations for diagnosing COVID-19 infection. HR-CT has a high sensitivity for diagnosis and may be considered as a primary tool for the current COVID-19 detection in epidemic areas.

In one cohort studies from Wuhan, China, the positive rates of RT-PCR were 59% (601 of 1014 patients) and HR-CT were 88% (888 of 1014 patients) for the diagnosis of patients suspected of having COVID-19 infection. With RT-PCR as a reference standard, the sensitivity of HR-CT for COVID-19 was 97% (580 of 601 patients). In 308 patients with negative RT-PCR, results with positive HR-CT scans, 147 of 308 (48%), were reconsidered as highly likely cases and 103 of 308 (33%) as probable cases with a comprehensive evaluation. With analysis of serial RT-PCR assays and CT scans, 60% (34 of 57) to 93% (14 of 15) of patients had initial positive HR-CT scans consistent with COVID-19 before the initial positive RT-PCR results; 42% of patients (24 of 57) showed improvement on follow-up HR-CT scans before the RT-PCR results turned negative (41).

9. Laboratory tests or imaging tests? Comparative analysis

Although quantitative and qualitative tests of viral nucleic acid RT-PCR tests are the primary assay for SARS CoV-2 detection, the sensitivities of these tests remain low for oropharyngeal (32%) and nasal (63%) and swab samples (42).

RT-PCR tests can often take up to more than a week due to a shortage in testing supplies or lack of technical skills. Therefore, suspected cases, either with or without RT-PCR results, require additional affirmations. Combinations of radiographic, molecular, and antigen-based assays have been used alone or in combination to determine the optimal means to make a definitive diagnosis of SARS CoV-2 infection (43).

After the respiratory symptom presentation and nucleic acid viral detections, an initial evaluation of patients with COVID-19 commonly includes radiological examinations. While RT-PCR remains the gold standard for a virologic diagnosis, a CXR affords 69% sensitivity (44).

The value of the CXR is further supported by meta-analyses of patients with lower respiratory infections, including those treated in an intensive care unit. Serial chest X-rays can shorten symptom duration and reduce disease co-morbidities (45).

As per the available literature, during this COVID pandemic, the ‘fairly accurate diagnosis’ of COVID-19 relies on a combination of clinical symptomatology and imaging tests, preferably HR-CT. RT-PCR testing is basically for the identification of the causative pathogen, and imaging tests to detect inflammatory response or fluid collection organs, preferably in the lungs.

Numerous studies have scrutinized HR-CT images of patients infected with SARS CoV-2, considering that abnormalities may also be due to other causes of pneumonia, leading to false-positive results. In one study performed in Tongji Hospital, Wuhan involving 1,014 patients who were examined with both HR-CT and RT-PCR tests, 601 patients (59%) had positive RT-PCR results, and 888 (88%) had positive HR-CT scans. While the sensitivity of HR-CT scans for COVID-19 was 97%, on the basis of positive RT-PCR results, 75% (308 of 413 patients) had positive HR-CT scans with negative RT-PCR results (46).

Although HR-CT abnormalities may precede symptom onset in 44% of the patients with COVID-19, >90% of those with respiratory symptoms will have abnormal HR-CT after symptom onset (47).

Furthermore, abnormalities on HR-CT may be seen even in asymptomatic individuals with positive RT-PCR, as reported in 14 of 15 healthcare workers in one study (48).

Most recently, a Consensus Statement from the Fleischner Society was generated by a multidisciplinary panel comprised principally of radiologists and pulmonologists from 10 countries. These professionals had experience managing patients with COVID-19 across a spectrum of healthcare environments, evaluating the utility of imaging within three scenarios representing varying risk factors, community conditions, and resource constraints (49).

9.1 Why is imaging better than laboratory tests for diagnosis?

With inaccuracies for SARS CoV-2 as the causative pathogen for COVID-19, with no definite anti-viral for specific treatment, and with patient management being nothing but management of structural changes, HR-CT becomes the most important investigation for diagnosis and further management.

Studies have showed typical CT features consistent with COVID-19 in 60% of patients (34 of 57) even before the initial positive RT-PCR results, and almost all patients (56 of 57) had initial positive HR-CT scans before or within 6 days of the initial positive RT-PCR results. This indicates that CT can be very useful in the early detection of suspected cases. Almost 97% of

patients confirmed to have COVID-19 with RT-PCR assays showed positive findings at HR-CT (50, 51).

Given the sensitivity and specificity of HR-CT, typical CT imaging features were adopted in the revised 5th edition of the *Guideline of Diagnosis and Treatment*, in Hubei Province, China (52).

In addition, Pan *et al.*, demonstrated that multiple repeat HR-CT examinations can accurately reflect disease evolution and monitor the treatment effect. Patients recovery with treatment were better appreciated by imaging compared to RT-PCR. There are also cases of disease progression and patient deterioration on follow-up HR-CT scans after RT-PCR test results turned negative (53).

Many patients with negative RT-PCR tests, had typical HR-CT manifestations and had to be treated aggressively.

Even though there are other viral pneumonias, false-positive cases of COVID-19 can be identified with HR-CT. However, the management of structural changes would not change, depending on the causative pathogen. The management remains almost the same for viral lung diseases. Considering the rapidly spreading epidemic of COVID-19, the priority was to identify any CT cases suspicious for COVID-19, isolate the patients and administer appropriate treatment irrespective of the RT-PCR test reports, which may take longer time.

Because of the relatively low positive rate and other limitations of RT-PCR test reports, the so called “false-positive” cases at CT may be considered “true-positive” if RT-PCR is considered as standard of reference. With these results, many (about 81%) patients with negative RT-PCR results but positive HR-CT scans were reclassified as highly likely cases of COVID-19 by means of the comprehensive analysis of clinical symptoms, typical HR-CT manifestations, and CT follow-up. On the basis of serial RT-PCR tests and CT scans, 90% of patients (14 of 15) had initial positive HR-CT consistent with COVID-19 before (or parallel to) the initial positive RT-PCR results. In such cases negative RT-PCR results could be problematic for individual patient management as well public health measures.

A combination of exposure history, clinical symptoms, and typical HR-CT imaging features are used to identify COVID-19 with higher sensitivity, even with negative RT-PCR reports. In epidemic areas, negative RT-PCR findings but positive HR-CT features are highly suggestive of COVID-19. This has important clinical and societal implications. HR-CT reports take less than 15 minutes and this rapid detection with high sensitivity of viral infection allows better control of viral spread. Similarly, patient with positive RT-PCR and negative HR-CT, just needs supportive measures. Hence, HR-CT should be considered for COVID-19 screening, comprehensive evaluation, and follow-up, especially in epidemic areas with high pre-test probability for disease.

10. Summary

Evidences and literature review support HR-CT examination to confirm the inflammatory response in the lungs. HR-CT detects the structural changes which are diagnostic of COVID infection in a clinical setting. It helps in identifying patients with negative or nonspecific RT-PCR reports for proper treatment and management. Because of many false negative in RT-PCR results, HR-CT is the ideal investigation for statistical analysis of the disease. Patients with extensive lung infiltration shed more viruses than the asymptomatic patients. Hence, managing those patients is more important to prevent disease spread and protect others.

Specifically, HR-CT is vital for confirmatory analysis and evaluation of disease severity in patients with suspected SARS CoV-2 infection (54).

In advanced cases, SARS CoV-2 infection can lead to extensive lung tissue damage with reduced oxygen uptake in infected people, which can be well identified by HR-CT. Lung scoring helps in quantifying the disease and has good correlation with oxygen saturation. It helps in proper management with oxygen, steroids, and anti-coagulants (54).

11. Conclusions

1. Laboratory tests to detect nucleic acid of the virus are ideal tests. But the accuracy is less than 60% and has many limitations.
2. Laboratory tests can be positive in asymptomatic patients and negative in symptomatic patients. Test results will not provide guidelines to start or modify the treatment.
3. Laboratory test results have concealed many asymptomatic individuals for personal gains and avoidance of state guidelines.
4. Laboratory tests are modified by many countries and government agencies for political and commercial gains. Hence, they cannot be used for public health measures to prevent or protect people from the disease.
5. Increased number of tests and elaborative statistical reports do not have any significant role. They have not helped in reducing the mortality and morbidity, instead, they created unnecessary apprehension in people.
6. The disease has spread across the globe, skipping many countries especially countries with low socio-economic status.
7. Even in endemic Asian countries, the disease has skipped thickly populated areas with low hygiene and income (called as slums). This is a significant evidence to confirm

- that testing, tracing, and tracking is not the methodology for containing the disease. Similarly, it proves social distancing, mask-wearing, and sanitization are not the effective measures for prevention. Inherent immunity provides the maximum protection and co-morbidities are reasons for high mortality and morbidity.
8. Laboratory tests do not help in surveillance and quarantine. Patients with viral diseases carry almost similar risks of spreading just like COVID but perhaps with different fatality ratios. All such viral illnesses need self-quarantine instead of forced quarantine by state agencies.
 9. It is not mandatory to identify a causative pathogen before treatment. Moreover, as per Koch's postulates, the SARS CoV-2 virus still does not fulfil the criteria to be the causative pathogen for the COVID infection.
 10. Even if RT-PCR test is positive, there are no definite anti-viral drugs. Many drugs like *Remdesivir* are used hoping for the best. Hence, it is not worth doing elaborative testing.
 11. The management of COVID is tantamount to the management of inflammatory reactions in the lungs, which are identified and quantified by imaging tests such as HR-CT.
 12. HR-CT has to be done in all symptomatic patients with or without RT-PCR results. Clinical evaluation and HR-CT tests will give clear information about the disease manifestation and start effective treatment.

References

1. Coronaviridae Study Group of the International Committee on Taxonomy of Viruses (2020). "The species severe acute respiratory syndrome-related coronavirus: Classifying 2019-nCoV and naming it SARS CoV-2". *Nat. Microbiol.* 5:536–44.
2. Wang D *et al.*, (2020). "Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China". *J. Am. Med. Assoc.* 323:1061–9.
3. (U.S.) Centers for Disease Control & Prevention (2020). "Interim Guidelines for Collecting, Handling, and Testing Clinical Specimens for COVID-19". <https://www.cdc.gov/coronavirus/2019-ncov/lab/guidelines-clinical-specimens.html>.
4. Parasher A (2021). "COVID-19: Current understanding of its pathophysiology: Clinical presentation and treatment", *Postgraduate Medical Journal* 97:312-20.
5. Ackermann M, Verleden SE, Kuehnel M, Haverich A, Welte T, Laenger F. *et al.*, (2020). "Pulmonary vascular endothelialitis, thrombosis, and angiogenesis in COVID-19". *N. Eng. J. Med.* 383:120–8. doi: [10.1056/nejmoa2015432](https://doi.org/10.1056/nejmoa2015432).
6. Wang B, Li R. Lu Z, and Huang Y (2020). "Does co-morbidity increase the risk of patients with COVID-19: Evidence from meta-analysis". *Aging* 12:6049–57.

7. (U.S.) Centers for Disease Control & Prevention (2020). “Research Use Only: 2019–Novel Coronavirus (2019-nCoV) Real-time RT-PCR Primers and Probes”. <https://www.cdc.gov/coronavirus/2019-ncov/lab/rt-pcr-panel-primer-probes.html>.
8. Lipsitch M, Swerdlow DL, and Finelli L (2020). “Defining the epidemiology of COVID-19: Studies needed”. *N. Engl. J. Med.* **382**:1194–6.
9. Ai T, *et al.*, (2020). “Correlation of HR-CT and RT–PCR testing in coronavirus disease 2019 (COVID-19) in China: A report of 1014 cases”. *Radiology* **296**:E32–40.
10. Udugama B, *et al.*, (2020). “Diagnosing COVID-19: The disease and tools for detection” *ACS Nano* **14**:3822–35.
11. Winichakoon P *et al.*, (2020). “Negative nasopharyngeal and oropharyngeal swabs do not rule out COVID-19”. *J. Clin. Microbiol.* **58**:e00297-20 (2020).
12. Xu Y, Cheng M, Chen X, and Zhu J (2020). “Current approach in laboratory testing for SARS CoV-2.” *Int. J. Infect. Dis.* **100**:7–9 (2020).
13. D’Cruz RJ, Currier AW, and Sampson VB (2020). “Laboratory testing methods for novel severe acute respiratory syndrome-coronavirus-2 (SARS CoV-2). *Front. Cell Dev. Biol.* **8**:468.
14. Islam, Saiful Md, *et al.*, (2020). “COVID-19–related infodemic and its impact on public health: A global social media analysis.” *The American Journal of Tropical Medicine and Hygiene* **103.4**:1621.
15. Capaccione KM, Yang H, West E, Patel H, MaH, Patel S, Fruauff A, Loeb G, Maddocks A, Borowski A, Lala S, Nguyen P, Lignelli A, D’Souza B, Desperito E, Ruzal-Shapiro C, Salvatore MM (2021). “Pathophysiology and imaging findings of COVID-19 infection: An organ-system based review” *Acad Radiol.* **28**(5):595–607.
16. Hosseiny M, Kooraki S, Gholamrezanezhad A, Reddy S, and Myers L (2020). “Radiology perspective of coronavirus disease 2019 (COVID-19): Lessons from severe acute respiratory syndrome and Middle East respiratory syndrome”. *Am. J. Roentgenol.* **214**:1078–82.
17. Wong HYF *et al.*, (2020). “Frequency and distribution of chest radiographic findings in patients positive for COVID-19”. *Radiology* **296**:E72–8.
18. Dennie C. *et al.*, (2020). “Canadian Association of Thoracic Radiology/Canadian Association of Radiologists consensus statement regarding chest imaging in suspected and confirmed COVID-19”. *Can. Assoc. Radiol. J.* **71**:470–81.
19. Borkowski AA, Narayan A, Viswanadhan L, Thomas B, Guzman TD, Deland LA, and Mastorides SM (2020). “Federal practice using artificial intelligence for COVID-19 chest X-ray diagnosis” **37**(9):398–404.
20. Nair A, Rodrigues JCL, Hare S, Edey A, Devaraj A, Jacob J, Johnstone A, McStay R, Denton E, and Robinson G (2020). “A British Society of Thoracic Imaging statement: Considerations in designing local imaging diagnostic algorithms for the COVID-19 pandemic”. *Clin Radiol.* **75**(5):329-34.
21. Huang P, Liu T, Huang L, *et al.*, (2020). “Use of chest CT in combination with negative RT-PCR assay for the 2019 novel coronavirus but high clinical suspicion”. *Radiology* **12**:200330.

22. Lei J, Li J, Li X, and Qi X (2020). “CT imaging of the 2019 novel coronavirus (2019-nCoV) pneumonia”. *Radiology* **31**:200236.
23. Pan F, Ye T, Sun P, *et al.*, (2020). “Time course of lung changes on chest CT during recovery from 2019 novel coronavirus (COVID-19) pneumonia”. *Radiology* **13**:200370.
24. Labcorp’s COVID-19 RT-PCR Test EUA Summary – May 11, 202, Emergency Use Authorization (EUA) Summary COVID-19 RT-PCR Test (Laboratory Corporation of America).
25. Johnston L (2020). “U.K. lockdown was a “monumental mistake” and must not happen again-Boris scientist says”. UK Express, 26th August.
26. Williams J V (2010). “Déjà vu all over again: Koch’s Postulates and virology in the 21st Century”. *J of Infect Dis* **201**(11):1611-4.
27. Zhu N (2019). “A novel coronavirus from patients with pneumonia in China”. *N Engl J Med*; **382**:727-33.
28. Lu H (2020). “Outbreak of pneumonia of unknown etiology in Wuhan, China: The mystery and the miracle”. *J Med Virol* **92**:401-2.
29. (U.S.) Centers for Disease Control & Prevention (2020). “CDC 2019-novel coronavirus (2019-nCoV) real-time RT-PCR” *Diagnostic Panel*. <https://www.fda.gov/media/134922/download>.
30. Bustin S (2020). “RT-qPCR testing of SARS-CoV-2: A primer”. *Int J Med Sci* **21**(8):3004-12.
31. Boehme C, Hannay E, and Sampath R (2021). “SARS-CoV-2 testing for public health use: Core principles and considerations for defined use settings.” *The Lancet Global Health* **9.3**: e247-9.
32. van Beek J *et al.*, (2020). “From more testing to smart testing: data-guided SARS-CoV-2 testing choices.” *MedRxiv*.
33. Larremore DB, Wilder B, Lester E, Shehata S, Burke JM, Hay JA, and Parker R (2021). “Test sensitivity is secondary to frequency and turnaround time for COVID-19 screening”. *Science Advances* **7**(1):eabd5393.
34. Andrade RO, Ortiz-Garcés I, and Cazares M (2020). “Cybersecurity attacks on smart home during Covid-19 pandemic.” *2020 Fourth World Conference on Smart Trends in Systems, Security and Sustainability (WorldS4)*. IEEE.
35. Moore JT *et al.*, (2020). “Disparities in incidence of COVID-19 among under-represented racial/ethnic groups in counties identified as hotspots during June 5–18, 2020—22 states, February–June 2020.” *Morbidity and Mortality Weekly Report* **69**(33):1122.
36. Rashki A, Dehkordi H, Nemati R, and Tavousi P (2021). “What does COVID-19 testing results really say? The real statistics concealed behind the accessible data”. *Journal of Medical Virology* **93**(10):5977-87.
37. Kaushal J and Mahajan P (2021). “Asia’s largest urban slum-Dharavi: A global model for management of COVID-19.” *Cities* **111**:103097.
38. Beigel JH *et al.*, (2020). *N. Engl. J. Med.* **383**:1813–26 (2020).
39. WHO Solidarity Trial Consortium (2021). *N. Engl. J. Med.* **384**:497–511.
40. Sender R *et al.*. (2020). Preprint at medRxiv <https://doi.org/10.1101/2020.11.16.20232009>.

41. Tao A, Yang Z, Hou H, Zhan C, Chen C, Lv W, Tao Q, Sun Z, and Xia L (2019). “Correlation of HR-CT and RT-PCR testing for coronavirus disease 2019 (COVID-19) in China: A Report of 1014 Cases”.
42. Wang W, *et al.*, (2020). “Detection of SARS-CoV-2 in different types of clinical specimens”. *JAMA* **323**:1843–4.
43. Hosseiny M, Kooraki S, Gholamrezanezhad A, Reddy S, and Myers L (2020). “Radiology perspective of coronavirus disease 2019 (COVID-19): Lessons from severe acute respiratory syndrome and Middle East respiratory syndrome”. *Am. J. Roentgenol.* **214**:1078–82.
44. Ai T, *et al.*, (2020). “Correlation of HR-CT and RT–PCR testing in coronavirus disease 2019 (COVID-19) in China: A report of 1014 cases”. *Radiology* **296**:E32–40.
45. Wong HYF, *et al.*, (2020). “Frequency and distribution of chest radiographic findings in patients positive for COVID-19”. *Radiology* **296**:E72–8.
46. Ai T, *et al.*, (2020). “Correlation of HR-CT and RT–PCR testing in coronavirus disease 2019 (COVID-19) in China: A report of 1014 cases”. *Radiology* **296**:E32–40.
47. Bernheim A, *et al.*, (2020). “HR-CT findings in coronavirus disease-19 (COVID-19): Relationship to duration of infection”. *Radiology* **295**:200463.
48. Shi H, *et al.*, (2020). “Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: A descriptive study.” *Lancet Infect. Dis.* **20**:425–34.
49. Rubin GD, *et al.*, (2020). “The role of chest imaging in patient management during the COVID-19 pandemic: A multinational consensus statement from the Fleischner Society”. *Radiology* **296**:172–80.
50. Pan Y, Guan H, Zhou S, *et al.*, (2020). “Initial CT findings and temporal changes in patients with the novel coronavirus pneumonia (2019-nCoV): A study of 63 patients in Wuhan, China”. *Eur Radiol* (2020 Feb 13 Epub ahead of print).
51. Guan WJ, Ni ZY, Hu Y, *et al.*, (2020). “Clinical characteristics of coronavirus disease 2019 in China”. *N Engl J Med.* [doi: 10.1056/NEJMoa2002032](https://doi.org/10.1056/NEJMoa2002032).
52. General Office of National Health Committee (2020). “Notice on the issuance of a program for the diagnosis and treatment of novel coronavirus (2019-nCoV) infected pneumonia (trial revised fifth edition)”. Published February 8, 2020.
53. Pan F, Ye T, Sun P, *et al.*, (2020). “Time course of lung changes on chest CT during recovery from 2019 novel coronavirus”.
54. Hosseiny M, Kooraki S, Gholamrezanezhad A, Reddy S, and Myers L (2020). “Radiology perspective of coronavirus disease 2019 (COVID-19): Lessons from severe acute respiratory syndrome and Middle East respiratory syndrome”. *Am. J. Roentgenol.* **214**:1078–82.

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During the COVID-19 pandemic, Dr. Shetty did extensive work in two medical college hospitals. More than 200 thousand lab tests have been carried out and about 50 thousand patients were treated. Because of the scarcity of beds during the second peak in India, Dr Shetty managed about 300 families at home with on-line consultation. His on-line interactions with Prime Minister Narendra Modi and multiple on-line lectures in local language are quite useful for the communities served (ref: YouTube, Balakrishna Shetty, Vice Chancellor, COVID protection).

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Chapter Ten

Health policy, evidence, and practice gaps in the response to the COVID-19 pandemic in Africa: The case of Ghana

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Abstract - The SARS COVID-19 pandemic was expected to ravage African countries, but learning from previous epidemics helped mitigate it. Key to successful mitigation and recovery from the pandemic is health systems strengthening but we argue that the current ‘Six Building Blocks’ approach as put forward by the World Health Organization has inconsistencies arising from, amongst other things, the meaning of equity and ethical framing. Moreover, disruption of health systems by COVID-19 in Africa remains severe and has consequences, especially for women and children. In Ghana this means the COVID-19 response that was successful in helping to mitigate its impact may also have longer-run consequences that may be revealed in coming years in higher perinatal and child mortality, both of which existing areas of concern for Ghana health policy. Health systems strengthening requires increased community involvement as both the source and beneficiary of resilience to future COVID-19 waves, future epidemics and long-run healthcare improvement. However, in Ghana, COVID-19 revealed pre-existing engagement gaps in the Human Resources Building Block that may delay the longer-run health system recovery from the Pandemic and make harder the process of overall strengthening of the Ghana health system.

Key words: COVID-19, Africa; health systems strengthening; human resources; perinatal mortality, neonatal mortality.

Abbreviations

BMC:	Budget Management Centers
CBPR:	Community-Based Participatory Research
CHPS:	Community-Based Health Planning and Services
CMA:	Common Management Arrangement
GHS:	The Ghana Health Service
HSWG:	Health Sector Working Group
IALC:	Inter-Agency Leadership Committee
ICC:	Inter-Agency Coordinating Committee
LMIC:	Lower and Middle Income Countries
NHIA:	National Health Insurance Authority
PCR:	Polymerase Chain Reaction
PPE:	Personal Protective Equipment
UNECA:	United Nations Economic Commission for Africa
WHO:	World Health Organization

*Dr. Antwi and Dr. Walsh dedicate this chapter to their late colleague Dr. Isaac Adams who died suddenly, shortly before the completion of its writing. We have lost a great friend and colleague who we were privileged to spend time with, when he was not in demand in his former role as Director of Research and Health Information Systems at the Ghana Ministry of Health. Isaac devoted his whole life working for the Ghana Ministry of Health and its Agencies. May his soul rest in perfect peace.

1. Introduction - The SARS COVID-19 pandemic in Africa

Whilst the SARS COVID-19 pandemic has been globally severe, the experience of responding to previous epidemics of disease in Africa should have offered some advantage to its healthcare management, and this seems to be the case. Epidemics of international concern are those tending to cause more deaths, disability, and distress than usual but, normally, general continental and global resources are mobilized through a variety of international agreements and agencies in order to help recovery in the, typically, one or two countries affected. The high-profile Ebola epidemic of 2013-2016 stood out because it involved many more countries than normal (Coltart *et al.*, 2017). The mobilization of general resources in the epidemic helped reduce suffering and enabled the economic and social recovery that allowed people and communities to resume their lives. It was so important that the Royal Society accordingly published in 2017 a special themed issue in its Philosophical Transactions (Biological Science).

However, in contrast to other epidemics, early forecasts of the SARS COVID-19 pandemic by the United Nations Economic Commission for Africa (UNECA) predicted it would overwhelm African countries' health systems with the fear that nations would be "ravaged" (Diop *et al.*, 2021). This was a reasonable worry because scarce African continent health and global resources were to be both prioritized differently and shared between many more countries than in a typical epidemic, whilst richer countries were concentrating on their own COVID-19 response. It is remarkable, therefore, that African countries have not been affected by COVID-19 to the extent feared. This success is attributed to local knowledge gained from dealing with previous epidemics and from early and coordinated political and public health responses (Diop *et al.*, 2021, p. 1). Later in this chapter we will explain how Ghana responded to the pandemic in policy and practice.

Nevertheless, there have been consequences both directly from COVID-19 deaths and distress and indirectly by the disruption of African health systems, with Diop *et al.*, (2021) identifying women and children as especially vulnerable to the very measures taken to deal with the pandemic. Diop *et al.*, (2021) highlight the need to respond to further COVID-19 waves or pandemics by communities becoming the first responders and by leveraging past research to inform continuity of essential services – by engaging decision makers early on to ensure local relevance, strengthen health systems especially in terms of human resources, involve communities, and build on successful interventions and collaborations. However, this agenda has many challenges. We will focus especially on those of what the World Health Organization (WHO) identify as the "Six Building Blocks" of a strong health system (World Health Organization, 2007). We will begin by explaining why these are important, explore some key challenges, and examine the implications for COVID-19 in Africa before we turn to the case of Ghana.

2. The challenges of health systems strengthening

Gilson (2012, p. 13) argues that "Health systems are widely recognized to be vital elements of the social fabric of every society" for treatment and prevention of ill-health and for addressing health inequity and social injustice. Yet, for decades, a continuing challenge for healthcare in Africa is the perennial maldistribution of healthcare resources. The WHO sees this as a failure of health systems to distribute what is already available because of fundamental weaknesses in the "Six Building Blocks" of a strong health system. These blocks are:

1. "Good health services are those which deliver effective, safe, quality personal and non-personal health interventions to those that need them, when and where needed, with minimum waste of resources.
2. "A well-performing health workforce is one that works in ways that are responsive, fair, and efficient to achieve the best health outcomes possible, given available resources and circumstances (i.e. there are sufficient staff, fairly distributed; they are competent, responsive, and productive).

3. “A well-functioning health information system is one that ensures the production, analysis, dissemination and use of reliable and timely information on health determinants, health system performance, and health status.
4. “A well-functioning health system ensures equitable access to essential medical products, vaccines and technologies of assured quality, safety, efficacy and cost-effectiveness, and their scientifically sound and cost-effective use.
5. “A good health financing system raises adequate funds for health, in ways that ensure people can use needed services, and are protected from financial catastrophe or impoverishment associated with having to pay for them. It provides incentives for providers and users to be efficient.
6. “Leadership and governance involves ensuring strategic policy frameworks exist and are combined with effective oversight, coalition- building, regulation, attention to system-design and accountability.”

WHO views these blocks as a systemic entirety (2007, p. 7) that clearly claims to provide a unitary analytical model, in a view endorsed by the U.S. Government (2012), as set out in the Harvard perspective of Roberts *et al.*, (2002), who see the task of health systems strengthening as fundamentally that of change based on rigorous analysis of healthcare. Crucially, this is not to be based on intentions or ideas but “by the changes they actually produce” (Roberts *et al.*, 2002, p. 3). This claim is central to public confidence in the allocation of healthcare resources. However, there are substantial challenges.

An immediate indication of difficulties in the WHO’s Six Building Blocks is that Roberts *et al.*, (2002) argue the analysis should focus on at least five critical but also, they claim, universal variables (or to use their term “control knobs”) – payment, financing, organization, regulation, and behavior. How these relate to the WHO’s Six Building Blocks is left undiscussed – do they replace, support, or enhance the Six Building Blocks? Clearly their five control knobs overlap with the agenda of the WHO’s Six Building Blocks, but critics may see them as actually forming an agenda within them – that of constituting the preferred model for access to U.S. government aid. Interestingly, Koon *et al.*,’s (2019) comparative review of five cases of USAID Health Systems Strengthening finds evidence on implementation of health systems strengthening is scarce but identifies ways donors can better support countries to attain universal health coverage. Yet, it is ironic that the Roberts *et al.*, model is borne out of one of the most sophisticated health economies – that of the U.S. – that is also regarded as both hugely expensive [at 17% of GDP and growing (Appleby, 2013)] whilst wasting a third of resources (Berwick, 2011).

Other difficulties arise when, as Gilson (2012, p. 13) argues is the case, the evidence available to support health systems strengthening has limitations in scope, nature, rigor, methods, and

generalizability from one country to the next, with the knowledge base for Lower and Middle Income Countries (LMICs) especially lacking. Indeed this gap inspired Gilson (2012) and colleagues to publish a methodological reader on health systems strengthening in LMICs.

Yet, if health systems are so important, why are there such apparently intractable gaps between evidence, policy, and practice in health systems strengthening? There are many possible explanations – perhaps it is simply a lack of analysis as Roberts *et al.*, (2002) suggest, or perhaps there is a lack of utilization of existing evidence for political, cultural or institutional reasons, or a relative lack of intelligibility of health system evidence limiting its uptake, or maybe there is a lack of resources to generate the evidence, or a lack of evaluation, or a lack of investment in research by decision makers, or perhaps there are weaknesses in the logic models of health systems. We cannot address all of these in this chapter, but we will focus on the increasing awareness of the importance of engagement, the emergence of health causation models in contrast to disease causation and logic challenges in health systems that make resource allocation decisions contentious.

Gilson suggests health policy systems research remains a marginal field in health research with few national researchers and a lack of training. But this too begs the question why is health policy systems research so marginalized? Gilson suggests one answer by citing Frenk from the First Global Symposium on Health Systems Research (World Health Organization, 2010) on the need to mobilize the power of ideas to influence those with the power to make decisions, a view elaborated by Frenk & Chen (2011). Thus, Gilson sees the cause of the gap as not simply a weak knowledge base but also a weak power base – the power to influence decision makers to resource and utilize health systems research.

Gilson's argument seems somewhat circular, but it is consistent with over a half-century of evidence that has sought to link evidence and decisions to local communities' needs and understandings. Nyswander's (1956) call from a health education perspective in Africa to "start where the people are", acknowledged by the U.S. Public Health Service (Derryberry, 1957), emphasizes the moral and practical necessity of deepening engagement in healthcare (and social and economic life more generally). Engagement consciousness developed in healthcare gradually leading eventually to such initiatives as NUKA in Alaska, (Gottlieb, 2013), which is a community-owned and led healthcare system that has, over thirty years, transformed Inuit healthcare and outcomes from amongst worst in the world to amongst the best (Berwick, 2011).

Meanwhile, there were convergent developments in the overlapping disciplinary fields of Operational Research, Management Science, and Systems Thinking like that of Churchman & Ackoff (1949) who developed an explicitly ethical perspective leading Churchman (1970) to argue that a "sweeping in" of perspectives was necessary, not simply to improve effectiveness, but also for ethical solutions to problems seen as systemic in nature. Many discrete methods emerged including Soft Systems Methodology (Checkland & Poulter, 2010; Wilson & Van Haperen, 2015), Strategic Choice Approach (Friend & Hickling, 2012), Structured Democratic Dialogue

(Laouris & Michaelides, 2018) amongst many other methodological contributions. Examples of substantial applications to healthcare problems can be found in the special issue of the European Journal of Operational Research edited by Johnson & Midgley (2018). In a particularly interesting contribution, Frerichs *et al.*, (2016) identify five synergies between community-based participatory research (CBPR) and systems science perspectives to address health disparities with paradigmatic (systemic logic coupled with community perspectives), socioecological (working at multiple system levels to overcome health disparities), capacity building (system models informing community work), co-learning (building on participatory knowledge generation and utilization) and translational (implementation to reduce health disparities). They argue that the failure to account for systemic aspects of health policy implementation can lead to policy resistance and further emphasize that CBPR works by building on strengths at multiple levels, from individuals to organizations.

Freirich *et al.*'s (2016) view is similar to that of Walsh *et al.*, (2016) who argue there is need for a systemic reconceptualizing of health and social care building on awareness that “social injustice was killing on a grand scale kill” (Commission on Social Determinants of Health, 2008, p. 26) [an assertion praised as “courageous” by Navarro (2009) whilst pointing out the report ignores politics]. There is increasing awareness of the limitations of the medical deficit model (a *pathogenic* model concerned with the causation, diagnosis, and treatment of disease) and increasing interest in health assets, resources or strengths of individuals and their communities (a *salutogenic* model that appears highly concerned with the causation of health and well-being, introduced by the sociologist Antonovsky, 1979, see Mittelmark *et al.*, 2016 for more information) and arguably exemplified by the NUKA system of healthcare mentioned earlier. There is strong evidence of peer influences on individual health behavior (Christakis & Fowler, 2008) of the benefits of individual and group involvement and participation in healthcare (Gomes *et al.*, 2009), the emergence of new healthcare information and communication technologies (Weiner *et al.*, 2013). There have been attempts to overcome coordination and cost problems by integrating the typically separate systems of health and social care (Naylor & Curry, 2015). Together, these developments suggest that healthcare is improved when communities themselves become more effective in processes that mobilize the resources and efforts of individuals, families, and groups in co-producing and distributing the benefits of healthcare, and this may help explain the success of NUKA in Alaska. Failure to achieve this is likely to increase costs and/or health disparities, as Frerichs *et al.*, (2016) suggest typifies current health systems. All of this suggests there is no lack of evidence to support health systems but there is a lack of utilization of health policy and systems evidence to deliver the future pandemic resilience measures identified by Diop *et al.* (2021).

However, there is another difficulty in that whilst the WHO Six Building Blocks consist of what are strongly asserted as *necessary* elements of healthcare, validated through often hard experience, there is no consensus as to the meaning of each of the individual building blocks or even of what they mean as a systemic whole for, as the WHO acknowledges (WHO, 2007, p. iii), health systems are “context specific”. It may be better therefore to see the Six Building

Blocks as an eclectic model to be somehow optimized in a local context. It is in this, however, that important challenges become clearer especially relating to values, quality, and equity in healthcare.

In the mid-20th century, Easton (1953) argued that “policy” is an allocation of values involving a claim to authority or legitimacy but, as Mooney (2003) pointed out, from a health economic viewpoint *whose values* are incorporated into healthcare decisions is contentious. Clearly, if each system element is open to value-laden interpretation this will make priority setting for the allocation of scarce resources politically challenging and contestable. In practice, it means some sub-populations and communities will appear favored over others and this may become a focus for dispute about fairness.

An especially conspicuous example can be seen in the first WHO Building Block that equates to quality in healthcare. The difficulty is that there is no world-wide consensus on quality: is it understood as the constructs listed by the highly influential (U.S.) Institute of Medicine (2001) (safe, effective, patient-centered, timely, efficient, equitable) or Maxwell (1992) (effectiveness, acceptability, efficiency, access, equity) or Donabedian (2003) (structure, process, outcome), or some other way like Zeitham et al. (1990) model of service quality, or even the “loss function” model of Taguchi *et al.*, (2005) amongst many others? Faced with the plethora of ideas, Maxwell (1992) argued that quality in healthcare is multi-dimensional but, although Maxwell still presumed there is an underlying conceptual unity with diverse but related constructs, the problem for Maxwell is how these constructs are interpreted in practice. Yet, this claim to an underlying unity also is questionable. Consider the problem of equity.

Both the Institute of Medicine (2001) and Maxwell (1992) make equity a key dimension – more precisely a measurable construct - of the concept of quality and equity is an explicit policy aim of WHO. Indeed, the Commission on Social Determinants of Health, (2008) conclusion that inequalities in health kill justifies making reducing inequality into vital international health goal [although note Navarro (2009) responds to the Commission report critically by asserting it is those who benefit from health inequalities that kill]. Yet, as Mooney (2003) points out, there is no consensus as to the meaning of equity. If healthcare is seen as a process of transforming inputs into outputs which directly or indirectly cause desired outcomes, a chain that is at the heart of logic models and health improvement programs in healthcare, for instance smoking cessation in South Africa (Agaku *et al.*, 2021) or increasing utilization of insecticide-treated mosquito nets in Ghana (Frishkopf *et al.*, 2016), or achieving equal outcome for women and children post pandemic (Diop *et al.*, 2021) then equalizing any one of inputs or process or outputs or outcomes for a population necessarily requires allowing the others to vary. For example, any attempt to produce equal outcomes for any population for any disease (such as reducing COVID-19 deaths or long-COVID to the same level for all) must mean unequal inputs are needed dependent on the health and socio-economic status of the individuals and groups in diverse communities, or as MacGregor *et al.* (2021) put it on COVID in Africa, one size does not fit all – there must be local, contextually sensitive, adaptation.

However, this means that if unequal inputs are needed to attain an equal outcome, there must be a choice of resource allocation based on what is valued by the decision maker (whether an individual, a group, an agency, or institution) who face what is sometimes called by those seeking to justify unpopular actions a “hard choice”. It is such hard choices that lead to the situation Diop *et al.*, (2021) is highlighting when pointing out women and children will be the longer-run victims of the COVID-19 pandemic. The fact that a “hard choice” means some are necessarily going to be favored over others in health resource allocation decisions also exposes a disturbing difference between a morally conscientious “hard” decision within the bounds and process of professional scrutiny and one that is “hard” within the bounds of political scrutiny. The management of the COVID-19 pandemic globally is redolent with politically induced differences of management in the face of what is, in fact, highly consistent science.

It appears, then, that the many possible meanings of equity surely undermine unitary notions of quality and imply that plurality arising from differing values and interpretations rather than Maxwell’s multi - dimensionality is a better description of quality. This seems to mean the first of the six WHO Building Blocks is necessarily pluralistic and must be understood contextually. Yet, the same kind of reasoning can also be applied to each of the Six Building Blocks in turn. For example, on the second Building Block, a health workforce that is “responsive, fair, and efficient in sufficient numbers” in many African LMIC countries such as Ghana looks quite different to that in Kuwait or Saudi Arabia, and these all differ sharply from those workforces of the U.S. or the U.K. What Mabunda *et al.*, (2020) find is that although human resources are the “cornerstone” of health systems in countries like South Africa, Eswatini, Botswana, Lesotho, and Namibia “their impacts do not always match the policy objectives” (p. 2) due to such factors as poor HRH planning, poor monitoring mechanisms, poor HRH skills mix, disjointed HRH information systems and over-reliance on neighboring countries and/or the referral of future health professionals abroad for studies. Mabunda cites the practice of Eswatini, Lesotho, Botswana, and Namibia of funding and sending health sciences students to study in South African medical schools with Botswana and Namibia only training their own medical students from 2009 and 2010, respectively. Meanwhile, Mabunda *et al.*, note, wryly it seems, that South Africa sends medical students to study medicine in Cuba. Indeed, it is almost a truism that local interpretation and adaptation are necessary – for what works in one country cannot simply be assumed to be easily or simply implemented in another. Thus MacGregor *et al.*, (2021) are correct, one size really does not, and never can, fit all.

There is a price for this plurality of meaning and practice in healthcare that it seems to make any analysis in healthcare potentially capricious in its selection of underpinning assumptions and inevitably political in any policy action – for whose values will underpin health economic decisions? This puts WHO in a difficult position. WHO have been criticized over their prior policy of promoting Primary Care for harming the development of healthcare internationally (Roberts *et al.*, 2002, p. 33), although note the expert panel review by Black *et al.*, (2017) flatly contradict this by advocating community- based primary health care. This simply illustrates

how WHO may, fairly or otherwise, face criticism for their current strongly normative attempts to promote the strengthening of health systems with the Six Building Blocks.

On the face of it, in arguing for objective analysis of healthcare in terms of changes “actually produced” Roberts *et al.*, (2002) seem to be overlooking, or denying, pluralism in healthcare. Roberts *et al.*’s Control Knobs approach presumes that values have been clarified beyond reasonable doubt and that both outputs and outcomes and changes in these have been unambiguously determined. This is far from clear even in sophisticated modern health systems like those of the U.K. or the U.S. But Roberts *et al.* also in fact discuss at length the plurality of viewpoints about healthcare. Indeed, they offer and illustrate three ethical perspectives (utilitarianism, liberalism, and communitarianism) that each comprise a different set of values in healthcare analysis – at the same time they overlook or ignore other ethics perspectives, including elitism, egalitarianism, and libertarianism. But, this undermines Robert *et al.*’s claim to universal improvement, for each ethical framing means different ways of choosing who benefits from an improvement and who bears a cost (which is more than financial costs including, for example, avoidable distress or death or loss of wellbeing) and how these are valued. Similar arguments about inconsistency can be made for the other health systems strengthening building blocks.

We are forced to conclude therefore that the practical response to the SARS COVID-19 Pandemic in Africa has been effective in preventing a “ravage” of African nations but that there are longer-run consequences arising from the disruption of health systems already seen as relatively weak, that there is no universal way of strengthening health systems, there is simply the need to continue practically adapting health systems in each nation, making use of the evidence in processes that involve communities as the main resource (and beneficiary) of resilience and response to future waves of COV, of future COVID epidemics and of general equitable improvement in healthcare. It is against this backdrop that we now turn to the case of Ghana and their COVID-19 policy response.

3. COVID-19 policy response in Ghana

Ghana’s policy response to COVID-19 was centered around five main objectives (Ofori-Atta, 2020):

- Curb the importation of cases,
- Identify and contain cases,
- Care for those affected,
- Mitigate the effects of COVID-19 on the economic and social life of citizens, and
- Enhance local production to ensure the country’s dependence on domestic products.

The COVID -19 policy directives were delivered in a series of broadcasts by the President of the Republic, Nana Akuffo Addo. It would be recalled that the first policy statement on COVID -19 delivered by the President occurred in March 2020 alongside his famous and globally acclaimed

quote ‘We know how to bring the economy back to life. What we do not know is how to bring people back to life’ (The Presidency, Republic of Ghana, 2020). The President also revealed a \$100 million COVID-19 package to strengthen existing public health infrastructure, equipment, and to improve health education (The Presidency, Republic of Ghana, 2020). In other policy announcements, the president pledged government’s total support for frontline health workers with procurement and supply of personal protective equipment (PPE’s), allowances, medical insurance, and tax exemptions on basic salaries for all health workers (Presidency, Republic of Ghana, 2020).

The implementation of COVID-19 policy directives was backed by science and data with contact tracing as the public health tool to identify and isolate suspected cases. The government immediately identified and certified several public and private facilities to conduct COVID-19 PCR testing (Presidency, Republic of Ghana, 2020). The PCR testing was however constrained with a number of challenges including inadequate testing materials, shortages of test kits, and people traveling long distances to testing centers to be tested (Ghana Health Service, 2021). Social distancing protocols which appeared to be a new way of staying with one another in public places emerged and people struggled to adapt to this new social phenomenon. Personal hygiene etiquettes were to be rigidly enforced and this led to the popularity and use of the ‘Veronica Bucket’ for hand-washing placed in frontage of shops, offices, households etc.

Gaps within the Six Building Blocks of the health systems emerged, however, during the implementation of the COVID-19 policies and were especially visible within the health workforce. These health workforce gaps emerged in many areas; there were systemic gaps in the numbers and skills of health workers, the attitude and behaviors of health workers to respond to emergencies, the equipment and technology health workers have to work with, and the organizational cultures where some health workforce gaps identified. Five main areas of the workforce building block are explored in this gap analysis and recommendations for effective responses provided (see Figure 1); analytical, wellbeing, engagement, technology, costing).

The existence of this engagement gap is revealed by many sources. Studies conducted by the World Bank (Appiah-Denkyira, Herbst, Soucat, Lemiere, and Saleh, 2012, p. 14) indicate that decision making in the public health sector in Ghana is mainly centralized and that lower-level health workers are not often involved in major decisions about their career. Similarly, the World Health Organization, (WHO, 2008) found that females have very low representation in senior management positions, which highlights their marginalization in the health policy process. In attempts to improve engagement, health services and functions in Ghana have been decentralized. For example, Budget Management Centers (BMCs) have been created to promote financial decentralization to and within districts and to improve access to health services. Management Committees have been established in almost all peripheral health facilities.

Figure 1 - The WETCAN workforce gap analysis model for a robust, resilient, and responsive workforce building block

Analytical Gap	Technological Gap	Costing Gap	Well-being Gap	Engagement Gap
Analysis of Health Workforce data for informed decision remains a critical concern	Health workers face challenges with application of emerging technology in healthcare delivery	Increasing fiscal space for HRH by government has implication on other areas of service delivery	Health workers remain committed to the health of individuals and society but who cares for the caregiver?	Limited HRH engagements in policy process and client involvement in care delivery remain unresolved
Prioritize HRH analytics, research and use of data for HRH Planning and Management	Enhance Health Professional Education Curricular in Areas of Digitalization	Strengthen NHIA to Support Payment of Salaries and the Private Sector to provide decent jobs in the health sector	Establishment of Well-being and Wellness Centres for Health Workers	Continuous Engagement of HRH, Clients and Stakeholders in Health Policy development

The Ghana Health Service (GHS), an agency of the Ministry of Health, runs a system of health services based on a strategy called Community-Based Health Planning and Services (CHPS). At the apex is a Common Management Arrangement (CMA) which perhaps was designed to promote effective relationships, collaboration, and coordination in the sector but how effective this has been remains unclear. Key engagement entities captured in the CMA include Health Sector Working Group (HSWG), Inter-Agency Leadership Committee (IALC), and Inter-Agency Coordinating Committees (ICCs). These arrangements though present a central framework for coordination and yet fail to provide a link between the central level and the lower decentralized decision-making bodies. The corollary is that there is a preexisting engagement gap that has perhaps been amplified by the centralized emergency action taken to manage COVID-19 and this gap may have been augmenting the other gaps in Figure 1. This may delay the longer-run health system recovery from the Pandemic and make harder the process of overall strengthening of the Ghana health system.

Diop *et al.*, (2021) suggest that disruption to health systems may especially adversely affect women and children and Gabrysch *et al.*, (2019) note that perinatal and neonatal mortality remain unacceptably high in many countries. In Ghana, Gabrysch *et al.*, (2019) found from a secondary analysis of surveillance data from 119,244 pregnancies from large cluster-randomized controlled trials that the introduction of free childbirth care in April 2005 and free pregnancy health insurance on July 2008 (the so-called Free Maternal Healthcare Policy) led to reduced

perinatal mortality in Ghana. Meanwhile Sackey & Tagoe, (2019) found that Neonatal Intensive Care Mortality in Accra from 2011 to 2015 was 19.2%, compared to the worldwide range of 3.1% to 29%, with the range of outcomes due to differences in the severity of illness and the organization of resources for obstetric and neonatal care. To reduce this high neonatal mortality rate, they argue that complex interventions are necessary to improve outcomes, not just an increase in the allocation of particular resources. This particular finding in Ghana supports the general view of Diop *et al.*, (2021) that disruption of the health system by COVID-19, accentuated by the engagement gap, increases longer-run risks to women and children. However, it may take some time before the data is available to demonstrate such impacts as found, for instance, in perinatal and neonatal mortality trends.

4. Conclusion

In this chapter we have shown that the COVID-19 Pandemic was expected to ravage African countries but that the learning from previous epidemics helped mitigate it. In Ghana, this meant the COVID-19 response was led Presidentially as actions and resources were made available to the health system with successful mitigation. However, disruption of health systems by COVID-19 in Africa remains severe and has consequences, especially for women and children. In Ghana, the longer-run consequences of the pandemic disruption of the health system are not yet clear but are expected to be revealed in coming years in higher perinatal and child mortality and morbidity – both of which were existing areas of concern for Ghana health policy prior to the pandemic. Key to strengthening health systems, which in the absence of any universal ethical framing, must be seen in contextual terms, is local adaptation, which requires increased community involvement as both the source and beneficiary of resilience to future COVID-19 waves, future epidemics, and long-run healthcare improvement. In Ghana, this is exemplified by attempts to decentralize the health system and increase the engagement of local communities. However, COVID-19 revealed pre-existing engagement gaps in the Human Resources Building Block. This may delay the longer-run health system recovery from the Pandemic and make harder the process of overall strengthening of the Ghana health system. This may especially adversely affect women and children, becoming visible for example in perinatal and neonatal mortality figures in future years.

References

- Agaku I, Egbe C, and Ayo-Yusuf O (2021). “Utilization of smoking cessation aids among South African adult smokers: Findings from a national survey of 18,208 South African adults”. *Family Medicine and Community Health* 9(1):e000637. <https://doi.org/10.1136/fmch-2020-000637>
- Antonovsky A (1979). “Health, stress, and coping”. In *The Jossey-Bass social and behavioral science series* (Vol. 1st, Issue Book, Whole). [https://doi.org/10.1016/0277-9536\(82\)90411-7](https://doi.org/10.1016/0277-9536(82)90411-7)

- Appiah-Denkyira E, Herbst CH, Soucat A, Lemiere C, and Saleh K Eds.). (2012). Towards Interventions in HR for Health in Ghana”. World Bank.
- Appleby J (2013). “Spending on health and social care over the next 50 years Why think long term?” *Kings Fund*.
- Berwick DM (2011). “The moral test keynote presentation at IHI ’s 23rd Annual National Forum on Quality Improvement in Health Care” (pp. 1–25). *Institute for Health Improvement*.
- Black RE, Taylor CE, Arole S, Bang A, Bhutta ZA, Mushtaque A, Chowdhury R, Kirkwood BR, Checkland P, and Poulter J (2010). “Soft systems methodology”. In *Systems Approaches to Managing Change: A Practical Guide* (pp. 191–242). https://doi.org/10.1007/978-1-84882-809-4_5.
- Christakis N and Fowler J (2008). “The collective dynamics of smoking in a large social network”. *New England Journal of Medicine* **358**:2249–58.
- Churchman CW (1970). “Operations research as a profession”. *Management Science* **17**(2), B-37-B-53. <https://doi.org/10.1287/mnsc.17.2.B37>.
- Churchman C and Ackoff R.(1949). “The democratization of philosophy”. *Science & Society* **13**(4): 327–39.
- Coltart C, Lindsey B, Ghinai I, Johnson A, and Heymann D (2017). “The Ebola outbreak, 2013-2016: Old lessons for new epidemics”. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, **372**(1721). <https://doi.org/10.1098/RSTB.2016.0297>.
- Commission on Social Determinants of Health (2008). “Closing the gap in a generation, Final Report”. World Health Organization.
- Diop N, Kamal M, Renaud M, and Naffa S (2021). “COVID-19 and beyond: How lessons and evidence from implementation research can benefit health systems’ response and preparedness for COVID-19 and future epidemics”. *Family Medicine and Community Health* **9**(4), e001150. <https://doi.org/10.1136/fmch-2021-001150>.
- Donabedian A (2003). “An Introduction to Quality Assurance in Health Care”. Oxford University Press.
- Easton M (1953). “The Political System. An Inquiry into the State of Political Science”. Knopf.
- Frenk J and Chen L (2011). “Overcoming gaps to advance global health equity: A symposium on new directions for research”. *Health Research Policy and Systems* **9**(11). <https://doi.org/10.1186/1478-4505-9-11>.
- Frerichs L, Lich KH, Dave G, and Corbie-Smith G (2016). “Integrating systems science and community-based participatory research to achieve health equity”. *American Journal of Public Health* **106**(2):215–22. <https://doi.org/10.2105/AJPH.2015.302944>.
- Friend J and Hickling A (2011). “Planning Under Pressure: The Strategic Choice Approach” (3rd ed.). Routledge. <https://doi.org/10.4324/9780080480053>
- Frishkopf M, Hamze H, Alhassan M, Zukpeni IA, Abu S, and Zakus D (2016). “Performing arts as a social technology for community health promotion in northern Ghana”. *Family Medicine and Community Health* **4**(1), 22 LP – 36. <https://doi.org/10.15212/FMCH.2016.0105>.
- Gabrysch S, Nesbitt RC, Schoeps A, Hurt L, Soremekun S, Edmond K, Manu A, Lohela TJ, Danso S,

- Ghana Health Service (2021). “Ghana’s outbreak response management updates: Ghana Health Service. <https://ghanahealthservice.org/covid19/archive.php>.”
- Gilson L (2012). “Health Policy and Systems Research: A Methodology Reader” (L. Glison (Ed.)). World Health Organization.
- Gomes B, Harding R, Foley KM, and Higginson IJ (2009). “Optimal approaches to the health economics of palliative care: Report of an international think tank”. *Journal of Pain and Symptom Management* **38**(1): 4–10. <https://doi.org/10.1016/j.jpainsymman.2009.04.008>.
- Gottlieb K (2013). “The Nuka system of care: Improving health through ownership and relationships”. *International Journal of Circumpolar Health* **72**. <https://doi.org/10.3402/ijch.v72i0.21118>.
- (U.S.) Institute of Medicine. (2001). “Crossing the Quality Chasm: A New Health System for the 21st Century”. National Academy Press.
- Johnson M and Midgley G (2018). “Community operational research: Innovations, internationalization, and agenda-setting applications”. *European Journal of Operational Research (Special Issue)*, **268**(3):761–1192. [https://doi.org/10.1016/S0377-2217\(18\)30234-0](https://doi.org/10.1016/S0377-2217(18)30234-0).
- Koon AD, Conrad A, Naimoli JF, Saxena S, Connor C, and Rodriguez DC (2019). “Implementing health system strengthening projects at USAID: Findings from five cases using an integrated framework”. *Global Public Health* **14**(12):1829–46. <https://doi.org/10.1080/17441692.2019.1622758>.
- Kuresh N, Lanata CF, Phillips JF, Taylor M, Victora CG, Zhu Z, and Perry HB (2017). “Comprehensive review of the evidence regarding the effectiveness of community-based primary health care in improving maternal, neonatal and child health: 8. Summary and recommendations of the Expert Panel”. *Journal of Global Health*, **7**(1), 010908. <https://doi.org/doi:10.7189/jogh.07.010908>.
- Laouris Y and Michaelides M (2018). “Structured democratic dialogue: An application of a mathematical problem structuring method to facilitate reforms with local authorities in Cyprus”. *European Journal of Operational Research* **268**(3):918–31. <https://doi.org/10.1016/j.ejor.2017.04.039>.
- Mabunda SA, Angell B, Yakubu K, Durbach A, and Joshi R (2020). “Reformulation and strengthening of return-of-service (ROS) schemes could change the narrative on global health workforce distribution and shortages in sub-Saharan Africa”. *Family Medicine and Community Health* **8**(4): e000498. <https://doi.org/10.1136/fmch-2020-000498>.
- MacGregor H, Leach M, Tshangela A, Hrynicky TA, Lees S, Niederberger E, Parker M, Ripoll Lorenzo S, Rohan H, Schmidt-Sane M, Tulloch O, and Wilkinson A (2021). “One size does not fit all: Adapt and localize for effective, proportionate, and equitable responses to COVID-19 in Africa”. *Family Medicine and Community Health* **9**(2):e000709. <https://doi.org/10.1136/fmch-2020-000709>.
- Maxwell RJ (1992). “Dimensions of quality revisited: From thought to action”. *Quality in Health Care QHC* **1**(3):171–7. <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1055007&tool=pmcentrez&rendertype=abstract>
- Mittelmark MB, Sagy S, Eriksson M, Bauer GF, Pelikan JM, Lindström B, and Espnes GA (2016). “The Handbook of Salutogenesis”. <https://doi.org/10.1007/978-3-319-04600-6>.

- Mooney G (2003). “Economics, Medicine, and Health Care”. Financial Times Prentice Hall.
- Navarro V (2009). “What we mean by social determinants of health”. *International Journal of Health Services* **39**(3):423–41. <https://doi.org/10.2190/HS.39.3.a>.
- Naylor C and Curry N (2015). “Transforming our health care system: Ten priorities for commissioners”.
- Ofori-Atta K (2020). “Statement to Parliament on Economic Impact of the COVID-19 Pandemic on the Economy of Ghana”. Accra: Ministry of Finance.
- Roberts MJ (2002). “Getting Health Reform Right” (Issue October). Oxford University Press.
- Royal Society (2017). “Theme issue: The 2013–2016 West African Ebola epidemic: Data, decision-making and disease control”, *Philosophical Transactions (Biological Sciences)* **372**.
- Sackey AH and Tagoe LG (2019). “Admissions and mortality over a 5-year period in a limited-resource neonatal unit in Ghana”. *Ghana Medical Journal* **53**(2):117–25. <https://doi.org/10.4314/gmj.v53i2.6>.
- Taguchi G, Chowdhury S, and Wu Y (2005). “Hitachi’s *Quality Engineering Handbook. Part III: Quality Loss Function*”. John Wiley & Sons.
- The Presidency (Republic of Ghana). Speeches, 2020. Available: <https://presidency.gov.gh/index.php/brie-ng-room/speeches> [Accessed 20th September 2021].
- Tomlin K, Kirkwood B, and Campbell OMR. (2019). “Does facility birth reduce maternal and perinatal mortality in Brong Ahafo, Ghana? A secondary analysis using data on 119,244 pregnancies from two cluster-randomized controlled trials”. *The Lancet. Global Health* **7**(8):e1074–e1087. [https://doi.org/10.1016/S2214-109X\(19\)30165-2](https://doi.org/10.1016/S2214-109X(19)30165-2).
- (U.S.) Government. (2012). “GHI principle paper: Health systems strengthening, draft 6, Global Health Initiative”. www.ghi.gov/principles/docs/principlePaperHSS.pdf accessed 04/09/13.
- Walsh M, Kittler MG, and Mahal D (2016). “Towards a new paradigm of healthcare: Addressing challenges to professional identities through community operational research”. *European Journal of Operational Research*. <https://doi.org/10.1016/j.ejor.2017.05.052>.
- Weiner JP, Yeh S, and Blumenthal D (2013). “The impact of health information technology and e-health on the future demand for physician services”. *Health Affairs (Project Hope)* **32**(11): 1998–2004. <https://doi.org/10.1377/hlthaff.2013.0680>.
- Wilson B and Van Haperen K (2015). “Soft Systems Thinking, Methodology, and the Management of Change”. Palgrave Macmillan.
- World Health Organization (2007). “Everybody’s Business Strengthening Health Systems to Improve Health Outcomes: WHO’s framework for action”. World Health Organization.
- World Health Organization (2008). “Managers in the Health Workforce; A Summary of Three Case Studies from Africa”. Department of Human Resources for Health.
- World Health Organization (2010). “First Global Symposium on Health Systems Research” (Issue November). www.hsr-symposium.org.
- Zeitham V, Parasuraman A, and Berry L (1990). “Delivering Quality Service; Balancing Customer Perceptions and Expectations”. Collier-McMillan.

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Chapter Eleven

Vaccines manufacturing in Africa - A revolution in the making?

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Abstract – Despite imports, about one-third of the world’s population, including that of Africa, is still without access to medicines. International funding envisions the provision of good quality medicines to everyone and the availability of priority medicines to those in need. However, it requires manufacturers to satisfy the World Health Organization’s qualification standards. Plunged in the midst of yet another pandemic (COVID-19), Africa is still tragically in the situation of having to import 99% of its vaccines from international procurement mechanisms. The African industry is mostly made up of small, privately owned companies that serve their local/national markets. However, the production is weak and limited to only a few drugs. There are only around 10 vaccine manufacturers. I discuss here the governing factors responsible for this situation in all its dimensions (external, internal, policy, international, continental, regional, and national). A ray of hope has been provided by the “2021 Vaccines Summit” held by Africa leaders. Together with the African Centers for Disease Control and Prevention, they charted a path to modernize and develop their regulatory bodies for medicines through the creation of an African Medicines Agency that will jump-start vaccine manufacturing. However, if Africa is to become self-sufficient in manufacturing its needed vaccines, then, a different approach must be hammered out with its international partners with the objective to empower the continent’s own researchers and businesses. When it comes to public health, COVID-19 has shown that vaccines are an international need. Countries that lack vaccines could cause resurgence of the pandemic through successive waves, including several variants of the original coronavirus. Intellectual property rights could be a major roadblock in Africa’s road to vaccines’ self-sufficiency. Their temporary waiver may not be a viable solution as COVID-19 vaccines can indeed be incredibly difficult to make. In the present situation, unfreezing by countries of their overcapacity or overstocks could have a more immediate and beneficial result. Here, scientists and researchers, and not only manufacturing companies and governments, have the knowledge to influence the debate and also have an important say in this matter. Vaccine technology should not be

the source of profiteering, especially to the detriment of poor countries who could ill afford it. This could also have a boomerang effect in that unvaccinated countries in times of pandemics could be the source of further infections, additional pandemic waves, and numerous variants as already seen. Vaccine technology should perhaps be considered a future public good.

Keywords: *Africa; COVID-19 pandemic; Vaccines Summit; vaccine technology and manufacturing; qualification standards.*

Abbreviations

ACDC:	African Centers for Disease Control & Prevention
AfDB:	African Development Bank
AMA:	African Medicines Agency
API:	Active Pharmaceutical Ingredients
APS:	Africa Pharmaceutical Summit
AU:	African Union
AUC:	African Union Commission
CDC:	(U.S.) Centers for Disease Control & Prevention
CoV:	Coronavirus
COVID-19:	Coronavirus Disease 2019
D&V:	Drugs & Vaccines
EMA:	European Medicines Agency
EU:	European Union
FAPMA:	Federation of African Pharmaceutical Manufacturers Associations
FEAPMA:	Federation of East African Pharmaceutical Manufacturers Associations
FDA:	(U.S.) Food & Drug Administration
GATT:	General Agreement on Tariffs and Trade
GTZ (GIZ):	German Development Agency
HIV/AIDS:	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IAPMA:	International Federation of Pharmaceutical Manufacturers Associations
IP:	Intellectual Property
IPA:	Indian Pharmaceutical Association
LDC:	Least-Developed Countries
LDCA:	Least-Developed Countries Association
mRNA:	messenger-RNA
NGO:	Non-Governmental Organization
PMPA:	Pharmaceutical Manufacturing Plan for Africa
pre-Q:	(WHO) Pre-Qualification Standards.
QC:	Quality Chemicals
QC&A:	Quality Control & Assurance
R&D:	Research & Development
SAGMA:	Southern African Generic Medicines Association

SARS:	Severe Acute Respiratory Syndrome
SKAC:	South Korea-Africa Association
TRIP:	Trade-Related aspects of Intellectual Property Rights
UN:	United Nations
UNAIDS:	(Joint) United Nations program on AIDS/HIV
UNICEF:	U.N. Children's Emergency Fund
WAPMA:	West African Pharmaceutical Manufacturers
WHO:	World Health Organization
WTO:	World Trade Organization

1. Background

In earlier publications (Fymat, 2017), I noted a then current substantial rise in health donor funding for developing countries, including African countries. Thus, in July 2015, at the United Nations (UN), some \$ 3.4 billion were pledged by donor nations to help West African nations (Guinea, Liberia, and Sierra Leone) stamp out Ebola. Other funding was likewise pledged for HIV/AIDS, malaria, tuberculosis, and products required for reproductive health. These donations had triggered a flurry of global activity to increase local manufacturing of drugs and vaccines (D&V) in those countries. They also stimulated a greater demand for D&V, generating a greater potential for local manufacturers. Further, local production of D&V grew in popularity because, despite imports, about one-third of the world's population was still without access to medicines. However, two prerequisites were imposed: (a) manufacturers would have to satisfy the World Health Organization (WHO)'s pre-Qualification ('pre-Q') program and (b) international standards such as the WHO's 'Qualification Standards (Q-Standards) must be adopted and complied with.

The WHO's pre-Q Program envisioned the provision of good quality medicines to everyone and the availability of priority medicines to those in need. This was to be achieved through a multi-tiered process: (a) cooperation with national regulatory agencies, (b) national capability-building for sustainable manufacturing, and (c) inspection, monitoring, and evaluation of the quality of the medicines produced.

Today, plunged in the midst of yet another pandemic (COVID-19), Africa, with its ~ 1.37 billion people (1,367,407,642 as of 5 May 2021) is still tragically in the situation of having to import 99% of its vaccines. These come mostly from international procurement mechanisms such as the one organized through the United Nations Children's Emergency Fund (UNICEF). As of 23 May 2021, there have been 4,750,151 confirmed cases and 127,857 deaths and increasing by the moment. So far, just about over 20 million vaccine doses have been administered across the African continent corresponding to less than about 1.5 % of the population having received a single dose. What has happened since then? What progress, if any, has been made in the meantime? (*Note: Pfizer has announced in the last few days that it will supply 1 billion doses to the Third World, which should largely remedy this dreadful situation.*)

2. Introduction

The era of vaccines had a slow beginning in the mid-18th and 19th centuries and has since been concentrated in Europe, the United States, and India. It underwent several generations beginning with the smallpox virus (“variolation” or smallpox vaccination) and the cowpox vaccination, followed in 1880 by Louis Pasteur’s vaccines for chicken cholera and anthrax, The 20th century saw the introduction of several successful vaccines against diphtheria, measles, mumps, rubella, and polio. However, vaccines remained elusive for many important diseases, including malaria, Ebola, HIV, herpes simplex, and Zika. According to the WHO, licensed vaccines are currently available to prevent or contribute to the prevention and control of twenty-five infections. This should now be augmented by the new messenger-RNA (mRNA) and other vaccines against the SARS CoV2 virus and other coronaviruses.

Because of the current pandemic and its ravages in low- and middle-income societies, including African societies, it appears that homegrown manufacturing has surged again as a top priority for Africa’s policy makers. A witness to this renewed dedication was the two-day virtual Vaccine Summit held 12-13 April 2021 that was designed to share the latest developments in vaccine production and how to bring it to Africa. The Summit was attended by ~ 40,000 individuals (heads of state, civil society groups, business leaders, and researchers). Will this new effort be successful? For a tentative answer, I believe it should be viewed against the context of current and potential capabilities of the African pharmaceutical industry, including the roadblocks it faces from various perspectives: regional, national, provincial, and even local.

In this Chapter, I will review the state of the African pharmaceutical industry, the regulatory authorities, and the quality of the medicines produced.

3. Tribulations of Africa’s pharmaceutical industry

I provided earlier an assessment of the status of Africa’s pharmaceutical industry (Fymat, 2017). In global terms, this industry is relatively small, being worth approximately \$23.1 billion in 2011, or about 2% of the global market. However, as a percentage, it is the fastest growing industry in the world. It is driven by public and private manufacturers in a small number of countries: Ghana, Nigeria, South Africa, and a few North and East African countries.

There are a few large manufacturers such as *Aspen* in South Africa, which ranks in the top ten largest generics manufacturers in the world. Otherwise, the industry is mostly made up of small, privately owned companies that serve their local/national markets. However, the production is weak and limited to only a few drugs. Thus, these manufacturers produce less than 25%-30% of pharmaceuticals and less than 10% of medical supplies. Regarding vaccines, there are only around 10 manufacturers. I will summarize below the governing factors responsible for this situation.

3.1 Motivating factors

Several factors continue to favor the local manufacturing of pharmaceutical drugs and vaccines. Chief among these are that:

1. African nations want to improve their populations' access to essential medicines.
2. About half of Africans are still without medicines.
3. Many countries fear supply insecurity since their citizens' health depends on supplies from abroad.
4. Many countries want the benefits that accrue from local industries.
5. Local production is gaining in popularity and must be ramped up with other strategies to fill the gaps.
6. The least developed countries (LDCs), i.e. the world's poorest nations, are exempt from patent rules, which theoretically enables them to produce, if they can, more affordable copies of drugs and vaccines that would be subject to patent rules elsewhere (including in India).
7. The African Union (AU) was then devising a fully-costed business plan for the production of HIV/AIDS, tuberculosis, and malaria drugs on the African continent.
8. The WHO, several UN agencies, the EU and NGOs (Non-Governmental Organizations) were looking into local production strategies.
9. UNAIDS had called for local production of antiretrovirals to be ramped up.
10. The German Development Agency (GTZ/GIZ) dispatched inspectors for plant assessments to help identify the improvements necessary to reach international (pre-Q and Q-)standards).
11. Some African manufacturers (e.g., in Congo and Ethiopia) are in the process of receiving approval for the WHO's pre-Q standard, a world class seal of quality for manufacturing standards (Ref: WHO Committee for Medicine, Quality Assurance, and Safety).
12. Outside South Africa, *Quality Chemicals* (QC) in Kampala, Uganda, reached the WHO's pre-Q standard but still needs to attain the full Q-standard. However, allegedly, this success may have been owed to the Indian manufacturer *CIPLA*, which, reportedly, had set up in Kampala a carbon copy of its plant in Goa. It sent in its experts to train Ugandans and even applied for the qualification on behalf of QC. QC wants the

qualification for HIV and malaria drugs so it can sell its production to international agencies (such as UNICEF). In addition:

13. The Democratic Republic of Congo, Ethiopia, and Nigeria are being helped by international consultants to reach international standards.

3.2 Unfavorable factors

Notwithstanding the numerous factors favoring the local production of medicines, there are unfortunately equally long lists of unfavorable external and policy factors (international, continental, regional, and national) as discussed below.

3.2.1 External factors

The unfavorable outside-of-Africa factors that continue to exist are:

1. In many parts of the developing world, not just in Africa, producing medicines locally makes little economic sense and could even reduce access to medicines.
2. Few developing world manufacturers could compete with India and China (Laing, Kaplan, and Suerie, 2005).
3. Attaining the WHO pre-Q standard is still a long and costly process.
4. Competition from pharmaceutical powerhouses (including in India and China), which have:
 - Countries with enormous populations that have helped support local industries.
5. Plentiful supplies of skilled professionals, and
6. Decades of government support.
7. Skepticism over domestic or local manufacturing, particularly in LDC countries, notwithstanding the success of *Quality Chemicals* (in Kampala). Further:
 - Countries with enormous populations that have helped support local industries.
8. Allegations that Indian and Chinese manufacturers sell at artificially low prices because of their governments' support and subsidies, which damage the African industry.

In addition, the 2017 global economic slowdown also negatively impacted the situation from which African and other countries may not have yet fully recovered. Thus,

- China's dramatic rise has made it Asia's financial center, but its factories, consumers, and investors have also brought new wealth to neighboring countries, and also to Africa. However, as cracks spread through the foundations of Chinese growth (including currency devaluation, stock market crash, poor industrial and export numbers, etc.), many of those neighbors felt the tremors. These factors are compounded by the current rivalry between China and the U.S.
- Faced with weakening prices for oil and other commodities, along with a slowdown in Chinese demand for their resources, African states are slashing their growth projections and trying to stem the erosion of their currencies. Further:
- Chinese imports of African commodities have dropped steadily since 2016, oil prices have collapsed, and mining was in trouble.

The effects on some African countries have become progressively more devastating. Thus:

- Nigeria, one of the two biggest African economies, which depends heavily on oil revenue, a shrinking sector, has seen its slowest economic growth in a decade: down to 2.35% in the second quarter of 2015. This "growth" is half of its average 6% annual growth rate over the last decade.
- South Africa, the other second largest African economy, has seen a 1.3% decline in its economy during the second quarter of 2015. There has been a broad slump in several major sectors including the manufacturing and mining sectors. The manufacturing slump was due to chronic electricity shortages, poor labor relations, and high operating costs that have plagued its economy. More than half of South African mines are losing money. Its currency, the Rand, has fallen to an all-time low (1 US\$ = 14 R), a 12% loss in 2015. Also:
- Botswana, the Democratic Republic of Congo, Sierra Leone, Zambia, Zimbabwe, and other African countries have revised downward their economic forecasts. Thus, Botswana's diamond exports were down from 4.9% to 2.6%. Zambia's copper industry was down from 7% to 5% accompanied by a 25% currency loss. Zimbabwe's overall forecast was down from 3.2% to 1.5%.

Added to this long list of unfavorable external factors are the internal factors discussed next.

3.2.2 Internal Factors

Some factors have changed dramatically since 2005 (Seiter, 2005). These are:

- Cost disadvantages of manufacturing in Africa in general: energy cost, importation of raw materials, production of small volumes.
- Local manufacturers are neither able nor willing to invest for improvements to compete for international/donor funds.
- Drug manufacturers in Africa face numerous problems and constraints that can preclude the manufacture of medicines and/or push up their price:
 1. A weak financial base;
 2. High production cost;
 3. High cost of imported pharmaceutical ingredients and machinery;
 4. Need for imported machinery, packaging, and Active Pharmaceutical Ingredients (API);
 5. Infrastructural problems;
 6. Unreliable water and electricity supplies;
 7. Little, if any, production of starting materials: and
 8. Weak distribution systems.
- Manufacturers need to rely on expertise from Europe, Asia, and America when they require bio-equivalence studies or specific laboratory testing.
- Scarcity of technical specialists.
- Drug quality inferior to international standards.
- Weak to inexistent regulatory apparatus to combat substandard and counterfeit medicines. (This should hopefully be remedied if the 2021 Vaccine Summit mentioned earlier is followed by implementation steps.)
- Poor quality control & assurance (QC&A).
- Poor post-marketing monitoring of pharmaceuticals.
- Insufficient capacity to ensure full regulatory functions in line with international standards, including speedy registration of medicines. Further:
- Important laboratory studies delay the acquisition of the WHO's pre-Q standards for a lone African firm.

3.3 Policy Factors

Policy factors are international, continental, regional, and national in nature.

3.3.1 International

The WHO is shifting toward a more pragmatic approach to local production. Its agencies want to establish specific instances for local production and those for importation (Ref: WHO Directorate of Public Health, Innovation, and Intellectual Property.)

The Agreement on Trade-Related aspects of Intellectual Property Rights (TRIPs), a part of the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), became effective on January 1, 1995. It mandated member countries of the World Trade Organization (WTO) to establish “minimum standards of intellectual property protection for foreign and domestic products and processes, including the implementation of pharmaceutical patent laws” (Bass, 2015; Hoffman, 1999; Vick; 1999). Prior to that time, pharmaceutical manufacturers in WTO member countries were not subjected to the expensive prices charged by the multinational companies. They were, thus, able to manufacture comparable generic products at a fraction of the market price. As a result, the generic drug industry flourished and made available these drugs at affordable prices. Unfortunately, this is no longer the case, except perhaps for the least developed (or poorest) countries.

Further, regulators want to spot bad drugs and bad manufacturers (whether local or foreign), and prevent stock-out and the hefty price mark-ups levied by the supply chains.

More research is needed into D&V for diseases that disproportionately hurt the poor. Nonetheless, there remain lots of doubts in the global community as to whether firms from LDCs and other countries are capable of achieving WHO’s pre-Q and Q-standards.

3.3.2 Continental

The momentum for developing the pharmaceutical industry in Africa stems from the efforts of several organizations, principally:

- ***The Pharmaceutical Manufacturing Plan for Africa (PMPA)***: This is a business plan (and a WHO resource) addressing the pharmaceutical industry. Its mission is to “... *strengthen the ability to produce high-quality, affordable pharmaceuticals across all essential medicines and contribute to improved health outcomes and the realization of direct and indirect economic benefits*”. It was endorsed by the Heads of State and Governments of the 54 member states (in Accra, 2007). It aims to improve access to affordable, safe, and efficacious essential medicines, independent of donations. It also stressed the potential for local production and knowledge transfer. Developing the pharmaceutical industry would contribute to removing financial barriers to medicines

and improving access to essential medicines. Nonetheless, the conditions for the private sector to bloom have not yet been met.

- ***The African Development Bank (AfDB)***: The bank has asserted that now is the time to develop the pharmaceutical sector in Africa. It planned to support regional member countries through regional operations to vitalize the pharmaceutical sector to support sustained access to affordable quality medicines, job creation, and economic development in sub-Saharan countries. It has planned to develop a public/private dialog platform to discuss challenges and opportunities.
- ***The Africa Pharmaceutical Summit (APS)***: held in Tunisia in September 2013 was the first attempt to attract the public/private sectors. High-level policy makers were in attendance (including Ministers of Finance, Health, Industry and Trade) to lend credibility to this effort.
- ***The Federation of African Pharmaceutical Manufacturers Associations (FAPMA)***: This is a federation of three main regional associations of African pharmaceutical manufacturers: the West African Pharmaceutical Manufacturers Association (WAPMA), the Federation of East African Pharmaceutical Manufacturers Association (FEAPMA), and the Southern African Generic Medicines Association (SAGMA). Its vision is the development of “... a vibrant and self-sufficient pharmaceutical industry in Africa that contributes both to the reduction of disease burden and drives economic development of the continent”. Its immediate purpose is to develop and strengthen local pharmaceutical production in Africa. In particular, FEAPMA includes Burundi (1 manufacturer), Ethiopia (14), Kenya (22), Rwanda (1), Tanzania (4), and Uganda (6) for a total of 48 East African manufacturers. Its vision is to develop East Africa as the principal manufacturing source of world-class medicines for Africa. Its mission is to provide world-class facilities and training for technical personnel, championing an enabling environment, incentivizing domestic pharmaceutical production, promoting local research and development, as well as facilitating information exchange and transparency.

Other efforts are learning events such as visits to India, the South Korea-Africa Collaboration (SKAC) in innovation and technology, exchanges with foreign countries (for example, Brazil), and development of product knowledge of the pharmaceutical sector in Africa.

3.3.3 Regional

The AU wants to promote regional rather than national production. Thus, several neighboring countries might support one manufacturing plant located in one of them (Ref: African Union Commission (AUC) in Addis Ababa).

Alternatively, several countries might choose to club together to buy drugs from abroad at a cheaper price, or use the flexibility in world trade rules to access more imports. It may make more sense to produce locally some (not all) products. Indeed, not every drug is prohibitively expensive, but IV drugs may be tricky to import.

Further, some countries may wish to go it alone, e.g., Ethiopia, being the second most populous nation, might sustain local producers (Ref: GTZ Ethiopia).

However, for regional manufacturing to work, governments must coordinate/harmonize legislation of drugs, and step away if manufacturing does not make sense either economically or/and from a public health viewpoint.

3.3.4 National

National governments are mindful of claims accusing them of emphasizing industrial agendas ahead of public health (if they buy from inefficient local facilities rather than better quality medicines from abroad).

There are disagreements as to whether employment levels increase meaningfully as a result of local production. Likewise, there are disagreements on how insecure foreign supplies are. This insecurity seems unlikely because of the plethora of Indian and other suppliers [Ref: Indian Pharmaceutical Association (IPA)].

4. A vaccine-manufacturing plan

In preparation for, and during their “Vaccines Summit”, Africa’s leaders are on a path to modernize and develop their regulatory bodies for medicines and jump-start vaccine manufacturing. The Summit was jointly held by the recently created African Centers for Disease Control and Prevention (ACDC), based in Addis Ababa (Ethiopia), and the African Union. It was attended by ~ 40,000 delegates.

4.1 Establishment of an African Medicines Agency

The COVID-19 pandemic has led to calls to establish an African Medicines Agency (AMA) similar to the European Medicines Agency (EMA) and the (U.S.) Food & Drug Administration (FDA). This new agency would provide national regulators with guidance on new medicines - filling the major gap mentioned in section 3.2.2 above.

A treaty to create the AMA was agreed by the African Union (AU) in 2019. Led by the AU, this project will cost \$ 100 million to establish. To officially launch the AMA would require that it be ratified by 15 countries following the quick enactment of relevant laws in their national parliaments, Unfortunately, so far, only 8 countries have done so. (ref: Ncube *et al.*, 2021). This

may suggest that before COVID-19, the remaining required seven countries and perhaps also others may not have considered it as a priority. This must now change and more countries should quickly also ratify the Treaty.

4.2 Vaccine manufacturing and sharing

The COVID-19 pandemic has left Africa woefully short of vaccines. As a result, African leaders boldly pledged to increase the share of vaccines manufactured and used in the continent from 1% to 60% by 2040. This will involve building factories and bolstering capacity in research and development (R&D). This ambitious move represents an important step in boosting Africa's public health capacity. The conversation must also encompass the need for a long-term investment in R&D, especially domestic R&D for, without it, a vaccines industry could not be created. Despite the best efforts by some African researchers, many African governments pushed back against the idea that along-term domestic R&D is of long-term value.

It took the current pandemic to change the minds of African leaders and convince them otherwise of the case for bigger investments. Nonetheless, the holding of Summit(s) and the warm words uttered during their debates, will not suffice and do not insure that the plans being hatched will come to fruition.

Hard conversations with donor countries and organizations, their funders, their pharmaceutical companies, and their researchers would also need to be had. These should essentially be those entities that currently supply Africa its vaccines.

4.3 Self-sufficiency of the African vaccine-value chain

If Africa is to become self-sufficient in manufacturing its needed vaccines, then, a different approach must be hammered out with its international partners. The objective would be to empower the continent's own researchers and businesses. The current manufacturer-client paradigm must be modified or even totally changed. Some international companies may take umbrage at such a suggestion for they may regard it as a long-term risk to their businesses and even a loss of their influence. They would need to be convinced otherwise. A genuine partnership of equals would be far more stable and rewarding than the present arrangement and will be in everyone's best interests. In addition, when it comes to public health, COVID-19 has shown that vaccines are an international need. Countries that lack vaccines could cause resurgence of the pandemic through successive waves, including several variants of the original coronavirus.

4.4 Intellectual property temporary halt

This could be a major roadblock in Africa's road to vaccines' self-sufficiency. Floated by India and South Africa in October 2020, some 80-100 mostly low- and middle-income countries have

since then asked richer countries to temporarily waive their COVID vaccines-related intellectual property (IP) so they can ramp up their own manufacturing. But high income countries prefer technology-sharing-and- transfer through a trusted third party, such as preferably the WHO. In such arrangements, their pharmaceutical companies would share know-how, tools, and skills. In the past, these arrangements proved to be successful in creating vaccine-making capacity in middle-income countries.

Some have argued that the IP issue should be kept separate and apart from Africa's manufacturing ambitions, but the reality is that they are closely linked. Whichever of the vaccine technologies are deployed: viral vector, live virus, messenger-RNA (mRNA) (see Fymat, 2021), patent holders will need to be consulted and appropriately compensated. That bottleneck is one of the reasons why a temporary IP-waiver of limited duration (say, for the duration of the COVID-19 pandemic) has become popular and needs to happen. If properly organized, and an agreed process is followed, it will allow countries to quickly get on the first few rungs of the vaccine-manufacturing ladder.

Scientists and researchers, and not only manufacturing companies and governments, have also an important say in this matter. After all, they have been central to vaccines research, laboratory testings, clinical trials, evaluations, regulations, and roll-outs. Further, they have relations with most everyone involved and have also become involved in policies and diplomatic debates. If the pandemic persists unabated, the argument for holding onto the COVID-19 IP will be harder to defend. Here, again, researchers and scientists have the knowledge to influence the debate.

In closed-doors talks at the WTO in recent months, it was reported that Australia, Brazil, Britain, Canada, the European Union, Japan, Norway, Singapore, and even the U.S. opposed the waiver idea. China and Russia did not express a position but were open to more discussions. The EU (a 27-nation bloc) said it was ready to talk about the waiver idea. It remained noncommittal for now, emphasizing that the bloc has been exporting vaccines widely - while the U.S. had not. However, there is precedent, in that, in 2003, WTO members agreed to waive patent rights and allow poorer countries to import generic treatments for HIV/AIDS, malaria, and tuberculosis. Many hope for a historic replay to continue to fight COVID-19.

On 28 April 2021, two countries with major drugmakers (France, U.S.) joined in supporting an easing of patent protections on COVID-19 vaccines. The objective is to help poorer countries get more doses and speed-up the end of the pandemic. In so doing, the U.S. was waiving its protections embodied in the "Bayh-Dole Act" (which opened the door to universities to commercialize their discoveries) and a Supreme Court ruling (which granted the first patent on a genetically-modified organism). Nonetheless, while a laudable effort, it does not overcome the many obstacles discussed in earlier sections. The decision drew cheers from activists and complaints from Big Pharma. Still, even just one country voting against a waiver would be enough to block efforts at the WTO. It is hoped that other countries would reassess and change their positions.

In their May 2021 meeting, European Union (EU) leaders criticized the U.S. call to waive COVID-19 vaccine patents, arguing the move would yield no short-term or intermediate improvement in vaccine supplies and could even have a negative impact. They cautioned that relaxing patent rules could harm efforts to adapt vaccines as the coronavirus mutates. Rather, they urged the U.S. to lift its ban on exports of vaccines and their components as hundreds of which can go into manufacturing a vaccine. (For instance, the German company CureVac could not produce a vaccine in Europe because the necessary components were blocked in the U.S.) The EU further urged the U.S. to boost its vaccine exports as a way to contain the global COVID-19 crisis, insisting that that move was the most urgent need.

While the U.S. has kept a tight lid on exports of American-made vaccines so it can inoculate its own population first, the EU has become the world's leading provider by distributing about 200 million doses within the bloc and exporting about the same amount abroad to almost 90 countries. Still further, the EU insisted that production capacity first must be ramped-up by reconverting factories so they can quickly start producing vaccines through a transfer of technology. Likewise, developed nations should also increase vaccine donations to poorer countries as patent waivers alone will not remedy the situation.

The International Federation of Pharmaceutical Manufacturers and Associations (IAPMA), for its part, has resisted the waiver, insisting that production of coronavirus vaccines is complicated and cannot be ramped-up by easing intellectual property protections. Instead, it favors reducing bottlenecks in supply chains and a scarcity of ingredients that go into vaccines. It insists that a faster solution would be for rich countries that have vaccine stockpiles to start sharing them with poorer ones. It argued that *“waiving patents of COVID-19 vaccines will not increase production nor provide practical solutions needed to battle this global health crisis ... and an IP waiver will do more harm than good in the long run ... (further) easing patent protections would eat into their profits, reducing the incentives that push innovators to make the kind of tremendous leaps they did with the COVID-19 vaccines ... (and still further) disagreed on whether there are any manufacturers standing by that could make the vaccines if they were given the blueprints”*. The COVID-19 vaccines can indeed be incredibly difficult to make.

4.5 Should vaccine technology be considered a future public good?

Vaccine technology should not be the source of profiteering, especially to the detriment of poor countries who could ill afford it. This could also have a boomerang effect in that unvaccinated countries in times of pandemics could be the source of further infections, additional pandemic waves, and numerous variants as seen with COVID-19. By their very nature, pandemics are global and of worldwide concern. What happens in one side of the world may quickly propagate and infect other sides.

It should be possible to reasonably compensate inventors while building national capabilities and capacities, and keeping life-saving technologies in the public domain. The world's researchers

have created, and continue to create innovative vaccines. It is now time to share this knowledge with colleagues in under-served regions. While it may be too late for Africa at this juncture in regard to COVID-19, other pandemics are unfortunately bound to happen and require vaccines. Being prepared to that eventuality and having the technology on-hand to manufacture the required vaccines would be in the best interests of everyone.

5. Conclusions

Improving access to good, safe and affordable drugs is not just about ensuring local production, however laudable that objective might be. As the WHO stated, “... *local production is not a panacea; the tragedy is that it is sometimes promoted blindly*”. Of course, countries want to create industries to provide medicines for their people, but the trade-off should not be higher prices for lower quality. From a public health point of view, it does not matter where drugs come from as long as they are safe, of good quality, and affordable. If Africa is to become self-sufficient in manufacturing its needed vaccines, then, a different approach must be hammered out with its international partners with the objective to empower the continent’s own researchers and businesses. Vaccines are an international need and countries lacking them could cause resurgence of the pandemic through successive waves, including several variants of the original coronavirus. Unfortunately, intellectual property rights could be a major roadblock in Africa’s road to vaccines’ self-sufficiency. Rather than their temporary waiver, unfreezing by countries of their overcapacity or overstocks could have a more immediate and beneficial result. Vaccine technology should perhaps be considered a future public good.

References

- Bass N (2015). “Implications of the TRIPS Agreement for Developing Countries: Pharmaceutical Laws in Brazil and South Africa in the 21st Century”, 191.
- Fymat AL (2015a). “Perspectives on drug manufacturing in Africa”, Invited Address presented at the 3rd International Scientific Conference of the Society for the Advancement of Science in Africa, August 2015, Toronto, Canada.
- Fymat AL (2015b). “Generic drugs manufacturing in Africa: A contextual review of interest to Africa”, Invited Address presented at the 4th International Scientific Conference of the Society for the Advancement of Science in Africa, August 2015, Toronto, Canada.
- Fymat AL (2021a). “Predicting and preventing the next pandemics”. in Health Perspectives on the COVID-19 Pandemic Across Africa.
- Fymat AL (2021b). “Pandemics: Prescription for Prediction and Prevention”, Tellwell Talent Publishers, **published October 2021, 352 pages. ISBN: 978-0-2288-6721-0 (hardcover); 978-0-2288-6720-3 (softcover).**
- Hoffman V (1999). “Cure Sought for Problem of Getting Medicines to Poor Nations”, Boston Globe, November 25, 1999, page A23.
- Laing R, Kaplan W, and Moon S (2005): World Bank Report.

Ncube BM (2021). *J. Pharm. Policy Project* **14:29**.

Pharmaceutical Manufacturing Plan for Africa (PMPA). “Drug Development Process”, *Food and Drug Law Journal* 54:187-194.

Seiter A. World Bank.

The Lancet (2015). March 2015 issue.

Vick K (1999). “African AIDS Victims: Losers of a Drug War”, *Washington Post*, December 9, 1999, page A1.

World Health Organization, *Pre-Qualification Program* (www.apps.who.int/prequal/).

World Health Organization, *Global Health Advisory Data (2007-2013)*.

World Health Organization Committee for Medicine, Quality Assurance and Safety.

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Chapter Twelve

African traditional healing practices and technology: Implications for COVID-19 treatment

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Abstract – The aim of this literature study was to explore African traditional healing practices and technologies. Though we each subscribe to a different belief, we acknowledge the reality of African traditional healing being highly spiritually charged. African traditional healing has made strides over centuries, yet it suffers subjugation. An obvious example is the treatment of COVID-19 which promotes Western healing methods and technologies instead of teaming up with traditional healing. Guided by Ecological Systems Theory (EST) and Social Systems Theory (SST), African traditional healing practices and technologies are discussed. It is shown how African traditional healing is faced with struggles raised by the Western contestation. It is also shown how the African traditional healing cannot escape its magico-religious nature due to the element of spirituality that is undergirded in indigenous knowledge systems as it is manifested through the natural forces. The belief of African indigenous people in traditional healing impacts on how they respond to the Western healing practices and technologies, thus medical authorities and practitioners can learn alternative practices and technologies of treatments of COVID-19 and other diseases, as well as ensure relevance of treatment to African indigenous people.

Key words: *African traditional healing; indigenous; technologies; botho; Western medicine; practices*

Abbreviations

AIDS:	Acquired Immunodeficiency Syndrome
COVID:	Coronavirus Disease
EST:	Ecological Systems Theory
HIV:	Human Immunodeficiency Virus
H1N1:	Hemagglutinin Type 1 and Neuraminidase Type 1
SST:	Social Systems Theory
UNESCO:	United Nations Educational, Scientific and Cultural Organisation
U.S.:	United States
WHO:	World Health Organisation

1. Introduction

This study explored African traditional (or indigenous) healing practices and technologies. The study was motivated by the interest that the COVID-19 pandemic has aroused in the development of traditional healing techniques in health care delivery (Utsua, 2020, p. 456). COVID-19 has similar symptoms to other common colds, as such, common preventive measures can be used to stop the spread of the pandemic (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020). There have been success stories which back the growing interest in traditional medicine and healing. Firstly, the World Health Organization (WHO) (2002) estimates that more than 80% of the world's population relies on traditional healing modalities and herbals for primary health care and wellness. Secondly, WHO states that in the United States (U.S.), 25% of all prescription drugs are derived from plant sources and that they were first used by traditional healers. Thirdly, traditional medicine is the primary source for healthcare to more than 80% of the population across Africa (Emeagwali & Dei, 2014; Shizha, 2013; UNESCO, 2020). Fourthly, the Center for Disease Control and Prevention (2020) acknowledged that Africa was the last to be hit by the Corona viral pandemic and that it accounts for only 5% of the globally reported cases of COVID-19. Fifthly, surveys conducted by the WHO Roll Back Malaria Program in 1998 showed that in Ghana, Mali, Nigeria and Zambia, more than 60% of children with high fever are effectively treated at home with herbal medicines since they are easily accessible and cost effective (Pesek, Helton & Nair, 2006). Sixthly, Africa has a very rich tradition and medicine and healing heritage which had been useful in the treatment of various ailments ranging from viral to bacteria and protozoa to fungi infections (Utsua, 2020, p. 461).

It is however concerning that (African) traditional healing still receives some degree of rejection in favour of Western medicine. Ajima and Ubana (2018) point to the misconception of Westerners and some Africans “who must have been influenced by colonial mentality to the effect that anything alternative medicine is fetish, pagan and heathen” (p. 1). Media plays a part in focusing away from or bad-reporting traditional healing practices and holistic ways of thinking and problem-solving (Pesek *et al.*, 2006), which adds to the problem. Traditional healing is dismissed

mainly due to its magico-religious or spiritual aspect (Adu-Gyamfi & Anderson, 2019). Also, it is dismissed due to its interest in the healthcare which is guided by *botho* (*ubuntu*) – caring, unity and community, thus, it pays homage to the ecological and social systems. For example, in the U.S., some white people dismissed the spiritual side of African American medicine claiming that it was uncivilised and thus perceived its practitioners as quacks to a point of beating slaves when they were found practising medicine (Fitzgerald, 2016). Plantation owners forbade them from treating themselves or other slaves with herbal remedies partly because they feared that slaves would poison them as revenge for their mistreatment (Fitzgerald, 2016). As a result, the South Carolina General Assembly passed a law in 1749 which prohibited slaves from being employed by physicians to concoct poisons or administer medicine of any kind; this was after realising that the number of African American herbalists had risen exponentially (Fitzgerald, 2016). At the time (mid-nineteenth century), Westernised medicine which depended on the use of powerful drugs and modern surgery to cure both physical and psychological ailments was growing fast and aimed to block traditional medicine (Fitzgerald, 2016). However, Fitzgerald (2016) explains some white people actually benefited from traditional healing which as it saved their own family members where modern medicine had failed, thus, they allowed slaves to practise traditional medicine ultimately. Also, the physicians in the Southern U.S. observed that many native Africans were not susceptible to malaria and pulmonary diseases such as tuberculosis or whooping cough. The Tswana adage fits here: *Motshega-kgarejana ke monyadi wa yona* (he who despises a lady ends up marrying her). As a result, the racial ideology that Africans are biologically inferior to Whites (Fitzgerald, 2016) cannot hold.

In the light of the above, there is a need to understand African traditional healing practices and technologies and the role that they can play to treat ailments such as COVID-19. The next section describes the central concepts which we engage in the chapter.

2. Conceptualisation: African indigenous people and their knowledge of healing

Three critical concepts which are *botho*, traditional healing and disease are described in this section. *Traditional* in the context of this chapter means the same thing as *indigenous*.

2.1 Botho

The Tswana adage, *motho ke motho ka batho ba bangwe* (a person is but through other people) carries the meaning of *botho*. *Botho* originates from African indigenous people; it means a web of relationships which bind them and are anchored on the spirit of interdependence and mutual trust (Mbaya, 2011). Therefore, *botho* is a system which is built on humanness (or being human) which denotes a worldview defined by unity, caring, sharing, compassion, communocracy, etc (Khoza, 2005). Communalism views humanity according to the collective existence and inter-subjectivity which is the basis for support, cooperation, collaboration and

solidarity (Khoza, 2005). Furthermore, communalism refers to community which denotes communitarianism which in turn views a person through social bonds and cultural traditions as opposed to individual traits (Mabovula, 2011). Ramose (2002) views the African community as a continuous dynamic association of people who are specially committed to one another and have developed a distinct sense of common life. Etta and Asukwo (2019) assert that knowledge depends on human and social factors rather than on objectivity which is informed by impersonal object-knower relations. Self-detachment in this sense unaccommodated in *botho*, rather, the African philosophy of *botho* situates self in the centre of the world so that self can experience (feel, live with and grasp) relations of the personal world. In this chapter, we contextualise the traditional healing system within *botho* – the traditional healer wants to understand the patient’s health condition within the order of relations that define the ecological and social environments. Therefore, in this chapter, we do not limit the meaning of *botho* to people only, but we extend it to these environments. Our understanding is that the natural resources and forces (including spiritual forces) are critical in the healing process, therefore, people should not only be harvesters but care-takers of resources as well. They should show *botho* towards nature so that they can enjoy the healthy relationship between themselves and the nature.

2.2 Traditional healing

Traditional healing is the service of healing which involves magico-religious acts and concepts (Adu-Gyamfi and Anderson, 2019). Though the concept magico-religious is twofold, i.e. *magico* and *religious*, understood and used in its unified form, it involves an uneasy explanation of the unseen (lack of rationality) related to the element of faith. Therefore, traditional medicine cannot be talked about by limiting it to the physical cures without reference to magico-religious therapies. The concept, magico-religious connotes “diverse health practices, approaches, knowledge and beliefs incorporating plants, animals, and or mineral based medicines, spiritual therapies, manual techniques and exercises applied singularly or in combination with other things to treat, diagnose and prevent diseases” (Adu-Gyamfi, Aminu, Kwasi, and Sampson, 2017, p. 20). The distinguishing characteristic of traditional medicine, according to Adu-Gyamfi and Anderson (2019) is that it is not classified under biomedicine, hence, as an aspect of indigenous knowledge systems, it is unpopular within the system of conventional pharmacopoeia.

The complexity of traditional medicine explicated by Adu-Gyamfi and Anderson (2019) is also expressed in the WHO Report (2000), which defines traditional medicine as:

“the sum total of all the knowledge and practices, whether explicable or not, used in diagnosis, prevention and elimination of physical, mental or social imbalance and relying exclusively on practical experiences and observation handed down from generation to generation, whether verbally or in writing (p. 8)”.

Due to its magico-religious nature, traditional medicine consists of both the natural (herbs, roots, animals, spices, oils, etc) and supernatural elements and is based on the experiences

which are indigenous to different cultures practicing it. It is tied to culture, hence, Addrisu (2017) writes that the traditional healing system is closely bound to the culture of people as an assorted collection of indigenous, unorthodox and folk medical practices and procedures loosely bound together by practical experience and/or non-scientific approach related to healing or healthcare problems. Furthermore, African medicine is aimed at healing the whole of a person; it is therefore close to the Christian concept of healing of making whole compared to the Western medicine which focuses on the restoration of health in the body (Ustua, 2020, p. 457). Our understanding and application of the concept of traditional healing in this chapter is not a dismissal attitude for Western medicine. Rather, we opine that an increased understanding of traditional medicine creates the opportunity to appreciate its value and usefulness in combating diseases, and that it could compensate Western medicine and *vice versa*. It could also provide an avenue to acknowledge and deal with the strengths and weaknesses of the two in the provision of healing.

2.3 Disease (health and illness)

In light of the description of traditional healing given above, and indigenous Africa people's holism concept, ill-health is perceived as whatever endangers better life (Islam & Sheikh, 2010; Addrisu, 2017). Therefore, healing in traditional African societies is all about the process of restoring life to its fullness – “healing the whole of a person”. Connected to magico-religiousness, diseases are related to the spiritual, physical, social and mental well-being of an individual especially the harmony of the total human body (Islam & Sheikh, 2010; Addrisu, 2017). Across the African continent, people consult diviners and healers in order to discover the nature of their illness (Addrisu, 2017). They prefer to consult diviners and healers because they (diviners and healers) seem to cover the physical, social and spiritual dimensions of the person as the explanation involves a deity as part of the diagnosis for the fact that it is also grounded in natural phenomena. In this sense, the traditional African healer focuses on the cause of the patient's misfortune pertaining to his/her social, natural and spiritual environment (Addrisu, 2017). Health is not regarded as an isolated phenomenon, rather, it is a sign that a person is living in, tranquillity, peace and harmony with and within his/her community and its practices (Addrisu, 2017). Medicare system is anchored on restoring the body equilibrium to the natural forces (Addrisu, 2017). The violation of natural forces results in four types of diseases, which include acts of God; moral or ritual infringement, e.g. sexual abuse, stealing, killing, ignoring taboos, etc; witchcraft or sorcery; and (ancestral) spirits (Addrisu, 2017).

The violation of natural forces can be caused by the victim of the disease or other entities, physical or spiritual. For purposes of this chapter, we deemed it important to look at the causes of diseases from a colonial perspective to help understand the fate of indigenous people, their knowledge, understanding of medicine and healing practices. The work of Islam and Sheikh (2010) about the cultural and socio-economic factors related to the atrocities that colonialism has and continues to inflict on indigenous people is helpful in this regard. We do not subscribe

to the idea where the authors seem to situate the health of indigenous people within Western methods and systems. We therefore free our thinking to a great extent in presenting these causes.

The authors maintain that the history of indigenous people is a battlefield due to the European invasion of their contexts. This contrasts with the fact that before European invasion of indigenous people's spaces, they (indigenous people) had the ability to control diseases which threatened their lives. Islam and Sheikh (2010) explored a number of indigenous societies and their contexts affected by colonialism, e.g. Latin America, Caribbean, Sweden, Australia, Africa. Among the factors that are linked to colonialism are the following:

Ethnicity or indigenous identity: Mortality rates are higher among indigenous peoples than non-indigenous peoples. This is as a result of the health systems and diseases that European invasion introduced which already show weaknesses of diagnosis and treatment of diseases which are non-magico-religious and/or prioritise non-indigenous people. Devaluing indigenous people's lives and thus delaying services to them compromises their rights to the health systems.

Dispossession of land: Indigenous people and land are inseparable as they use herbs and animals from the land. The confiscation of their land and the introduction of 'developmental' projects such as logging, mining, dam building, etc have frustrated their lifestyles leading to cultural disruption, social exclusion, tension, increased stress, etc. The herbs and animals that they use for medicinal purposes have been bulldozed to make provision for the above cited projects. The attachment of indigenous people to the land has been profusely disturbed by confiscation; this has caused disequilibrium in the human-nature-spiritual relationship resulting in their dis-ease (disease).

Housing: Indigenous households are larger than non-indigenous households, yet their lands have been restricted, causing their cramping in small spaces compared to the minority invaders as it is the case in South Africa where the housing problem is attributed to colonial practices – overcrowding in slums, ghettos and shacks which in turn exacerbate health problems.

Level of education: Indigenous education, including their language and culture are discriminated against both in the occident and the orient. Besides the lack of medical facilities, their knowledge, which includes medicinal knowledge is not accommodated in the education systems with a resultant production of professional medical staff instead of traditional herbalists and other types.

Environmental health: Industrial development has played part in the displacement of indigenous people, destroying their lands and rewarding them with diseases caused by their toxic emissions which cause lung and skin diseases.

Income: It is not all about money, but indigenous people in precolonial times used to own cattle, goats, chicken, etc and as a result they were competent farmers. However, shrinking their lands due to rezoning for selfish ends brought by the coloniser's aggrandizement has tempered with their self-sustaining economic activities and insulated social structures as well as their indigenous approach to occupation and employment. In cases where they are absorbed in professional job environments, they occupy the lowest ranks and type of jobs, e.g. clerical or sales jobs, seasonal employment, agricultural or household works, etc.

3. Theoretical lens

Each human being, by very nature of being social, can be perceived as part of and participating in multiple nested systems (Kamenopoulou, 2016). The implied relationship within systems made us opt for Brofenbrenner's EST. Although the theory focuses on child development from a psychological perspective, it suited the traditional healing from an indigenous perspective due to the human-ecological relationship aspect that the theory purports – human beings like other living species develop within the systems of relationships. We base this claim on Brofenbrenner (in Kamenopoulou, 2016), who situates human development within the complex interactive processes which take place between numerous systemic work. Kamenopoulou (2016) borrows from Brofenbrenner and perceives development within this framework and thus states that the person's conception of the ecological environment evolves in his/her relation to it. The EST encapsulates the five key concepts briefly described below (Kamenopoulou, 2016) and contextualised within this chapter:

1. **Micro-system:** Immediate contexts in which the individual participates and people in these contexts are in direct contact with the individual. As the EST is ecological theory, the connection is not only limited to people but to the living and the non-living as well as forces which impact on them.
2. **Meso-system:** There are influences between members of micro-systems. Within the context of this chapter, this could mean how indigenous medicinal practices are perceived and responded to, especially by authorities and those in biomedical professions.
3. **Exo-system:** External influences on the individual from systems not directly related with the micro-system. This could mean, on a broader scale, the attitudes levelled against indigenous people and their traditional medicine, as well as the extent of legislative accommodation of the same.
4. **Macro-system:** Broader cultural and social influences. This happens on even a bigger scope such as national, continental and global. Indigenous people and their medicinal practices are impacted upon by cultural and social influences.

5. **Chrono-system:** Changes in all systems and their members across time. Indigenous medicinal knowledge and practices are handed down from generation to the next. In the passage of time, they are being modified or improved to suit the needs of those times. Also, as people move around, they adopt new ways to better process and administer indigenous medicine and other cultures may even benefit from it, e.g. the slave masters cited in the introduction above.

EST implicates the SST due to the relationship dynamics which both theories harbour. Pesek *et al.* (2006) state that EST describes the dynamics of people’s interaction with the environment in which each part affects every other part and the system as a whole. According to Pesek *et al.*, (2006), people impact the environment and vice versa (reciprocal relationship) daily and this dynamic relationship is self-sustaining. A social system is defined as an interaction between people viewed in different capacities such as family, friends, acquaintances, co-workers, etc (Shea, 2011). Social systems are bound together by related activities (Shea, 2011). Shea (2011) further identifies other systems within the social systems such as cultural, economic, demographic and organisational systems. These social systems have a role to play in a positive or negative manner. For example, the factors described above make traditional medicine attract attitude from the Western world, whereas at the same time they attract many clients.

The explanations given this far about relationship between EST and SST and how they apply to traditional healing are be illustrated in Figure 1.

Figure 1: The relationship between EST and SST and their application to traditional healing

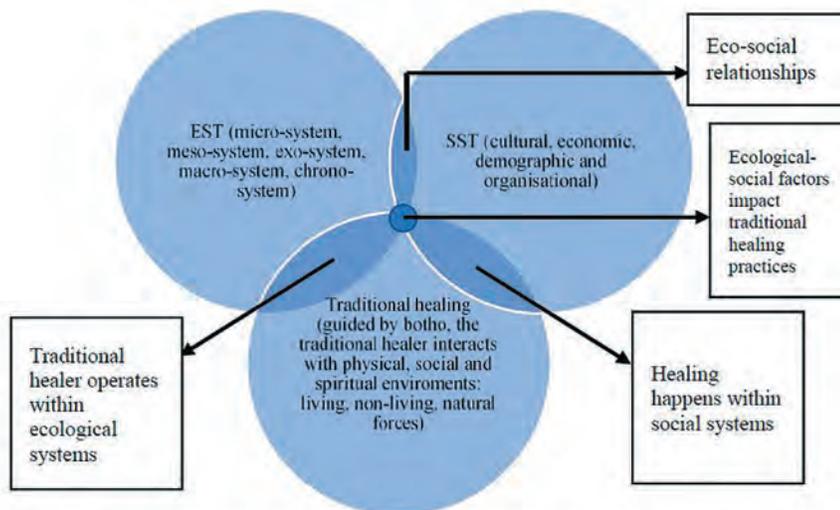


Figure X.1: The relationship between EST and SST and their application to traditional healing

4. African indigenous healing in the face of Western healing

African indigenous medicine is as old as Africa and was the sole source of health care before the arrival of Western knowledge systems to Africa (McFarlane, 2015). African indigenous healing is the primary source of health care for the vast majority of Africa's people (Khaya, 2014) as stated in the introduction. This means that for most poor people, traditional healers are often the first and last line of defence against any form of illness (Madamombe, 2006). African indigenous medicine is embraced and used due to traditional healers being trusted and respected individuals in their community, being readily available even if the transport is unviable, it is cost-effective as compared to allopathic medicine, associated with the community's cultural, environmental, religious and spiritual values, and people's dissatisfaction with conventional medicines (Gumbo & Gaotlhobogwe, *in press*; Tan, Otake, Tamming, Akuredusenge, Uwinama, and Mana, 2021). The above-mentioned factors are a testament to the value of African indigenous medicine amongst the people in this context.

The entrenched biases that African traditional medicine is unscientific or irrational arise from the colonial construction of Africa's otherness and primitiveness (Crick, Griffiths, and Payne, 2011), the lack of research on the cultural and spiritual aspects of African indigenous medicine and its assumed association with witchcraft/voodoo, supernatural, and metaphysics. Imperceptibly, the widespread use of African indigenous medicine by Africa's people allows African countries to embrace Sustainable Development Goal 3 in terms of good health and well-being, as African indigenous medicine is easily accessible and affordable as well as offers quality health services. African knowledge and methods in this regard have successfully guided people in all spheres of life, including the spiritual, social, educational, agricultural, political and economic (Tanyanyiwa and Chikwanha, 2011). These knowledge and methods have stood the test of time and their preservation to date attests to the value that their custodians attach to them – it cannot be that people cling to something over centuries that cannot work for them.

This discussion suggests differing paradigms which would help with the understanding of African traditional healing and technology compared to the conventional options.

5. Differing paradigms

In the first place, traditional cultures embrace the stewardship world views whereas Western cultures embrace the anthropogenic worldview of dominion over the natural world (Pesek *et al.*, 2006). Traditional cultures perceive themselves as care-takers of the land, not the owners thereof; this relates to their approach towards the entire ecological system espoused in EST (also see Figure 1). To them, the land is a precious resource nurturing life, promoting good health and educating those who are willing to learn from careful observance. Over time, indigenous people develop close ties with the land such that confiscating their land is tantamount to disturbing their knowledge of local plants, animals, rivers, etc. This is illustrated by Odhiambo's personal account cited by UNESCO (2020), who inherited herbalism from his grandparents who were

both herbalists – generation-to-generation transference of knowledge and skills. His parents treated their patients from locally available plants and herbs. That raised his interest in plants at a young age as he learnt how some plants could be mixed together to heal diseases, such as boiling, soaking, burning, pounding, chewing, roasting, steaming under a blanket, etc (Odhiambo in UNESCO, 2020). Furthermore, he was curious about why dogs chewed grass and chicken coughed and whizzed as they breathed. His grandfather told him to pound hot pepper mixed with *Aloe Secundiflora* leaves and *Kendogensis Foetidissima*, add water and administer it to the chicken. He realized that after a few days the chicken were well again. He then started to treat his family members off coughs, headaches and chest tightness with different plant remedies.

The approach to nature makes the traditional cultures to live in harmonious and sustainable fashion that honours and protects their natural habitat. Most Western cultures, however, ascribe to landownership and policies which lead to encroachment, abusive practices and disconnection from the natural world which, in turn, is the source of many problems including health and wellness ones (Gumbo & Gaotlhobogwe, *in press*). This behaviour devalues existence in healthy ecosystems and overshadows the full understanding of crucial matters such as environmentally derived illness, unsustainable and damaging food production strategies and spiritual imbalance. According to Pesek *et al.*, (2006), modern medicine is mechanistically focused and biased to Western worldview with a business underpinning, thus, it continually evolves toward a model of the treatment of illness when it should be focused more on prevention of illness. Ajima and Ubana (2018) refer to this model as inomedical/inological, i.e. it views health as intrinsically scientific and it is mechanical, individualistic, dualistic and reductionist. As such, it “construes the physical body as being separate from the social processes” (Ajima & Ubana, 2018, p. 2). On the other hand, the traditional healing model, in line with the SST, relates health to the social, economic, political, cultural and environmental factors which are at play to affect an individual. Ajima and Ubana (2018) aver that it emphasises the society’s responsibility towards the health of the individual.

Universally, there is a hierarchy in the classification of knowledge where Western medical knowledge is considered superior to African indigenous medicine. This provides the reason not to dismiss but to critique Western medicine (also known as biomedicine) and its ontological view as it is associated with neo-colonial ideologies and is entrenched in colonialism. Western medicine is viewed from a positivist perspective (Handayani, Wilujeng, and Prasetyo, 2018) as scientific, evidence-based empirical observations and analysis, clinical and the most reliable value-free form of knowledge is acquired formally (Apple, 1996), it demands standardised practice, emphasises the assumptions of objectivity, rationality, replicability, comparability and generalisability. The emphasis on the science and evidence in Western medicine limits “the ontological world of health and healing to observable and measurable physical phenomena” (Horden and Hsu, 2013).

On the other hand, African Indigenous medicine is construed as non-scientific, informal, personal and contextual and operates within a spiritual realm and has no official professional

body to regulate practice (Ngang and Ageh, 2019). It is for this unfortunate view that it suffers dismissal by Western standards. We argue that the deep knowledge displayed by its custodians includes the science related to it as well. Biomedical training is specific, standardised, regulated by a professional body and recognised in Western medicine when African indigenous medicine is frowned upon most probably because it is magico-religious. African indigenous medicine healers rely on experience and observations handed down from generation to generation either verbally, frequently in the form of stories, spiritually by ancestors or, sometimes, in writing. In the Christian circle the belief is that God endows people with the knowledge of nature and its uses on the human body – *“Every moving thing that is alive shall be food for you; I give all to you, as I gave the green plant”* (Genesis 9:3). The first author in this chapter attended a conference in Namibia in 2012. A presenter, who is both a traditional and biomedical practitioner, presented on “God’s secrets hidden in nature”. His presentation shared insights into the healing properties of herbs from the Biblical, indigenous knowledge and scientific perspectives as he demonstrated with parts of herbs and/or plants. This confirms the healing resources which are stored in nature which African indigenous people have identified.

There are instances where the traditional healer only shares or passes on their knowledge with their families or close allies, and sometimes the knowledge is not shared at all and dies with the healer. Consequently, such knowledge is lost or is not developed over time (Amoah, Sandjo, Bazzo, Leite, and Biavatti, 2014). The non-sharing of this knowledge is because it is classified as sacred knowledge. This means that there is no curriculum, therapeutic method, or common diagnostic nomenclature for African indigenous medicine. Hence, there is a need to revitalise inter-generational ties to ensure its continued prevalence and preservation. Additionally, African indigenous medicine is intricately intertwined with the individual, community or environment (see Figure 1), where harmony exists between the physical and metaphysical worlds. The implications of this harmony are that African indigenous medicine knowledge and its acquisition method have a practical, collective, social and interpersonal slant while Western medicine understands diseases as culture-free and neutral (Owusu-Ansah, 2013).

The striking difference in the training received by practitioners and the disconnect to the patients’ sociocultural and spiritual beliefs has resulted in Western medicine being construed as a panacea to most African health-related problems. Western medicine and spiritual hegemony have relegated African traditional medicine and spirituality to the margins or periphery for a long time. A case in point of the potential and value of African indigenous medicine is the example in Tanga, Tanzania, where four thousand HIV/AIDS patients received treatment from traditional healers and survived without access to modern antiviral drugs. Because of the treatment provided by traditional healers, patients were able to resume their daily lives and live longer (Audet, Ngobeni, and Wagner, 2017).

Numerous studies have noted the use of traditional medicine for sexual reproductive health such as overcoming infertility (Dyer et al., 2002), alleviating maternal and reproductive complaints (Shewamene, Dune, and Smith, 2017), treating issues relating to menstruation (Steenkamp,

2003), prenatal and antenatal care (Ngunyulu, Mulaudzi, and Peu, 2016) as well as traditional practices of contraception and the prevention of teenage pregnancy (Shange, 2012). If African indigenous people use herbal medicine for the treatment of COVID-19, would this not then be evident that herbal medicine is effective? Many indigenous plant-based medicines have been used as home remedies for COVID-19 prevention and symptomatic management. In South Africa, *Lengana* (Tswana)/*Umhlonyane* (Zulu) (*Artemisia afra*) is very popular and sold by the roadsides for the treatment of COVID-19 among black Africans. Therefore, rather than viewing African indigenous medicine as inferior, it may yet turn out to be the answer to the treatment of a host of existing and emerging diseases such as malaria, HIV/AIDS, Ebola, Zika, and COVID-19, that may defy orthodox medicine.

6. Treatment and approach

Western medicine is dissimilar to African indigenous medicine. Western medicine is static and the treatment is universal, whilst African indigenous medicine is adaptable and evolves to the changing circumstances in which community members find themselves (Siambombe, Mutale, and Muzingili, 2018). Moreover, the consultation with the traditional healer is very different from that of the Western clinician in that the healer speaks the same local languages as patients, has a holistic approach to the diagnosis process, spends more time with patients explaining the source of the illness and the necessary treatments as well as offers greater perceived compassion than clinicians (Audet, Ngobeni, and Wagner, 2017; Gumbo and Gaotlhobogwe, *in press*). In an African society, an ailment is very different from allopathic Western medicine as stated in the above description of disease. The difference stems from how an African society views a human being. A human being is seen to have a physical, spiritual, moral and social aspects (Makundi, Malebo, Mhame, Kitua, and Warsame, 2006). Therefore, healing or treatment involves the body, spirit and mind. This means that humans exist in three interconnected worlds physical, social and supernatural/spiritual, all of which are inseparable (Petrus and Bogopa, 2007; Iddrisu, 2017; Gumbo, 2020). If these worlds are in harmony, a person enjoys good health – equilibrium exists between these worlds (Figure 1). However, if there is an imbalance (disequilibrium) among these worlds, it may result in an ailment (dis-ease). In other words, the ailments arise from some relational disharmony between the patient and one of the worlds mentioned above.

On the other hand, Western treatments follow a positivist approach in the sense that they separate the spirit from the body and focuses on the body only, meaning that nature and spirits are excluded from the diagnosis. Accompanying this is the tendency by biomedical practitioners to discourage their African indigenous patients from taking herbs but only their own prescription. Thus, the ailment or disease is viewed as a “failure” of the body’s part, and subsequently, treatment is an attempt to “fix” that particular body part by surgery or medication. Such an approach to healing is fragmented and addresses the symptom rather than the cause of the disease (Hahn, 1995). Biomedicine aims to treat diseases of the body and prevent physical suffering, unlike African indigenous medicine, which aims to restore balance.

The practice setting of biomedical practitioners differs from that of a traditional healer. The biomedical practitioner has access to many forms of state-of-the-art technologies to assist with diagnosis and treatment, tried and tested drugs, clean consultation rooms, hospitals for referrals. The biomedical practitioner uses the support of laboratory services and advanced technologies to diagnose diseases. The traditional healer, however, frequently treats his/her patients in community settings, with their family members present, in a place of non-sophisticated technologies which include herbs, plant products, animal products, spiritual resources, etc (Ngang and Ageh, 2019). It respects *botho* where the ultimate goal is for all members of the family to understand the disease of the patient in a relational context so that they can collectively make an effort to restore the lost balance in the network of relations. Ancestor spirits guide traditional healers to seek protection against the disease, evil and misfortune, and clients are exposed to in-depth questioning about their relationships, social and psychological circumstances. Further diagnosis is facilitated by throwing divining bones. Unlike modern technology (which has strong diagnostic and predictive powers) the divining bones sometimes fail to ‘talk’ to the healer, prolonging this phase of the consultation process.

There are mainly three types of healers in Africa: herbalist, diviners and faith healers (King, 2000; Mokgobi, 2014) who are known by various names. For example, in South Africa, *Inyanga* is a herbalist who is knowledgeable about curative herbs and medicines of animal origins. Herbalism is a popular form of traditional medicine in which the traditional healer who is also a member of the community uses their thorough knowledge of the medicinal properties of indigenous plants and the steps necessary for processing these plants and their parts into drugs to treat various ailments (Mothibe and Sibanda, 2019). However, the indigenous plants used to treat the same ailments may differ from place to place due to plant biodiversity (Semenya, Potgieter, and Erasmus, 2013; Maroyi, 2017). Although there is lack of disclosure among traditional healers on the preparation procedures and correct dosage of herbal medicines, they are highly sought after due to their low cost, affordability, availability, acceptability and low toxicity (Zuma, Wight, Rochat, and Moshabela, 2016). A diviner is called *Insangoma* in South Africa; he/she identifies the cause of illness by consulting the “ancestral spirit world” or discovers whether there was a violation of an established order from the sick person’s side (Aniah, 2015). It is a transpersonal technique in which the diviner bases his/her knowledge on communication with the spiritual forces such as the ancestors, spirits and deities. He/she establishes the nature of disharmony among the four aspects mentioned previously and prescribes corrective measures (Mabvurira, 2016).

Furthermore, information concerning an individual or circumstance of illness is obtained through randomly arranged symbols such as shells, seeds or animal bones to gain healing knowledge (White, 2015). After the consultation with the spirit world, the diviner recommends the appropriate action in counselling, prescribing medicines and instructing on ritual ceremonies. *Umthandaz* is a faith healer. His/her primary form of healing is the use of holy water and by touching his/her patient to heal them.

The medication prescribed by the traditional healer provides an important role in the patients' psychological and emotional wellbeing even though it may not relieve the symptom of the illness (Abdool Karim *et al.*, 1994, p. 6). The point, as mentioned above, brings the vital role that African indigenous healing plays in the healing process. In a way, traditional healers promote traditional African culture and act as the custodians of traditional beliefs and customs, provide cultural education, counselling and mediation (Moshabela, Zuma, and Gaede, 2016).

The illness is thus believed to be natural, cultural, social or spiritual, i.e. it is caused by witchcraft/sorcery, gods or ancestors. Adu-Gyamfi and Anderson (2019) add personalistic, God-cause and human cause due to the African's mystical belief. Most African cultures believe that there is no distinction between man and the rest of creation (Pesek, Helton, and Nair, 2006; Olumbe, 2008). The traditional healer attaches significance to the patient's personal experiences surrounding ill-health, which has no space in Western Medicine which mainly limits diseases to the physiology of the individual and the environment. Therefore, all treatment embraces the physical, spiritual, social and moral components (Kahissay, Fenta, and Boon, 2017). The patient is seen as a part of a family and community, and hence oftentimes, family members participate in the treatment process. Thus, the service of the healer goes beyond the use of herbs to healing the mind, body and spirit. African indigenous healing embraces herbalism, surgery, dietary therapy, psychotherapy, exorcism and sacrifice. A large percentage (80%) of Africans depend on plants for their health care (Oyebode, Kandala, Chilton, and Lilford, 2016). This supports the idea shared above regarding Africa accounting for only 5% of the world's reported cases of COVID-19.

7. Treatment methods

Many traditional healers engage in many types of healing. They are good psychotherapists, proficient in faith healing (spiritual healing) and in therapeutic occultism. They also perform male and female circumcision, treat snake bites, whitlow, tuberculosis, cutting the umbilical cord, Caesarean section, piercing ear lobes, removal of the uvula, extracting a carious tooth, abdominal surgery, infections, midwifery, removal of bullets and poisonous arrows from wounded traditional fighters, bone setting, cupping and so on (Ubrurhe, 2003). Traditional bonesetters were practising long before Western medicine was introduced to the developing world. Fitzgerald (2016) writes about *Asafetida*, preventative medicine against a number of pulmonary diseases such as whooping cough, bronchitis, smallpox, influenza and other forms of viral flus. It is also an antibiotic. According to Fitzgerald (2016), Onesimus, a native-born West African herbalist, brought the knowledge of smallpox inoculation to the U.S. When ingested, *Asafetida* weakens bacteria growth in the gut, whereas when worn around the neck, its pungent fumes open congested airways to kill harmful bacteria in the nasal passages. According to Fitzgerald (2016), *Asafetida* was approved by the U.S. Pharmacopeia to fight the spread of the Spanish Influenza in 1918. Again, "in 2009 it was later found out that the roots of the plant produce a natural antiviral drug compound that was effective in fighting strains of flu like H1N1 virus *in vitro*" (Fitzgerald, 2016, p. 45).

Furthermore, modern science has also found that the root of burdock possesses antibacterial and antifungal properties (Fitzgerald, 2016). Bhat (2014) studied medicinal plants and traditional practices by the Xhosa in Eastern Cape. Among others, Bhat identified fever related treatments, e.g. *Alepidea amatymbica* – its underground stem is grated boiled with milk and flower and used daily twice for a week; *Artemisia afra* – few leaves are boiled with water and filtered using a clean cloth; leaf decoction is given three times a day for a week.

Traditional healers use interviews to assess patients, diagnose, treat and prevent disease. Interviews are used to establish the history behind the illness in order to treat the patient. Medical reports are maintained for future reference. In African indigenous medicine, a holistic approach is embraced during the healing process. Hence, the healers do not separate the natural from the physical, spiritual or the supernatural (Amegbore, 2014; Addrisu, 2017). Healers use a spiritual and physical perspective during the treatment. These perspectives are elaborated upon next.

7.1 Perspectives during treatment

Due to the strong presence of spirituality in traditional healing, there are physical perspectives and spiritual perspectives which can be differentiated but which are complementary to each other to provide a complete service to the patient.

7.1.1 Physical perspectives

These include the following (Mokgobi, 2014; White, 2015):

- **Herbs:** These are prescribed to the sick person according to the nature of the illness. Each prescription has specific instructions on preparing the herb, the dose, dosing regimen and timeframe.
- **Clay and herbs application:** Applying a mixture of white clay with herbs may be relevant during the healing process. In the case of skin diseases, the mixture is applied over the whole body and left for many days. The rationale for using clay is that body is composed of dust. The clay and herb mixture is also used to ward off evil spirits that cause the illness.
- **Counselling:** The sick person is sometimes counselled on the treatment, dietary requirements, the need to adhere to good behaviour and social norms when they have violated a taboo. Counselling is intended to avoid further illness, misfortune and death.

7.1.2 Spiritual perspective

Spiritual perspective is composed of the following (White, 2015):

1. **Confession:** This involves confession of sin and guilt so that the lost equilibrium can be restored.
2. **Spiritual protection:** A talisman, charm, amulets, specially designed body marks and a spiritual bath are utilised to drive the evil spirits or elements away and protect a person, family or community when the disease is considered to be an attack from evil spirits.
3. **Sacrifices:** Animals such as dogs, cats or cows are sacrificed as an offering upon the request of ancestors, spirits and gods to save the life of the person on the death's bed. Rituals are performed to consecrate herbs before they are applied.
4. **Expiation:** Sacrifice to ask for protection from the wrath of the gods, ancestors and enemies.
5. **Purification or spiritual cleansing:** To be cleansed spiritually, the sick person may be required for a set number of days at a specific time with water or animal blood poured from head to toe.
6. **Propitiation or appeasing of gods:** The diviner appeases the ancestors, spirit or gods if the disease is considered to be caused by curses or violations of taboos. The affected individual must provide items for sacrifice. The gods usually specify these items.
7. **Exorcism:** Exorcism can only be performed by the priest or religious leader. It involves driving demons or evil spirits from people or places that are possessed or are in danger of being possessed by them. It entails singing, beating of drums, dancing and touching the individual with objects to drive out the spirit.
8. **Libation:** Libation involves pouring some liquid, mostly local gin/water/whiskey or wine.
9. **Warding off evil spirit:** This is about giving the spirit what it wants to keep it off.
10. **Reconciliation:** When one is at loggerheads with the society or a close relative or friend, he/she reconciles to bring about harmony or sow compactness.

7.2 Technological knowledge and skills involved in traditional healing

With regards to the technological knowledge and skill, it is worth noting that African indigenous medical technology has not only developed drugs and surgical skills for fighting ailments but

is also replete with a reputable body of knowledge for the training of specialists in the healing of various diseases and disorders of various complications (Onu,1999). Healers have in-depth knowledge of plants and plant parts and minerals (clay, silt, stone) that may be used to treat various diseases. They are cognisant of the sustainable harvesting of medicinal plants. For example, in Tanzania and Nigeria, the health ministry creates awareness of the importance of traditional medicine plants and the need for good practice, conservation and sustainable harvesting (Ozioma and Chinwe, 2019). In Nigeria, training schools exist for both herbal medicine and homoeopathy, subsequently traditional health practitioners have excellent knowledge of the pharmaceutical properties of herbs, shared cultural views of diseases in society. Their deep African indigenous knowledge together with modern skills and techniques in processing and preserving herbal medicines are used in the management of diseases.

Moreover, renowned silviculturists and plant taxonomists are helping traditional healers identify and classify plants and share and document evidence-based therapeutic knowledge. In this way, successful treatments are formalised and prescriptions of the correct methods of preparation and dosage are noted. Of significance in the points mentioned above is the “scientific” process involved African indigenous medicine. Often the western worldview casts African indigenous medicine as being irrational and ungrounded in scientific methods as mentioned earlier.

The plant parts are harvested fresh, and the following methods of preparation (Ozioma and Chinwe, 2019) are utilized:

- **Extraction:** The plant is pulverised and left to dry first, thereafter, it is soaked in water or any solvent on a mass by volume basis. Sometimes the solvent is evaporated to produce a soft mass of plant medicine.
- **Infusions:** They are made by soaking the crushed plant or plant part in cold or hot water for a short period. Honey is added to prevent spoilage and to serve as a preservative.
- **Concoctions:** These are made by boiling woody pieces for a specified time and filtering the mixture.
- **Tinctures:** They are alcoholic infusions. These infusions must be diluted for intake or application.
- **Ashing:** The dried parts of the plant are burnt to ashes. The ash is sieved to separate it from larger unburnt parts of the plant. the ashes are added to food or water.
- **Miscellaneous:** This category includes liniments, poultices and snuff.

There are also different methods of administration such as smoking, inhalation, steaming, oral, rectal, topical and nasal route.

8. Implications for COVID-19

Modern chemical science facilitates the understanding that herbal cures are advanced in their biological complexity and ability to cure ailments (Fitzgerald, 2016). For example, Thomson, a self-taught herbalist and botanist from Alstead in New Hampshire, invented Thomsonianism, a branch of medical treatment which came from homeopathic ideology which uses heat to heal the body (Fitzgerald, 2016). Hence, *go aramela* (Tswana for steaming), which is one of the recommended ways to combat COVID-19, has been a common practices to treat flu-related ailments (Gumbo and Gaotlhobogwe, *in press*).

Cross-culturally, people possess innate healing capacities, as such healing happens from within through healthful life-ways and ecosystems. Different cultures share a consciousness of the world and commonly have a characteristic view of life and health. This suggests a careful observation of nature which can make us learn about diseases and healing. Solutions can therefore not only come from the laboratory but from ensuring a balance between human life and nature. Conventional healing methods can benefit from indigenous healing methods and *vice versa*. Efforts should therefore be combined to combat diseases instead of looking only to the West for solutions. Also, it should be noted that spirituality and healing have always been a combined tradition among African indigenous people. Thus, traditional healing evolves from ancient times with its systems and practices varying according to geography and culture (Iddrisu, 2017). According to Mokgobi (2014) and Iddrisu (2017), traditional healing predates the application of science and technology to medicinal practice.

There is thus a need to research and learn about traditional healing rather than discriminating against it. Ways should be found quickly to engage interdisciplinary teams of African scientists and traditional modern practitioners as well as with scientists and practitioners from other contexts (Atsua, 2020). Atsua (2020) states that the purpose of doing this is to transform African herbal drugs and traditional remedies into modern medicine. The risk of following this approach is to uplift modern medicine as superior to traditional medicine and thus perpetuate the *status quo*. Transformation should happen on both sides by appreciating winning solutions and combining them where possible. The philosophy of George Kelly's Constructive Alternativism could be helpful here; it challenges objectivity (Mokgobi, 2014). This philosophy acknowledges difference in the construction, interpretation and understanding of reality. One construction may not be perceived supervisor to another because the world is too large and complex for anyone to claim and universalise a perfect perspective (Mokgobi, 2014).

The rich traditional healing heritage should be encouraged and achieved by stimulating talents in this field which show good results to enjoy some degree of security as they collaborate with medical science research institutes and pharmacological industries (Atsua, 2020, p. 461). To achieve this, selfish attitudes should be dealt with. A noteworthy example is that of Madagascar. Atsua (2020) cites a promising development in this regard about the cure and/or treatment of COVID-19 in that context. However, the WHO quickly distanced itself from the

COVID-Organics herbal-solution developed by the Malagasy Institute of Applied Research (Atsua, 2020). It is confirmed that there has been a marked improvement in the country's COVID-19 recovery ratio of 105 out 171 patients who were reportedly cured (Atsua, 2020).

Lastly, methods and technologies of traditional healing are not divorced from spirituality, happen within the tripartite relationship of humans, social and spiritual worlds – magico-religious, hence the ecological systems and social systems which impact on them (figure X.1). Fundamentally, African traditional healing is guided by *botho*

9. Conclusion

Traditional healing is fundamentally a health care resource for many African indigenous people. The fact that African indigenous people in Diaspora in the U.S. cling to their traditional healing practices and technologies is also an indication that this study has relevance to other indigenous contexts. The study has shared knowledge about how much life is valued within African traditional healing. Unlike the Western healing practices and technologies, African traditional healing happens in an open environment of consultation which is most a home of the patient. It involves the family, not the individual alone, thus it thrives on *botho* as members of the family should understand the disease of the individual being treated so they can show support and know how to behave to restore him/her to a healthy state again. This expanded scope of treatment honours the ecological and social systems and the balance that should be maintained, failing which a disease encroaches. This study suggests the need to appreciate the contribution that African traditional healing can make in the treatment of diverse ailments including COVID-19. A change of attitude towards traditional healing is therefore recommended. Also, there is a need to intensify a collaboration between biomedicine and traditional medicine. African traditional is a fundamental component of indigenous knowledge systems which should be preserved as they are crucial for sustainable development.

References

- Adu-Gyamfi S, Aminu D, Kwasi A, and Sampson A (2017). “Public health: A socio-political history of a people (1902-1966)”. *Journal of Arts and Humanities* 6(8), 11-32.
- Adu-Gyamfi S and Anderson EA (2019). “Indigenous medicine and traditional healing in Africa: A systematic synthesis of the literature”. *Philosophy, Social and Human Disciplines* 1: 69-100.
- Ajima OG and Ubana EU (2018). “The concept of health and wholeness in traditional African and social medicine”. *Arts and Social Sciences Journal* 9(4), 1-5. <https://doi.org/10.4172/2151-6200.1000388>.
- Amegbore P (2014). “Health seeking behaviour in Asikuma-Odobenbrakwa district: A pluralistic health perspective”. Unpublished master's thesis. Oslo: University of Oslo.

- Amoah SK, Sandjo LP, Bazzo ML, Leite SN, and Biavatti MW (2014). "Herbalists, traditional healers and pharmacists: A view of the tuberculosis in Ghana". *Brazilian Journal of Pharmacognosy* (1), 89-95.
- Aniah P (2015). "The contribution of indigenous health care providers to health care delivery in rural Ghana: An exploratory study of Bongo District". *Science Journal of Public Health* 1(3), 20-28.
- Apple MW (1996). "International perspectives on the Sociology of Education). *British Journal of Sociology of Education* 17(2), 125-144.
- Audet CM, Ngobeni S, and Wagner RG (2017). "Traditional healer treatment of HIV persists in the era of ART: A mixed methods study from rural South Africa". *BMC complementary and alternative medicine* 17(1), 1-6.
- Bhat RB (2014). "Medicinal plants and traditional practices of Xhosa people in the Transkei region of Eastern Cape, South Africa". *Indian Journal of Traditional Knowledge* 13(2), 292-298.
- Centre for Disease Control. (2020). Africa joint continental strategy for COVID-19 outbreak. <https://africacdc.org/download/africa-joint-continental-strategy-for-covid-19-outbreak/>
- Crick E, Griffiths M, and Payne C (2011). "The witch doctor will see you now: Cameroon – goat blood bath" [Documentary mini-series]. Washington, D.C.: National Geographic TV.
- Dyer SJ, Abrahams N, Hoffman M, and Van Der Spuy ZM (2002). "Infertility in South Africa: Women's reproductive health knowledge and treatment-seeking behaviour for involuntary childlessness". *Human Reproduction* 17(6), 1657-1662.
- Emeagwali G and Dei GJS (2014). "African Indigenous knowledge and the disciplines". Rotterdam: Sense.
- Etta EE and Asukwo OO (2019). "The reality of African epistemology". *International Journal of Innovative Science, Engineering & Technology* 6(10), 279-305.
- Fitzgerald C (2016). "African American slave medicine of the 19th century". *Undergraduate Review*, 12, 44-50.
- Gumbo MT (2020). "Considering alternative knowledge forms in Technology Education." In MT Gumbo (Ed.), *Decolonization of Technology Education: African indigenous perspectives* (pp. 171-188). New York: Peter Lang.
- Gumbo MT and Gaotlhobogwe M (2021). "African indigenous knowledge and practices to combat COVID-19 pandemic". *Journal of Management, Spirituality & Religion*. In Press.
- Handayani RD, Wilujeng I, and Prasetyo ZK (2018). "Elaborating indigenous knowledge in the Science curriculum for the cultural sustainability". *Journal of Teacher Education for Sustainability* 20(2), 74-88.
- Hahn R (1995). "Sickness and healing: An anthropological perspective". New Haven: Yale University Press.
- Horden P and Hsu E (Eds). (2013). "The body in balance: Humoral medicines in practice". New York: Berghahn Books.
- Iddrisu MT (2017). "Healing and medicine in traditional African societies: A reflection of the worldview". *UDS International Journal of Development* 3(2), 51-59.

- Kahissay MH, Fenta TG, and Boon H (2017). “Beliefs and perceptions of ill-health causation: A socio-cultural qualitative study in rural North-Eastern Ethiopia”. *BMC Public Health* **17**(1), 1-10.
- Islam R and Sheikh MA (2010). “Cultural and socio-economic factors in health, health services and prevention for indigenous people”. *Antrocom Online Journal of Anthropology* **6**(2), 263-273.
- Kamenopoulou L (2016). “Ecological systems theory: A valuable framework for research on inclusion and special educational needs/disabilities”. *Pedagogy* **88**(4), 515-527.
- King R (2000). “Collaboration with traditional healers in HIV/AIDS prevention and care in Sub-Saharan Africa: A literature review”. Geneva: UNAIDS best Practice Collection.
- Mabovula NN (2011). “The erosion of African communal values: A reappraisal of the African ubuntu philosophy”. *Inkanyiso, Journal of Human & Social Sciences* **3**(1), 38-47.
- Mabvurira V (2016). “Influence of African traditional religion and spirituality in understanding chronic illnesses and its implications for social work practice: A case of Chiweshe communal lands in Zimbabwe”. Unpublished PhD thesis. Polokwane: University of Limpopo.
- Madamombe I (2006). “Traditional healers boost primary health care: Reaching patients missed by modern medicine”. New York, NY: United Nations.
- Makundi EA, Malebo HM, Mhame P, Kitua AY, and Warsame M (2006). “Role of traditional healers in the management of severe malaria among children below five years of age: The case of Kilosa and Handeni districts, Tanzania”. *Malaria Journal* **5**(58), 1-9. doi: 10.1186/1475-2875-5-58.
- Maroyi A (2017). “Diversity of use and local knowledge of wild and cultivated plants in the Eastern Cape province, South Africa”. *Journal of Ethnobiology Ethnomedicine* **13**, 1-16.
- Mbaya H (2011). “Social capital and the imperatives of the concept and life of Ubuntu in the South Africa context”. *Scriptura* **106**, 1-8.
- McFarlane C (2015). “South Africa: The rise of traditional medicine”. *Insight on Africa* **7**(1), 60-70.
- Mmamosheledi E, Mothibe, ME, and Sibanda M (2019). “African Traditional Medicine: South African perspective”. *Traditional and Complementary Medicine*. https://www.researchgate.net/publication/331041088_African_Traditional_Medicine_South_African_Perspective
- Mokgobi MG (2014). “Understanding traditional African healing”. *African Physical Health Education Recreat Dance* **20**(Suppl 2), 24-34.
- Ngang CC and Ageh PA (2019). “Intellectual property protection of African traditional medicine within the legal framework of the right to development”. *African Journal of International and Comparative Law* **27**, 3, 426-445.
- Ngunyulu R, Mulaudzi F, and Peu M (2016). “Perceptions of midwives regarding the role of traditional birth attendants during postnatal care in South Africa”. *African Journal of Nursing and Midwifery* **18**(1), 47-60.
- Olumbe D (2008). “African worldview: An introduction”. https://watumishiwaneno.files.wordpress.com/2014/08/african_worldview_introduction.pdf

- Owusu-Ansah FE and Mji G (2013). "African indigenous knowledge and research". *African Journal of Disability* 2(1), 1-5.
- Onu AO (1999). "Social basis of illness: A search for therapeutic meaning". In AI Okpoko (Ed.), *Africa's Indigenous Technology* (pp 179). Ibadan: Wisdom Publishers Ltd.
- Oyebode O, Kandala NB, Chilton PJ, and Lilford RJ (2016). "Use of traditional medicine in middle-income countries: A WHO-SAGE study". *Health, Policy and Planning* 31(8), 984-991.
- Pesek T, Helton L, and Nair M (2006). "Healing across cultures: Learning from traditions". *EcoHealth* 3(2), 114-118.
- Petrus TS and Bogopa DL (2007). "Natural and supernatural: Intersections between the spiritual and natural worlds in African witchcraft and healing in reference to Southern Africa". *Indo-Pacific Journal of Phenomenology* 7(1), 2-10.
- Ramose MB (2002). "The philosophy of ubuntu and ubuntu as a philosophy". In PH Coetzee and, APJ Roux (Eds.), *Philosophy from Africa: A text with readings* 2nd Edition (pp. 230-247). Cape Town: Oxford University Press.
- Semenya SS, Potgieter M, and Erasmus L (2013). "Indigenous plant species used by Bapedi healers to treat sexually transmitted infections: Their distribution, harvesting, conservation and threats". *South African Journal of Botany* 87, 66-75.
- Shange T (2012). "Indigenous methods used to prevent teenage pregnancy". Unpublished Master dissertation. Durban: University of KwaZulu Natal.
- Shea N (2011). "Developmental systems theory formulated as a claim about inherited representations". *Philosophy of Science* 78(1), 60-82.
- Shewamene Z, Dune T, and Smith CA (2017). "The use of traditional medicine in maternity care among African women in Africa and the diaspora: A systematic review". *BMC Complementary and Alternative Medicine* 17(1), 1-16.
- Shizha E (2013). "Reclaiming our indigenous voices: The problem with postcolonial sub-Saharan African school curriculum". *Journal of Indigenous Social Development* 2(1), 1-18.
- Siambombe A, Mutale Q, and Muzingili T (2018). "Indigenous knowledge systems: A synthesis of Batonga people's traditional knowledge on weather dynamism". *African Journal of Social Work* 8(2), 46-54.
- Sobiecki JF (2014). "The intersection of culture and science in South African traditional medicine". *Indo-Pacific Journal of Phenomenology* 14(1), 1-10.
- Steenkamp V (2003). "Traditional herbal remedies used by South African women for gynaecological complaints". *Journal of Ethnopharmacology*, 86: 97-108.
- Tan M, Otake Y, Tamming T, Akuredusenge V, Uwinama B, and Hagenimana F (2021). "Local experience of using traditional medicine in northern Rwanda: A qualitative study". *BMC Complement Medicine and Therapy* 21, 1-11.
- Tanyanyiwa VI and Chikwanha M (2011). "The role of indigenous knowledge systems in the management of forest resources in Mugabe area, Masvingo, Zimbabwe". *Journal of Sustainable Development in Africa*, 3(3), 132-149.

- UNESCO (2020). “The place of African traditional medicine in response to Covid-19 and beyond”. <https://en.unesco.org/news/place-african-traditional-medicine-response-covid-19-and-beyond>
- Ubrurhe JO (2003). “Urhobo traditional medicine”. Ibadan: Spectrum Books Limited.
- Utsua TP (2020). “The importance of African traditional medicine and healing techniques in the fight against Covid-19 pandemic”. *IGWEBUIKE: An African Journal of Arts and Humanities* 6(5), 456-470.
- White P (2015). “The concept of diseases and health care in African traditional religion in Ghana”. *HTS Theological Studies* 71(3), 01-07.
- WHO Report (2000). “General guidelines for methodologies on research and evaluation of traditional medicine”. Geneva: WHO.
- WHO (2002). “WHO traditional medicine strategy 2002-2005”. Geneva: WHO.
- Zuma T, Wight D, Rochat T, and Moshabela M (2016). “The role of traditional health practitioners in rural KwaZulu-Natal, South Africa: Generic or mode specific?” *BMC Complement and Alternative Medicine* 16(1). <https://www.bing.com/search?q=The+role+of+traditional+health+practitioners+in+rural+KwaZulu-Natal%2C+South+Africa%3A+Generic+or+mode+specific%3F&go=Search&qs=ds&form=QBRE>

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Chapter Thirteen

The COVID-19 pandemic in education: Intersections with poverty

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Abstract - The global COVID-19 pandemic has continued to sweep across countries with most educational institutions needing to operate in crisis mode in an attempt to mitigate learning losses arising from the extended levels of lockdowns. In this chapter, we consider the impact of the pandemic on global endeavours to achieve the Sustainable Development Goals (SDGs), as part of the global agreement concluded in 2015 by the United Nations (UN). We also consider the mitigation strategies used in the education sector, focusing on low income countries, specifically in Africa, and consider the intersections of the pandemic with poverty and gender. In addition, the long term complications arising from the resultant learning losses, which reverse the gains made in respect of Goal 4 of the SDG as highlighted by various studies, are discussed. It is argued that the pandemic has thwarted our endeavours to ensure inclusive and equitable quality education and the promotion of lifelong learning opportunities for all – a goal indispensable for the achievement of all other 16 Goals of the SDG, specifically health and well-being (SDG 3) and gender equality (SDG 5), which are considered in the latter part of this chapter.

Key words: *COVID-19; education; digital divide; poverty; gender; learning loss; Sustainable Development Goals.*

Abbreviations

COMSEC:	Commonwealth Secretariat
DHET:	Department of Higher Education and Training
GDP:	Gross Domestic Product
ILO:	International Labor Organization
JET:	Joint Education Trust
SDG:	Sustained Development Goals
SES:	Socioeconomic Status

UN:	United Nations
UNESCO:	United Nations Educational, Scientific, and Cultural Organization
UNICEF:	United Nations Children’s Fund
UNISA:	University of South Africa
UNWFP:	United Nations World Food Program

1. Introduction

UNESCO refers to the pandemic as the most severe “global education disruption in history” with teaching and learning within educational institutions grinding to a halt and impacting more than 190 countries, 1.6 billion learners, 300 million higher education students, and 100 million teachers and school personnel (UNESCO, 2021a,b)

This chapter thus focuses on the disruption brought about by the pandemic, considers its intersection with poverty, and reflects on the effects of the resultant educational mitigation strategies in low income countries, specifically in Africa.

As the past two years have shown, the ramifications of the COVID-19 pandemic have extended beyond mere health-related risks. They include immense social ramifications (Lopes and McKay, 2020, 2021) structurally affecting the world economy with rising unemployment (ILO, 2020), rising public debt, and decreasing GDPs (Cutler and Summers, 2020). All this as populations saw their financial and earning capacities diminish, and social inequalities exacerbated (James and Thériault, 2020). These numerous negative consequences will have an impact on the achievement of all the SDGs and leave a mark on humanity for many years (Ottersen and Engebretsen, 2020).

Despite the implementation of their range of mitigation strategies, it has not been possible for developing countries to ensure that teaching and learning are equally available to all learners. UNESCO (2021a) refers to the considerable losses in learning through the disruptions across the education sector, showing how these are exacerbated by socioeconomic status (SES) and indicating that they will have long-term and lasting effects on the most vulnerable and marginalized in society. UNESCO (2021a) estimates that 24 million children and youths are at risk of dropping out and, as a result of learning loss, a further 100 million will fall below the minimum proficiency level in reading, which is a foundational skill for all learning. These problems are compounded by the economic downturn as a result of the economic slowdown and the national education budgetary cuts worldwide, which occurred at precisely the time when increased funding was needed across the educational sector and more especially in developing countries.

The discussion that follows highlights how this single medical protocol of ‘social distancing’, when considered through the lens of intersectionality (Meer and Müller (2017), gives rise to impacts which are differentiated by income-/socioeconomic-status (SES). It further reveals

other factors discussed in this chapter that include race, gender, ability, and urban/ruralness as interlocking systems of disadvantage and oppression (UNESCO, 2021a,b).

Through the medical mitigation interventions put in place, nearly 1.6 million children were ‘locked out’ of their classrooms. The impact of this varied in accordance with SES. For example, parents with little or no education themselves needed to become involved in home-schooling or remote teaching of their children; or the impact of parental absence shown when parents continued to work during the lockdown; or the increase in household poverty with parents being retrenched or losing income through ill health. These limitations are in addition to the lack of learners’ and parents’ access to online tools and digital competencies.

Despite the range of interventions, the pandemic has radically changed the landscape of education. Higher education is no exception and, after consideration of the methodology, this chapter will begin with a discussion of the shift to online and e-learning focusing on higher education, and will thereafter consider the impact of COVID-19 on schooling.

2. Methodology

This chapter is based on a review of a range of studies on the impact of the pandemic on education.

Firstly, it draws on an exploratory investigation into the mitigation strategies employed in six countries. The study was undertaken on behalf of the Commonwealth Secretariat (COMSEC) to examine the impact of COVID-19 on education systems. This research also forms part of the #OpenUpThinking Research Bootcamp which, through the establishment of cross-cutting partnerships, aims to benefit the broad education community by feeding the emerging findings from the thematic streams into the relevant debates at the Commonwealth Ministers of Education Conference in 2021. The study was conducted early in the pandemic, even before some of the countries went into lockdown, the research was aimed at providing realtime inputs on education processes.

The research approach was conceptualised as a “Research Bootcamp”, and was initiated some two months into the pandemic in June 2020. The research was conducted by a team of seven¹⁷ postgraduate researchers in Nigeria, Kenya, Tanzania, Zambia, India, and Sri Lanka who were located in their respective countries with myself in South Africa as the theme lead for the study. The Joint Education Trust (JET) coordinated the group of studies in the #OpenUpThinking series. In addition, Mabunda and McKay (2020) researched the impact of the pandemic on South African education, which is also discussed in this chapter.

Methodologically the COMSEC study conceived as a “Bootcamp” and was conducted totally virtually in order to comply with the pandemic developing an appropriate COVID-type research

¹⁷ Burure D, Chiwele K, Ishola E, Kusala F, Okang’a N, Shanmugam A, and Tizeba C.

approach. The Bootcamp was launched online on Tuesday 16 June 2020; using the Google Meet platform in order that the researchers for this study (known as Theme 1) were introduced to each other and informed of the COMSEC research plan. With all of us being in different countries, all the interactions used Google Meet video-communication, with Google documents used for all documents that needed to be co-developed, including the research proposal, survey tools, and the final report. ‘Google Forms’ was used as the basis for conducting the surveys. In addition, a WhatsApp group was set up to enable regular communication.

Primarily used in the ICT sector, ‘Bootcamps’ refer to short-term, intensive training programs that teach students practical and job-ready technical skills. The COMSEC Bootcamp gave the entire team valuable research experience on developing a virtual COVID methodology whilst making a contribution to the thinking around the pandemic that, with the other themes being researched at the time, were used for informing Commonwealth Education Ministers.

The comparative study involving six Commonwealth countries (across Africa and Asia) aimed at determining national responses and challenges in the education sector from the vantage point of teachers, parents, and officials in Ministries of Education.

This study explored how governments of the respective countries were positioning, activating, and supporting public educational institutions to implement multi-pronged efforts to contain COVID-19 whilst ensuring the continuation of teaching and learning. The study was initiated with a view to contributing to the thinking regarding the implications of COVID-19 on the education sector.

Key research questions for the Bootcamp study were:

1. What impact has COVID-19 had on education across the system – from pre- to post-schooling?
2. What mitigation strategies have been put in place to keep the education sub-sectors functional? What are the achievements/challenges of such interventions?
3. What were the envisioned scenarios for managing the reopening of schools?

The COMSEC Bootcamp (2020) study utilized a mixed-method approach in the form of literature reviews which sourced all policy and protocol guidelines which were emerging in the respective countries at the time. In addition, quantitative and qualitative surveys were administered digitally, either by email or using Google Forms that were administered by mobile phones.

The Bootcamp research team conducted three online surveys using Google Forms, aimed at exploring the views of officials in the Ministries of Education as well as teachers and parents. The surveys contained a combination of quantitative, closed-ended and qualitative, open-ended responses. The purpose of each survey was clearly stated to the respective participants prior to

participation, and electronic consent was required from all respondents who were also made aware that they might cease participation at any point during the survey.

This early stage study was unique in surveying officials in Education Departments, as well as parents and teachers, and contributed not only to providing pertinent information but also to developing alternative methodologies that complied with the COVID protocols. The following surveys were conducted:

- Ministry of Education officials were surveyed using open-ended questions, distributed via email, to establish the emerging COVID-19 strategies put in place, how they perceived the strategies to evolve during the pandemic, what post pandemic strategies needed to be put in place subsequently to get children back to school, and what impact the lockdown was likely to have on school children and university students. Two officials were surveyed in each of the six countries yielding a sample of 12 officials in total.
- Teachers and university lecturers were surveyed. Google Forms questionnaires were sent out as a cell phone survey. This was an ideal approach for use during the pandemic. The Google Forms were co-designed by the researchers and approved by the group as being appropriate for teachers across the range of countries. The questions were closed- and open-ended, and aimed at exploring the strategies being used to ensure the continuation of learning, what successes, if any, and challenges they experienced at that early stage in the evolution of the pandemic, and also what back-to-school strategies and challenges they envisaged. The survey considered the various mitigation strategies such as abridged/truncated curricula, the extent to which only certain school subjects were taught, and how they were taught in the context of the pandemic. A total of 24 teachers were surveyed – four from each country. They were purposively selected and stratified to have some representation of teachers across the schooling sector from pre-school to secondary school and post-school lecturers with 50% being urban and 50% being rural.
- Parents were also purposively drawn to from across the school phases, from pre-school to secondary school and post-school. The administration of the surveys for parents was done telephonically with the researcher asking the questions in the target language and completing the survey questions on the Google Form. This was done to accommodate parents who might not be able to read and to compensate for our not translating the survey into the many languages of all respondents across all the countries. The parents lack of data was also a consideration. Parents were surveyed regarding their role in supporting their children during the pandemic, what challenges they had, and what they perceived the situation of schooling to be post-COVID. Four parents from each country were selected with a total of 24 parents being sampled over the few studies, with the selection ensuring that 50% of the respondents were rural and 50% urban.

While the sample may not be generalized, the trends which emerged were important in giving rise to a number of themes that needed to be considered. This chapter demonstrates how, when the findings from these very early, small scale country studies were consolidated, they provided ‘early warnings’ for the design of mitigation strategies. The findings of the Bootcamp study resonate with the results of major global and international studies such as the global studies conducted by UNESCO, UNICEF, and the World Bank (2021), into teaching and learning in the context of the pandemic.

In the next section, I begin by examining the impact of the pandemic on Higher Education and on the transition to online and e-learning.

3. Some impacts of the pandemic on higher education

One of the critical sub-goals of SDG 4 is goal 4.3 which focuses on addressing equity in higher education with a view to ensuring equal access for all women and men to affordable and quality technical, vocational, and tertiary education including university education. This sub-target, SDG 4.3, is interlinked and is essential for the achievement of the other SDGs, such as the goals related to poverty (SDG 1), health and well-being (SDG 3), and gender equity (SDG 5), amongst others.

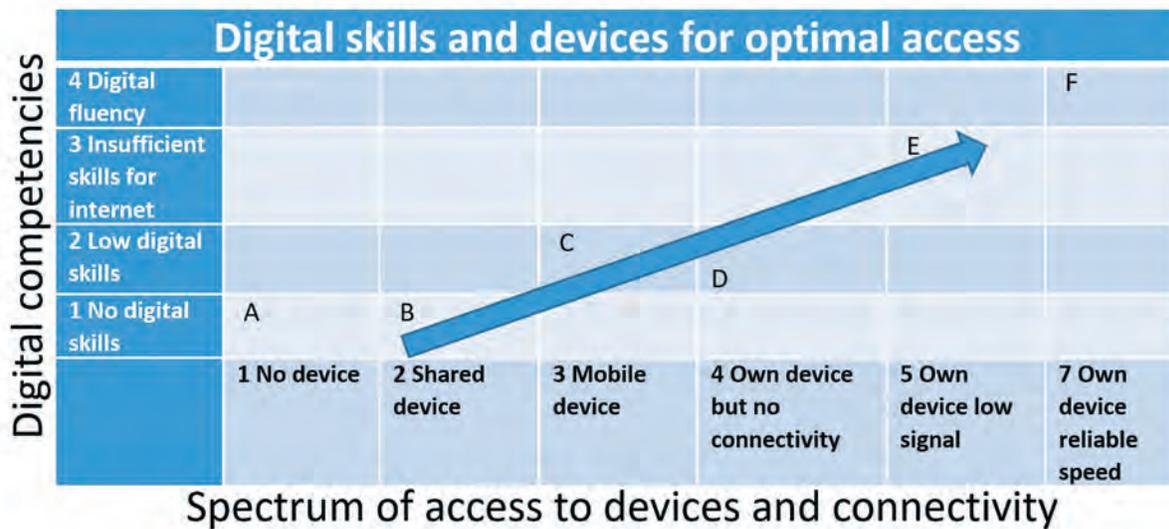
Over the past decade, Higher Education systems globally have responded to the need to expand provision, and specifically African countries have seen massive growth in this sector, as a result of the ‘youth bulge’ in many African countries.

UNESCO (2020) reports that the pandemic has globally impacted more than 220 million tertiary students whose education was disrupted as universities shut down despite online or e-learning becoming the default mode of ensuring the continuation of teaching and learning. The UNESCO (2020) study reports that many higher education institutions have, as a result, shifted permanently to hybrid models – using some distance and some contact, whilst trying to adhere to the protocols of social distancing – and to keep abreast of the alternating scenarios in accordance with the various “waves of the pandemic”. However, the socioeconomic status (SES) has been a significant factor in the digital contexts in which universities find themselves – specifically in the developing world as the higher education sector attempted to keep the doors of learning open.

Notwithstanding the many endeavours to use online learning, universities in general were not all well-prepared to fully utilize these approaches, with the situation in the developing world being acute as learners and teachers lacked appropriate technological competencies to ensure that no one was excluded (UNESCO, 2021a,b). In its surveys, UNESCO (2021a,b) points out that although digital communication is being used globally there are clear socio-economic disparities, with low and medium income level member states reporting the need for improvement in digital infrastructure to support online teaching and learning.

Indeed, in my own experience, as a university manager charged with the development of a remote emergency teaching and learning model for more than 400,000 students at the University of South Africa (UNISA), the challenges of the digital divide as well as the limitations imposed by the SES of many of our students were all too obvious. The challenges were more complex than students either having or not having digital access in that from our own university survey and from our analysis of the students’ social media sites, it was clear that access was not simply about the dichotomy of the digital ‘haves’ and the digital ‘have nots’ but rather access was nuanced as shown in Figure 1, which I developed to demonstrate the complexity of digital access. The chart considers both access to an appropriate *device* and also to students having optimal *digital competencies and skills* for usage, and I contend that there is more to dealing with the challenges than initially surmised.

Figure 1 - Digital skills versus available devices



Source: Author

This chart is useful in guiding thinking about students at *digital risk* during the pandemic, and I argue that the lower combined score of *digital competencies* and *access to devices*, the higher the digital risk of the student who will not be able to navigate online learning. Point F on the chart denotes a student who has both fluent digital skills as well as access to optimal digital tools and optimal connectivity.

In designing teaching and learning interventions for the pandemic at the University of South Africa, it was noted that the majority of students had access to a mobile device as indicated in point C on the chart. This guided our decisions to develop our intervention strategy using the (smart) mobile phone as the common denominator, allowing the students to handwrite assessments and using a freely downloadable scanning App to create a pdf with which they could upload their work (using their mobile phone) onto the assignment and examination

platforms. In addition, to ensure the integrity of the assessment processes, we introduced low-tech proctoring also using the mobile device to monitor student behaviour during the examination. As with students all over the developing world, data and connectivity were not as ubiquitous as mobile phones. Students needed to be provided with 30 GB of data per month during the three months the examinations were being held. Ideally, students ought to be provided with data for throughout the academic year as the cost of data for many families competed with other basic household needs such as food, transport or electricity.

With the implementation of emergency remote learning, the digital inequalities were starkly revealed. They showed that not all youth of the *TikTok* generation were well-connected digital natives and that they were disadvantaged to varying degrees, both in terms of lack of access to connectivity, lack of devices, and also lack of digital competencies. That the digital divide is complex and multifaceted across a spectrum was shown without a doubt to be true by Zimmerman, 2020, and Mabunda and McKay (in press). But, additionally, the spectrum of access indicated in Figure 1 is compounded by an unreliable power supply that is common in the developing world (Uwezo, 2020:1).

4. Interventions aimed at mitigating the medical and social effects of the pandemic in schooling

Globally, the health protocols relied on social distancing as the essential feature of all national health strategies to mitigate the spread of the virus and to ensure the health and safety of learners and teachers. For this reason, e-learning was the dominant mode employed by educational institutions. The COMSEC Bootcamp study (2020) explores ways in which the six countries set out to ensure uninterrupted learning through, amongst others, digital platforms, reorganizing the school calendars as an attempt to recoup learning time, adapting and abridging its curricula and assessment regime, and using a range of interventions such as EduFirst TV, U Tube channels, telegram chat groups amongst others (as cited in the COMSEC Tanzanian sub-report). This latter sub-report also referred to the use of both synchronous and a-synchronous learning with live lectures being recorded and uploaded to the university system so that students could access them at any time.

Radio and television broadcasts were also commonly used methods (as cited in the COMSEC Nigerian sub-report) for basic and post-basic education with zero-rated links to e-learning portals for basic and post-basic education sites to ameliorate some of the problems of access. What is important to note is how these early country studies, within weeks of the onset of the pandemic, identified problems, particularly SES problems that plague learning as shown in the global studies. The early COMSEC Bootcamp study (2020) thus offered early warnings of a number of the challenges confirmed in the later global studies including:

1. Inequalities in accessing digital platforms as a result of lack of devices, digital competences of learners and teachers, lack of connectivity and electricity.

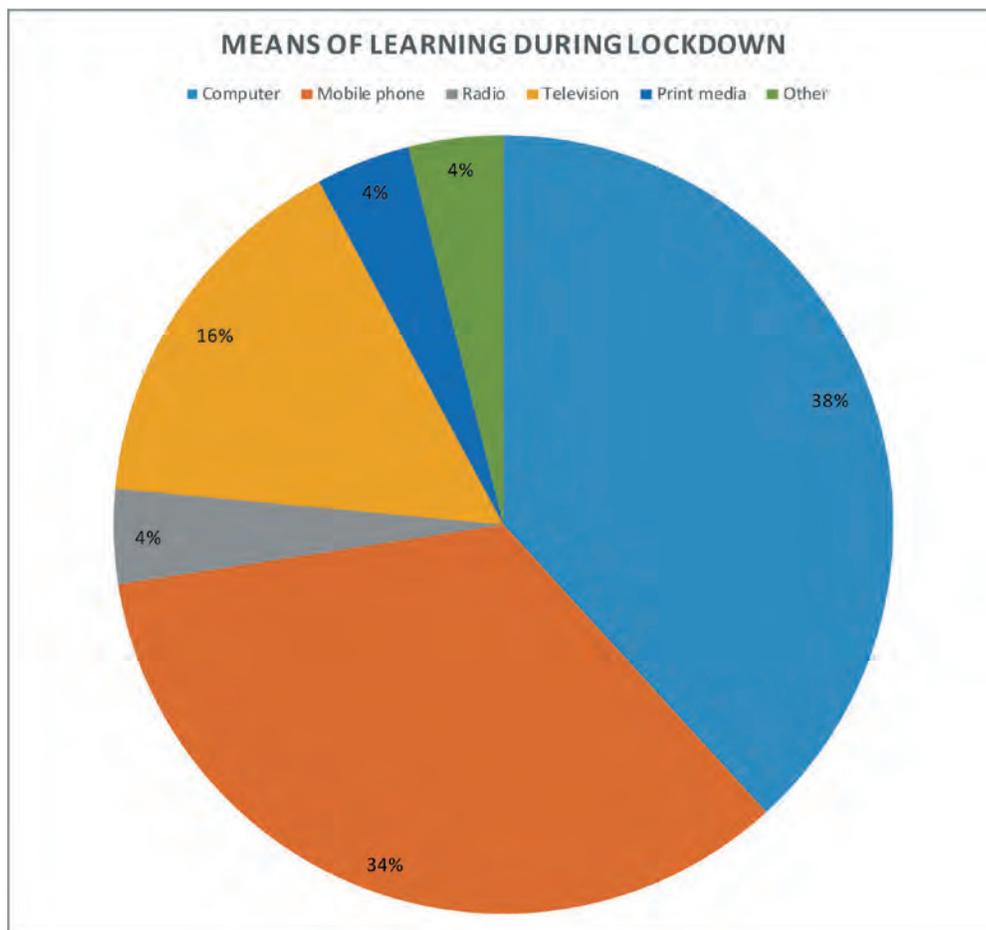
2. The consequential loss of learning potentially leading to high dropout rates.
3. The lack of safety associated with children being out of school and being largely unsupervised.
4. The high rates of teen pregnancy.
5. The increase in hunger among children especially those who usually receive meals at school.
6. The lack of sanitary pads for school girls who usually obtain these at schools.

4.1 Digitization and other means of learning utilised during lockdowns

The researchers involved in the COMSEC Bootcamp (2020) study reviewed their respective countries' use of digital platforms, learners' access to devices, and connectivity as well as the limitations imposed by digital competencies. These reviews highlighted SES as a differentiating feature and pointed to attempts to bridge the gap, for example, the Kenyan study, in fact, refers specifically to how the government was attempting to “bridge the technological divide by improving access to low-cost smartphones, TVs, radios, regular power supply, and internet facilities in rural areas” (COMSEC Bootcamp, 2020:45).

The cautions raised by the early June 2020 COMSEC Bootcamp study, were confirmed by the large scale international assessments such as the global study conducted by UNESCO, UNICEF, and the World Bank in 2021. These studies reports on the various kinds of e-learning interventions, with the mobile phone and TV being the dominant modes as well as other smaller interventions such as radio and newspapers. The modes of learning in the COMSEC study are illustrated in [Figure 2](#).

Figure 2 — Means of learning during lockdown

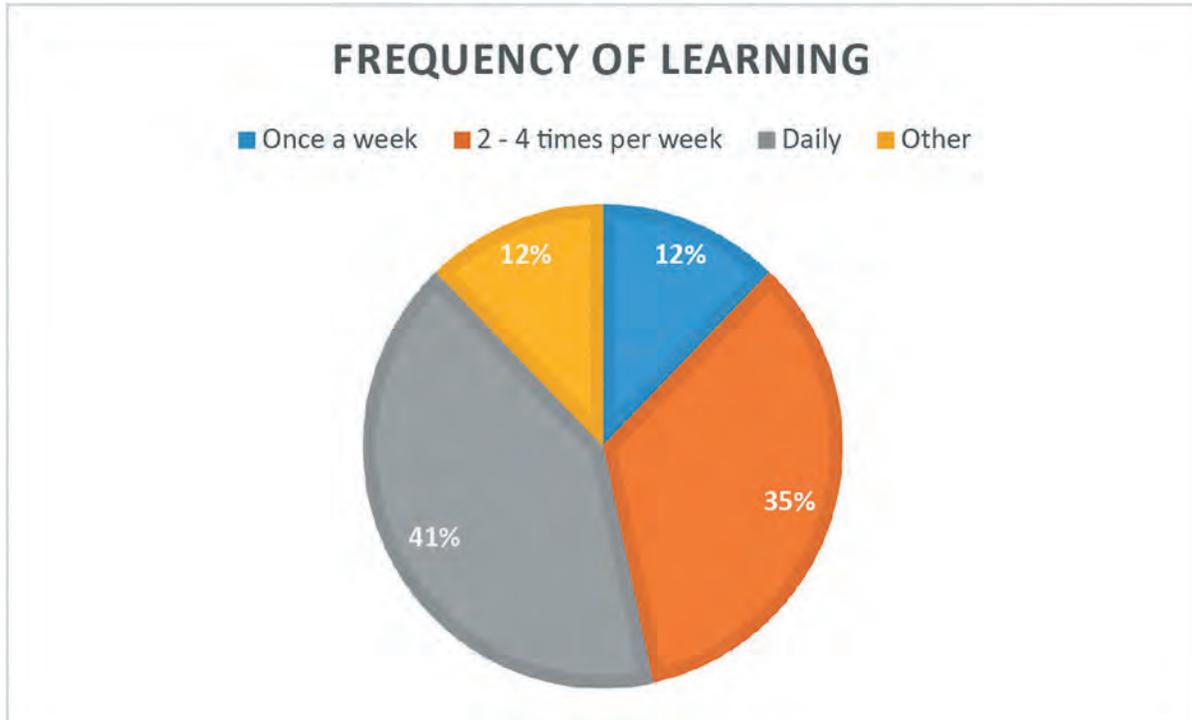


Source: COMSEC, 2020 (redrawn by the author)

4.2 Loss of learning time as a result of the pandemic

Figure 3 refers to the number of days that children were actually engaged in learning. While 4% were engaged on a daily basis, the remaining learners had sporadic learning that resulted in massive learning losses over the long term.

Figure 3 - Reports on the frequency of learning



Source: COMSEC, 2020 (redrawn by the author)

4.3 Viability of e-learning

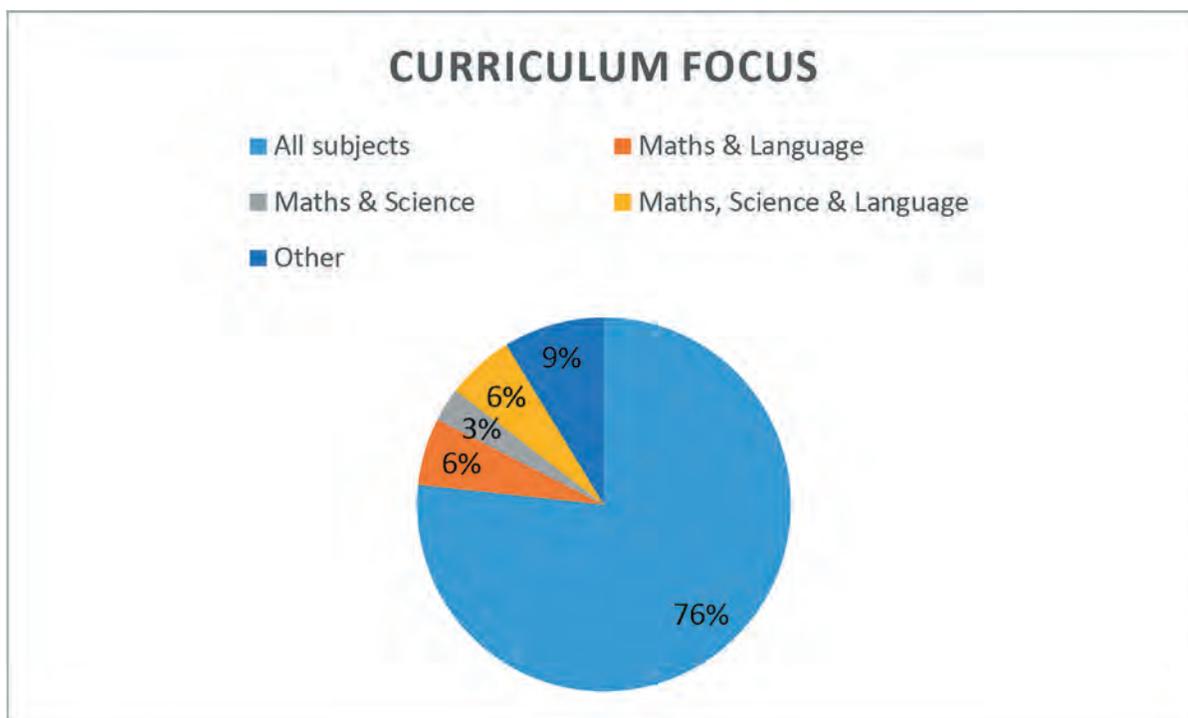
Figure 4 refers to parental views on whether e-learning was a viable alternative to in-school learning. As the COMSEC study (2020:45) indicates:

“The weakness of e-learning as a means of education is further evident in the parents’ inability to conclude that e-learning is tailored towards specific sets of identifiable goals and objectives. In spite of this ... half of the parents responded positively to making efforts to ensure that the students comply with the schedule of e-learning”.

While the challenges referred to in this study emanate from the emergency mode that had to be implemented without any prior preparation, McKay (2019) explains how the South African Department of Basic Education’s school workbooks, were developed following distance education principles and used in contact classrooms as a way of mediating learning when teachers lacked adequate skills. The use of such materials would have required only minimal e-teaching by teachers and parents as they were used to good effect in South Africa during the pandemic.

The COMSEC Bootcamp study also drew attention to the fact that schools tended to focus on some subjects with less attention given to others. This was a common trend in the more recent global studies, which referred abridged curricula or offered remedial and compensatory education on a rotational basis for classes that had been split to ensure social distancing. Figure 4 illustrates the differentiation in what was taught.

Figure 4 - Differentiation in what was taught



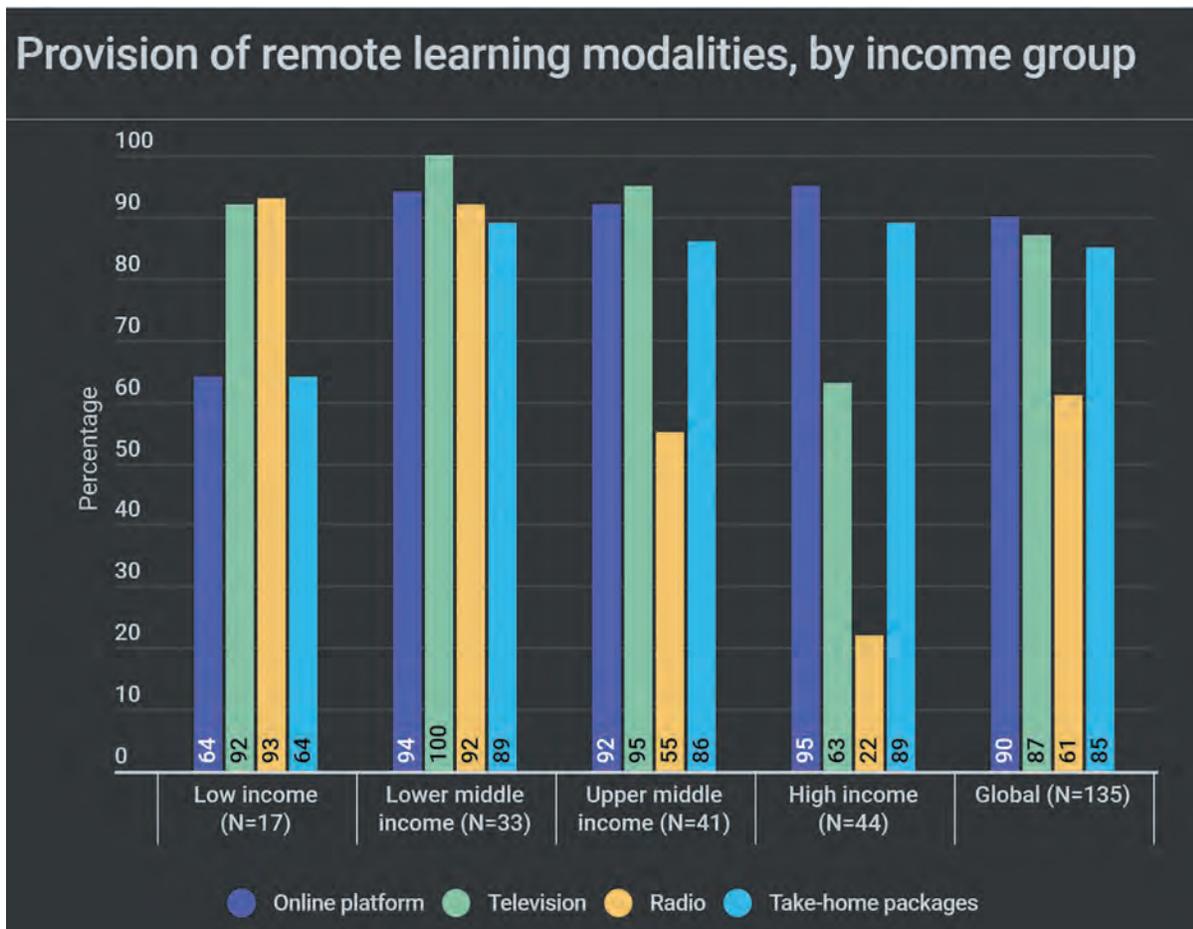
Source: COMSEC, 2020 (redrawn by the author)

4.4 The distribution of remote learning modalities

Figure 5 confirms the early predictions of the COMSEC Bootcamp study. The figure shows the differentiated provision of various modalities of teaching and how they were distributed across income groups. In fact, UNESCO (2021a) confirms this early finding, reporting that despite efforts of governments, nearly 500 million learners from pre-primary to upper-secondary school had no access to remote learning, three quarters of whom lived in the poorest households or rural areas. In the latter areas, the educational systems were unable to provide alternative options to ensure the continuation of learning and teaching because there were massive gaps in computer accessibility, access to electricity and connectivity, and even to low-tech applications such as television. Figure 5 also shows that the majority of the parents do not consider e-learning as a viable alternative to in-school learning and cautioned against the long-term feasibility of e-learning as a long term strategy for tackling educational challenges.

Figure 6 shows the actions undertaken by countries and by income groups with the intention of improving learners’ access to connectivity. Clearly (and ironically), the Figure demonstrates that low and lower income learners had the lowest access to subsidised or free internet access as well as little or no access to subsidised or free devices. The Figure also shows that the main mode for low income learners was the mobile phone,¹⁸ albeit to a limited extent.

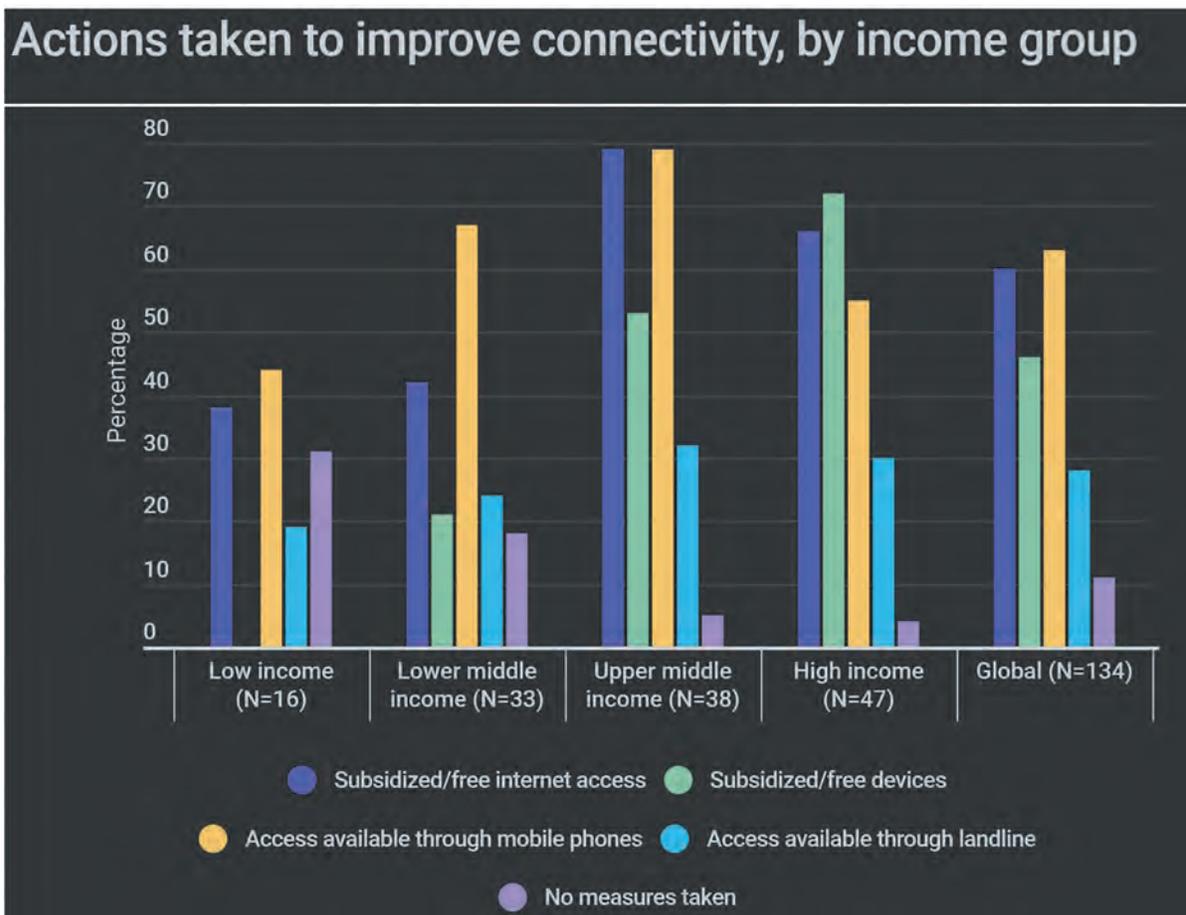
Figure 5 - The provision of remote modalities by income group



Source: UNESCO, UNICEF and the World Bank (2020)

¹⁸ The finding of the mobile phone being the most accessible option correlates with Figure 1, which shows that the University considered mobile phones as the default mode for UNISA students

Figure 6 - Actions taken to improve connectivity by income group



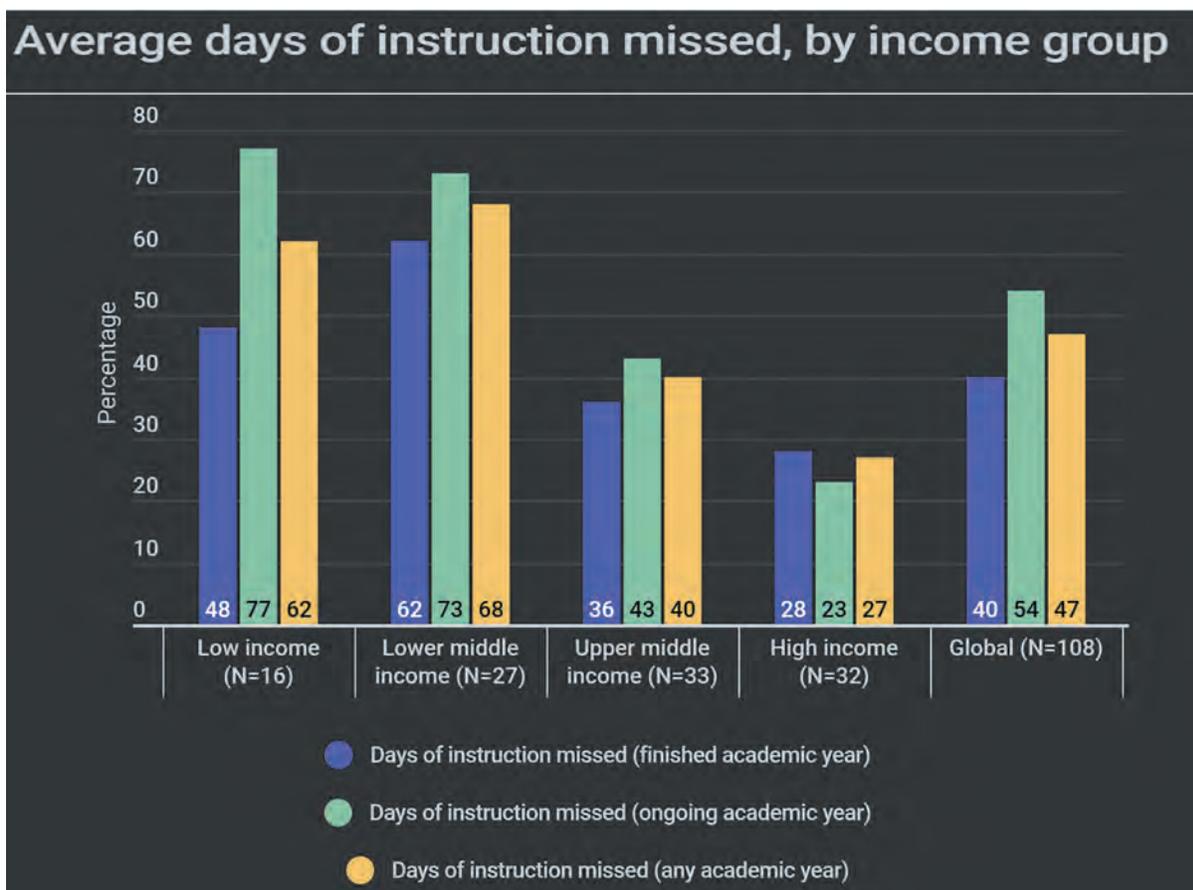
Source: UNESCO, UNICEF and the World Bank (2020) who have relatively high level competencies.

The global UNESCO, UNICEF, the World bank (2021), and the COMSEC Bootcamp findings show that while e-learning approaches may have some success for tertiary students, they are not a viable alternative to the conventional physical schooling context and cannot be considered a post-pandemic substitute in serving learners, irrespective of their SES. Moreover, the UNESCO, UNICEF, World Bank study refers to the intangible challenges accompanying e-learning such as digital competencies of teachers, catering for learners with special needs among others; all challenges that must be addressed before considering the use of e-learning in schooling. Beyond this, they argue there is a need to ensure that educational institutions have the capacity to ensure the health and safety of learners in preparing for the return to physical classrooms. With both the lack of digital possibilities, and also the lack of facilities for safe classrooms, the schooling system will need to provide innovative solutions to ensure the continuation of teaching and learning both during and post the pandemic.

4.5 Days of schooling missed

As shown in Figure 3, many children in poor schools lost learning time as a result of rotational timetables that were put in place to reduce the number of learners per classroom where splitting and then rotating classes offered a way of ensuring “social distancing”. These methods, usually necessitated by the high learner-to-teacher ratios in poor schools that are generally overcrowded (Shepherd and Mohohlwane, 2021), resulted in large-scale learning losses and learner attrition. Figure 7 reflects the number of days missed by learners who had completed their academic year, or who had carried over the next academic year.

Figure 7 - Average days of instruction missed by income group



Source: UNESCO, UNICEF and the World Bank (2020)

Whatever the quantum used, the World Bank (2021) refers to the magnitude of such learning losses and school dropouts of this magnitude as ‘an inequality catastrophe’ that intersects with poverty, gender, ability, and location that will affect an entire generation.

Making up the lost time is a lost cause as pointed out in the COMSEC Bootcamp Study. It avers the challenge of catching up with extra classes, the most common solution cited by teachers at

the early stages of the pandemic - a massive problem both because of the subdivision of classes resulting in more classes to be taught and the extensive and growing learning backlogs as the lockdowns proceeded.

Further, the problem of ill-equipped schools, also influenced by SES challenges, resulting in inadequate hand-washing facilities and inadequate sanitation, all of which disproportionately affected learners from lower income communities.

To corroborate this view of the interface of poverty and COVID-19, a recent South African study shows that approximately 750,000 children did not return to school in 2021 when the COVID--19 lockdown levels were lowered. School dropout was cited as a problem that was more prevalent among lower socio-economic households, and was found to be more acute in rural areas among households which had run out of money for food as a result of unemployment and lack of salaried income (Shepherd and Mohohlwane, 2021). These researchers (2021:12) state that “the effect of the COVID-19 pandemic, therefore, may have taken engagement in [South African] schooling back two decades with not having enough money for food, going hungry or relying on food donations”. This was reported as a critical challenge by more than 40% of higher education students (DHET, 2021), reflecting the analysis of Santos (2020) of the *Cruel pedagogy of the virus*.

4.6 The closure of schools and the lack of safety and protection

In addition to children relying on schools for meals, children in low-income households also depend on schools for sanitary towels that are often provided to school girls by government and social partners (COMSEC, 2020). The COMSEC Bootcamp study identified the impact on children’s safety and on their food security, which was exacerbated by the closure of educational institutions. Across studies it is indicated that while the school closures were implemented as a way “to save lives”, this conversely gave rise to wide-spread food insecurity and the question of “how to provide meals to children eligible for free or reduced lunch at school” among low-income school learners and university students who were residential – this concern was voiced across countries (Morgan, 2020) with the lack of institutional feeding giving rise to high levels of parental stress in low-income households (Shepherd and Mohohlwane, 2021).

In concurrence with this, the United Nations World Food Program (UNWFP) points out that 154 million children globally missed meals as a result of COVID-19-related school closures, bringing to bear on low income families where children rely on the school for their meals, and whose families are unable to fulfil the basic needs of food and shelter.

UNICEF has been driving a back-to-school campaign across the African subcontinent calling for the reopening of schools both for educational reasons and also for ensuring child safety, distribution of learning materials, learning continuity for the most vulnerable students, and continuity of school meal programs. UNICEF has specifically focused on girls’ education aiming

to sensitize caregivers about the importance of girls' returning to school as well as addressing the problems of safety for girls, gender-based violence, pregnancy and early marriage, which have spiralled.

It was recognized that home learning was a challenge across the developing world given the education levels of parents and parental absence as parents went back to work, resulting in children being left unsupervised. In calling for the reopening of schools, UNICEF (2021) draws attention to how SES differentiated the effects the pandemic, leaving millions of mostly poorer children, for whom adequate remote learning is not an option, and who "have been locked out their classrooms".

In order to drive its campaign, UNICEF quantifies that collectively these children have lost "1.8 trillion hours and counting of in-person learning due to COVID-19 lockdowns". As they point out: "In too many countries, classrooms remain closed while social gatherings continue to take place in restaurants, [pubs,] salons and gyms" (2021:n.p).

The UNICEF (2021) survey draws attention to the extended role that schools in the Southern African region play in the protection of children, especially for girls and for children in vulnerable and marginalized communities. The global shutdown has left millions of pre-primary, primary, and secondary school learners confined to their homes, often without adult supervision and exposing children to pornographic materials, substance abuse, and gender-based violence.

The UNESCO (2021a) study, conducted across 55 countries, indicated an increase in the prevalence of child labour related to COVID-19 school closures. It also reported on the consequences of the school shutdown beyond the immediate effects on learning loss and school dropout. In addition, UNESCO (2020a) reports that the disruption caused by the COVID-19 pandemic poses an immediate and long-term threat to gender equality that may have pernicious gender-specific effects in areas such as health, well-being, and protection. With regards to learning loss, it argues that girls carry a greater burden of household and domestic work demands which limited the time they had available for remote learning. In addition, girls were less likely than boys to return to school; and increases in rape and schoolgirl pregnancy increasingly being reported. This study added another dimension to the discussions on the digital divide and its impact on schooling, concluding that this was "gendered", with girls less likely than boys to have access to the internet and fewer of them owning a mobile phone.

5. Conclusion

I conclude this chapter by commenting on and commending the agility of Bootcamp-type modes of rapid research. As has been shown in this study, and analogously with rapid research appraisals, the Bootcamp-type research mode provides the brevity of implementation combined with the intensity of depth. This mode offers possibilities for the execution of research while more formal, representative and extensive methods are being planned. The brevity with which

these kinds of studies can be carried out makes the method extremely relevant for all forms of crises and for times when there is a need for real time data, rapid appraisals, and rapid information.

Emanating from this are the important findings to which we have been sensitized through the Bootcamp study. They were accentuated and fully explored in international global studies that showed the impact of the shutdown on SDG 4 – literally ‘closing the doors’ or learning. This devastating disruption, reversing gains already made globally, adds to the devastation seen across countries – a blow at a time when the UNESCO call for inclusive access to learning, specifically the education of women and girls, has already made inroads towards eliminating the gender gap in access to education and the continuation and progression of girls in education.

This chapter referred to the researched complications arising from the prolonged closure of educational institutions, which go beyond the resulting learning losses. The lockdown has had a severe impact on education but also cut access to vital services for protection, nutrition, health, and well-being – thereby impacting on SDGs 3, 4 and 5. It is these kinds of challenges that led the South African Minister of Basic Education in reopening schools to announce that despite the pandemic “classrooms remain the safest place for children”.

References

- Commonwealth Secretariat (2020) “How governments are positioning, activating and supporting public institutions such as school systems in multi-pronged efforts to contain COVID-19”. Unpublished report as part of the Commonwealth Researchers in Pursuit Bootcamp.
- Cutler DM and Summers LH (2020). “The COVID-19 pandemic and the \$16 trillion virus.” *JAMA*. Available from: <https://doi.org/10.1001/jama.2020.19759>
- ILO (2021). ILO Monitor: COVID-19 and the world of work. 7th ed. Updated estimates and analysis. International Labour Organization, (January). https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/documents/briefingnote/wcms_740877.pdf
- James N and Thériault V (2020). “Adult education in times of the COVID-19 pandemic: Inequalities, changes, and resilience,” *Studies in the Education of Adults* 52(2):129-33. [doi10.1080/02660830.2020.1811474](https://doi.org/10.1080/02660830.2020.1811474).
- Lopes H and McKay V (2020). “Adult learning and education as a tool to contain pandemics: The COVID-19 experience”. *International Review of Education* 66:575-602. <https://doi.org/10.1007/s11159-020-09843-0>.
- Lopes H and McKay V (2020). “Lessons from the COVID-19 pandemic for lifelong learning”, *Australian Journal of Adult Learning* 61(2):123-49.
- Mabunda PL and McKay V (2020). “An analysis of newspaper depictions of schooling: A participatory study for the development of a teacher education curriculum”. *Systemic Practice and Action Research* (2020). <https://doi.org/10.1007/s11213-020-09550-9>.
- McKay V and Mabunda PL (in press). “Online learning and the pedagogy of resilience, agency and protest: Lessons from the COVID-19 experience”. *Transformative Education for*

- Regenerative Development: Pathways to Sustainable Environments*. McIntyre-Mills, J (Ed.) Edward Elgar: Cheltenham, United Kingdom.
- McKay V (2019). Fit for purpose: using a distance education approach to support underperforming schools in South Africa. *Progressio*, **41**(1):1–26. <https://doi.org/10.25159/0256-8853/4597>.
- Meer T and Müller A (2017). “Considering intersectionality in Africa”, *Agenda* **31**(1):3-4, [doi: 10.1080/10130950.2017.1363583](https://doi.org/10.1080/10130950.2017.1363583).
- Mokgobu A (2021) “No need to panic’ - Motshekga assures on full-time return of primary school pupils”. East Coast Radio. 15 June 2021.
- Morgan H (2020). “Best practices for implementing remote learning during a pandemic”. *Clearing House* **93**(3):135–41. <https://doi.org/10.1080/00098655.2020.1751480>.
- Ottersen OP and Engebretsen E (2020). “COVID-19 puts the Sustainable Development Goals center stage”. *Nature Medicine* **26**:1671-2. Available from: [https://doi.org/https://doi.org/10.1038/s41591-020-1094-y](https://doi.org/10.1038/s41591-020-1094-y).
- Santos Boaventura de Sousa (2020). “*The cruel pedagogy of the virus*”. Coimbra, PT: Almedina.
- Shepherd D and Mohohlwane N (2021). “*The impact of COVID-19 in education: More than a year of disruption*”. Coronavirus Rapid Mobile Survey (CRAM) WAVE 5. National Income Dynamic Study: Stellenbosch.
- UNESCO (2021a). “One year into COVID-19 education disruption: Where do we stand?” Available from: <https://en.unesco.org/news/one-year-Covid-19-education-disruption-where-do-we-stand>.
- UNESCO (2021). “When schools shut: Gendered impacts of COVID-19 school closures”. Paris: UNESCO. Available from: <https://unesdoc.unesco.org/ark:/48223/pf0000379270>.
- UNESCO, UNICEF, and the World Bank (2020). “*Survey on National Education Responses to COVID-19 School Closures, round 2*”. Paris, New York, Washington D.C.: UNESCO, UNICEF, World Bank.
- UNICEF (2021). “#ReopenSchools. *There’s no time to lose*”. Available from: https://www.unicef.org/coronavirus/reopen-schools?gclid=CjwKCAjw2vOLBhBPEiwAjEeK9hZ7vwrFxaPuBMzgKE47vtyiWAEmcc_zqL1DyoASvf_3icpayahmFRoCrZIQAvD_BwE (Accessed 30 October, 2021.)
- United Nations (2015). “*2030 Agenda for Sustainable Development: Seventeen Development Goals*”. United Nations Summit: New York: United Nations.
- Uwezo (2020). “Are our children learning? The status of remote-learning among school-going children in Kenya during the COVID -19 Crisis”. Nairobi: Usawa Agenda. Available from: <https://infogram.com/da3bcab3-ff85-4f6a-8d9a-e6040c7fd83d/charts>.
- Zimmerman J (2020). “Coronavirus and the great online-learning experiment: Let’s determine hat our students actually learn online.” *Chronicle of Higher Education*. Available from: <https://www.chronicle.com/article/coronavirus-and-the-great-online-learning-experiment/>.

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Chapter Fourteen

Redesigning education for regeneration and wellbeing: Exploring the potential of digital engagement in the COVID context

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Abstract - This chapter makes the case that design choices protect and regenerate living systems, known as “Mupo” in the Venda tradition. Thus, the education system needs to foster and apply relational approaches, rather than top-down approaches to technological design. Human beings are not above nature; we are nature; thus policy and practice will need to change

direction (UN, 2021). We indicate why and how we should be mindful of the implications of our social, economic, and environmental choices linked with pathways to wellbeing and the ecological calendar that will help us to foster wellbeing stocks through re-generative social enterprise. The content and structure of education needs to protect living systems and find ways to maintain balance. Poverty, climate, and pandemics are the big challenges of the day. As a result of lockdowns and climate change, many people are facing greater levels of food insecurity and unemployment, which further undermines wellbeing and health. In the lead up to the next United Nations Climate Change Summit in Glasgow, policy decisions to support rapid transformation to address the necessity to lower carbon emissions as outlined in the recent IPCC report are crucial. The case study detailed in this chapter makes some suggestions which resonate with the philosophy of Indigenous scholars' and sages' expressions of relational knowing and being.

Key words: *Ecology of mind; new narrative; interdependency; re-thinking species boundaries; living systems; architectures for engagement.*

Abbreviations

AI:	Artificial Intelligence
IKS:	Indigenous Knowledge System
IPCC:	Intergovernmental Panel on Climate Change
OVME:	One Village, Multiple Enterprises
OVOP:	One Village, One Product enterprise
SDG:	Sustainable Development Goal
UN:	United Nations

1. Introduction

Instead of focusing on COVID *per se*, we are focusing in this chapter on new hopeful narratives supporting food security and employment. Food insecurity is a result of climate change, “business as usual” practices, and the problematic aspects of food production linked with pandemics. The chapter explores options for educational design for Africa, while referring to our understanding of some of the best practice potential in Indonesia in line with Indonesian Gender Mainstreaming Law and the “one village, one product/enterprise” (OVAP, Morihiko Hiramatsu – Governor of Oita prefecture, 1979; Yogyakarta, 2014) approach that has been legislated by President Jakowi since 2008. The chapter spells out the implications of ongoing research that we have been conducting in the locality of Venda in South Africa as an action-learning approach, where we focus on the systemic impact of convergent social, economic, and environmental challenges which have a cascading impact on health as a result of habitat loss, pandemics, poverty, and conflict

New approaches to education need to respond to the complex, diverse needs of the under-employed and unemployed through asking questions about what works, why, and how, in order to mitigate and adapt to social, economic, and environmental challenges whilst flattening the curve of COVID 19.¹ The literature upon which the research builds, includes the work of Shiva (2020a,b), Ostrom (1998), Elkington (1994), Stiglitz *et al.*, (2010), McIntyre -Mills *et al.*, (2014), and McIntyre-Mills (2017a,b; 2018) on how to motivate local people to work with nature by enabling them to move away from business as usual by mapping and modelling social, economic, and environmental accounting and accountability.

Re-designing education for regeneration and wellbeing: Exploring the potential of digital engagement in the Covid context

Currently small pilots in Indonesia and Vendaⁱⁱⁱ, South Africa are being developed and tested across multiple sites. This research is underpinned by a previous project, titled “Living virtuously and well” for which McIntyre received ethics clearance and was completed at Flinders University in 2018.

2. Statement of the problem and policy context

Burke (2021) discusses the impact of COVID in relation to Africa, which has a rapidly urbanizing population, but stresses that morbidity and mortality are probably higher than the reported data:

“More than 7 million cases and 180,000 deaths have been recorded in Africa, totals that most researchers believe are significant underestimates. Though many have been encouraged and inspired by the response of African countries to the pandemic, led by the newly created African Union’s Centers for Disease Control and Prevention, the economic effects of the pandemic have been drastic”^v.

Burke (2021) continues:

“A million people lost their jobs [in South Africa] last year and COVID definitely increased hunger. So, there are a lot more desperate people. The lockdown had a very negative effect on the economy and that is definitely contributing to the number of people involved in looting,” said Gareth Newham, the head of justice and violence prevention at the Institute for Security Studies, Pretoria. The trigger was economic sabotage, then there was opportunistic looting for personal gain and by local criminal networks too”.

The need for job creation and food security is paramount. For example, by 2020, 66 % of South Africans live in urban areas, which has implications for food security. High levels of food insecurity in Southern Africa (Wise, 2021) is a concern given the continuing application of the already discredited so-called green revolution (Shiva, 2020a,b). Shiva has demonstrated it to

be part of the problem, not the solution – because its focus is on unsustainable practices based on petrochemicals and terminator seeds that have to be purchased along with costly fertilizers. Shiva (1991, 2012) further stresses that seed companies attempt to prevent organic farming based on local traditional seeds and practices. Even if one does not agree with Shiva’s critique, one needs to accept that: (a) the costs of fertilizer and seeds have resulted in bankrupting small farmers and (b) seed diversity makes logical sense as a protection from disease. Locally-grown seeds need to be preserved, not weeded out by big agricultural companies. To sum up, food security is threatened by climate change destroying biodiversity through reliance on terminator seeds and single crop plantations, toxic chemicals, and pesticides that contaminate the food chain (and finally and most importantly) *what we define* as food and why. The nature of food, its production, consumption, and distribution cycle need to be re-thought in ways that respect the rights of sentient beings (McIntyre-Mills, 2021a-h). According to Ghosh (2021):

“... when the very first UN Food Systems Summit meets this week, its biggest concern should be how to make the necessary changes in our food production, distribution, and consumption patterns to adapt them better to nature and make them more resilient. Obvious, right? Apparently not. The growing fear among many stakeholders is that, instead of recognizing the need for truly transformative strategies, the summit may end up legitimizing and supporting corporate-oriented agricultural models which would exacerbate the problem.”

In the ministerial summary paper developed in preparation for the Glasgow Summit (July, 2021), the case is made for the need to strive “*to reduce rising temperatures and to avoid a rise beyond 1.5 degrees Celsius*”:

“Ministers agreed that Glasgow should recognize that the threat of loss and damage from climate impacts is escalating and demands attention and action.”

We need education that fosters an “ecology of mind” (Bateson, 1972), which means an understanding of human beings’ place within living systems and our need for an education to protect water, food, and energy security. The problems are associated with privileging the elite, power, and associated knowledge, excluding the poor, the disabled, and many diverse and gendered ways of knowing results in cascading problems linked with “business as usual” (see McIntyre-Mills, 2021, forthcoming chapters in Transformative Education).

2.1 De-bunking myths: Green revolution to create profit versus eco-hubs and -villages to create balance

Wise (2021) discusses the faltering green revolution, but to *what* is he referring? Reading between the lines, Wise, appears to be referring to the kind of revolution that is part of the problem – not part of the solution and certainly has nothing to do with the eco-village approach. Firstly, we need to define our terms, what do we mean by “Green Revolution”? If it is an

attempt to create industrialized agriculture based on land clearance and genetically modified seeds and chemical fertilizers – then, this is not the sort of green revolution that would support re-generation. Vandana Shiva has critiqued this sort of approach (2020a,b) and in Indonesia, the so-called green revolution led by president Suharto led to de-forestation, soil degeneration, increased vulnerability to the water table in, for example, the Bandung regional areas of West Java.

If we mean re-generative farming based on local social and environmental enterprise that supports balancing individual and collective interests, then the purpose is different. It aims to support wellbeing stocks for an entire community that can be scaled up. Although the industrial revolution and our extractive designs may have appeared to make the lives of human beings better, in fact our carbon-based economy has placed humanity in jeopardy and we face an existential risk (Bostrom (2011). Unless we change, we face a dismal future (IPCC, 2021).

2.2 Old style schooling is no longer smart: Why we need green ties not old school ties to protect food security

Education systems need to enable citizens to be critical, systemic, and capable of engaging with power. Old style curricula continue to privilege anthropocentric, urban lifestyles, which is a critical problem. Woolf (1928, 1938), VerKaik (2019), and Bri (2021), respectively, have discussed some of the flaws such as sexism and barring women from access to higher education and to the professions. The argument developed in this chapter is that we need ties and recognition of our place within nature not old school ties, based on business as usual, power, and privilege.

Higher education and the professions have tended to privilege some at the expense of others, defined *what* constituted power, and *who will be admitted to the upper echelons* of decision-making. Recently, Bri (2021) expresses similar points about the need for a new form of education that does not discriminate. The exclusion of women remains an issue in many parts of the world and needs to be urgently remedied as an anachronism that can no longer be rationalized as being anything other than injustice. Others have also been discriminated against on the basis of class, gender, culture, religion, and level of ability.

Whilst agency – which Virginia Woolf sums up as “a room of one’s own”, a liveable “income” and the right to express views and to be heard – remains important, it is now vital to re-think the *purpose* of education, which should also protect living systems and the fabric of life. Education is about more than old power elites and knowing the so-called “right” people – the content of this old style education is wrong and the 1% elites are part of the wrong system. Technology does not determine who we are; we are the designers. The old school tie and allegiance to sandstone monoliths may no longer be so smart.

3. A new form of education to support earning, learning and growing a future

The social enterprise projects in Indonesia and South Africa focus on earning, learning, and growing a future to develop a viable social enterprise around local products, sustaining the ecosystem, and creating ways to market products on line. The approach relies on a community of practice combining face-to-face engagement with local facilitators linked with the University of South Africa and Universitas Padjadjaran. The project team draw (in part) on Gunter Pauli's approach to developing a production, distribution, and consumption cycle that supports regenerative social enterprise and reduces the risks of unemployment whilst fostering regenerative approaches that support wellbeing stocks (Stiglitz *et al.*, 2010).

In terms of praxis (thinking and practice), the research is shaped by an ongoing collegial community of practice spanning the University of South Africa, the University of Adelaide (facilitated through Yunus Social Enterprise), and Universitas Padjadjaran that connects with local community. Our learning organisational approach follows these principles in order to safeguard that small groups of people who are able to work together in co-operatives to manage the co-operative, using block chain to ensure that the transactions cannot be altered. This learning organisation and learning community approach (updating Senge, 1990, 2006) supports social inclusion and green, re-generative entrepreneurship.

3.1 Tshidzivhe project in Venda, South Africa

As far as this community engagement project in Venda is concerned, the aim is to enable the running of a co-operative as a result of the action research and to raise awareness and capabilities for co-operative social enterprise in line with Indigenous local knowledge systems (Odora-Hoppers, 2013; South African Indigenous Knowledge System (IKS) policy, 2004). The intention of the research is to assess whether an online community of practice enables participants to learn more about community co-operatives in terms of potentials and pitfalls, bearing in mind the UN Sustainable Development Goals (USGs).

Overall, we are exploring the extent to which social enterprise can help to re-generate social, economic and environmental wellbeing and to achieve a sustainable living. We also aim to consider with participants via the action learning approach how can we build on the group approach (Ubuntu: "I am because we are") combined with The Indonesian model called "One Village, One Product" (OVOP) and the adapted model "One Village, Many Enterprises" (OVME) (Claymore, 2007; McIntyre-Mills *et al.*, 2021, forthcoming) and the concept of Ecovillages (Shiva, 2020), which are aimed at activating Sustainable Development.

Thus the focus of the project is on:

- Researching whether a community of practice (as per Wenger *et al.*, 2009) can help to support raising awareness after viewing webinars designed by Janet McIntyre (who publishes as McIntyre-Mills), Rudolf Wirawan, and facilitators of a social enterprise project in South Africa and Indonesia on the need for green circular social enterprises; and
- Considering whether the webinars plus workshops after the webinars help to support a community of practice which advances capacity building on how to run a community co-operative in line with social and environmental considerations congruent with regional/international and the UN Sustainable Development Agenda (2030).

The project supports the policy agenda underlined by the IKS Policy (2004), the South African Government Voluntary Review (2019) and Odora Hoppers' (2013) plea for more mode of engagement to promote IKS across the sectors, as well as Chilisa's view on Sustainable Development (2017). It also responds to the UN policy to address food, energy, water security, and the need to redress high rates of urbanization and the cascading impact on human security (UN Urbanization Report, 2014; UN Sendai Risk Platform, 2030; IPCC, 2020). In terms of innovation, we draw on and adapt the principle of the OVOP approach, decreed by President Jakowi (2014) in Indonesia, to enable working across sites to facilitate the mapping of opportunities and the cross fertilisation of ideas (that is, learning from practices in Indonesia in which Janet McIntyre-Mills and Rudolf Wirawan have been involved). It uses a gender mainstreaming lens which means that the focus is on ensuring that gender diversity is central to wellbeing. Also, the involvement of some youth in setting up sustainable social enterprises is important to this project.

The research links with an ongoing project linked with Visiting Research Fellow and Flinders University academic Janet McIntyre and industry partner Rudolf Wirawan. The project builds on current connections with Alam Endah, East Kediri, and the University of Padjadjaran to support setting up an eco-village enterprise with the support of the Indonesian Diaspora and the Yunus Centre. Overall, the Venda project (together with others detailed in a forthcoming volume on transformative education) addresses the question: "What should/could transformation entail?" The approach is premised on justifying research as being consciously interventionist towards activating transformative potential (McIntyre-Mills, 2014; Romm, 2020). The research is detailed in *Transformative Education* (McIntyre-Mills, Corcoran Nantes and Wirawan, 2021). In brief, it:

- Advocates for teaching systemic ethics as a form of life- long learning within nature's classroom to support social and environmental justice. Multiple species relationships, inter contextuality (to use Nora Bateson's phrase, 2021), and transdisciplinarity are encouraged through many ways of knowing, spanning the arts and sciences to inspire creativity with nature.

- Contributes to theory and practice by making suggestions as to how to re-frame the content, structure, and process of education for transformation. It also makes a case for a more *relational understanding* of human beings and other species as well as a more integrated curriculum where learners across primary, secondary, and tertiary levels are given the opportunity to explore many ways of knowing and to do applied learning. In contexts where unemployment is a family issue, it is vital to enable intergenerational learning through vocational training that enables people to earn, learn, and grow a future using green co-operatives linked with a learning community.

3.1.1 The so-called green revolution that supports petrochemicals and terminator seeds is not the same as ecovillage nodes and hubs

Drawing on the UN's urbanization report, the majority of the world's population will be living in cities by 2050, which will pose a security risk (Sendai Risk Platform, 2015-2030). Risk-associated climate change will exacerbate the convergent social, economic, and environmental challenges associated with urban living. This has also been stressed by the Sendai Risk Platform and associated reports (2015-2030). In a paper titled "Africans Publicly Challenge Green Revolution Backers", concerns are raised about markets that control agriculture:

"Director of the Biodiversity and Biosafety Association of Kenya and a member of AFSA Anne Maina said, 'We are here to state clearly and categorically that the Alliance for a Green Revolution in Africa does not speak for Africans. African farmers want to be able to produce healthy, nutritious, culturally appropriate food that positively impacts the environment. They want their right to food respected and protected. They want to practice agroecology. Farmers all over Africa have shown far more promising results sharing knowledge and working with scientists to establish low-input farming methods that leave the control of production in the hands of African farmers'".

We need to think about every step of the currently linear market and introduce a circular economy that works with nature in such a way that production, marketing, distribution, and consumption choices focus on re-generating living systems. Vandana Shiva (1991) in "Violence of the Green Revolution" has stressed that industrial-type agriculture has done more harm than good as it harms biodiversity and results in debt as farmers cannot afford the expensive fertilizers and seeds.

Our world view is shaped by honoring the ontology of kinship with nature, as expressed by Indigenous custodians known in Venda and West Java, epistemology based on working across cultures and disciplines using a cross cultural approach and mixed methodology, and axiologically based on the notion of transformative research that promotes a non-anthropocentric approach that places local custodianship center stage, whilst also updating some of the patriarchal notions. For example, in Venda, gender mainstreaming is as important as it is in West Java to

ensure that women have more agency in decision making, and control of their right to choose the kind of work they wish to do.

3.2 The area of concern and problem addressed by the project

The research approach explores to what extent can action learning, supported by online engagement, help to inspire and empower participants to enhance or set up and run a community owned social enterprise? Sub questions include: What works in practice (and why does it work) to facilitate, support, and encourage the concept of “One Village, Many (social) Enterprises” (OVME)? What action learning processes enhance social, economic and, environmental wellbeing in line with an Ubuntu-group approach to forward UN SDGs?

The purpose of the research is to develop agency plus mapping critical pathways to wellbeing and to explore what works, why, and how to achieve wellbeing. It also aims to enable participants to engage with one another through telling narratives and exploring key themes through a structured dialogue. It assesses whether webinars online can be used to encourage an understanding of social enterprise by engaging in workshops and focus group discussions with people while enabling them to plan and also set up co-operatives with a digital online marketing presence. The area of concern has not yet been explored in theory or practice in the literature on action-learning and it is a novel approach to organising capacity building in relation to co-operatives in terms of the value of social enterprise (that is, enterprise not based solely on a profit motive but based on social and ecological justice principles too). We wish to support participants in their learning while also learning ourselves about this way of supporting people and whether aspects of our approach can be improved. The area of concern is to explore the extent to which on line learning can foster personal as well as collective agency through action learning design consisting of webinars, focus groups, workshops, and discussions. The face-to-face engagement is facilitated by Pat Lethole and Mphatheleni Makaulule with the community participants. The idea overall is to help participants work with others (co-operatively) to enable them to earn a sustainable living in ways that support a circular economy and online marketing to help grow their social enterprises.

3.2.1 Balancing individualism and collectivism through standing together

An Open Letter to Indigenous Peoples of Brazil on surviving COVID-19 stressed the link between living in ways that destroy the wellbeing of the earth and that this impacts the wellbeing of humanity. It also stresses the need for people to stand together through protecting the earth:

“Our Elders tell us stories of rebirth, regeneration, and transformation. These stories teach us many things. They teach us to educate all members of our communities to understand the many signs that signal the collapse of Western society. They remind us that we should be more cautious than ever in our desire to be part of this system.”

The letter continues by referring to “Windigo, a cannibalistic spirit driven by greed, excess, and selfish consumption” and that they held ceremonies to prevent its spread. The letter makes a plea for the events of Standing Rock to be replicated, where people in South Dakota stood with Indigenous people against the oil pipeline through Lakota lands. The letter then explains:

“The Condor is also said to represent Indigenous people and the heart. The Eagle stands for Europeans and the mind. This is a story of connection and support. It reminds us of the importance of standing together, even when it seems we are opposed. It also reminds us that it is important to develop an ability to intelligently and critically navigate between the Indigenous and non-Indigenous worlds. By doing this we are able to maintain our Indigenous identity and our sovereignty as Peoples.”

3.3 Working with indigenous leaders in Venda to design from below in order to protect wellbeing stocks

Venda has an oral tradition of passing on stories, songs, and dances to protect their cultural and natural heritage. Patricia Lethole and Mphatheleni Makaulule are custodians who work with the members of the community who have formed the Bamboo Co-operative to develop partnerships with others in the community. They also share the learning with others, including school children, so that the local environment can be protected from development of coal mines and so that work can be created for the local community. The hoped-for outcome is to train participants aged above 18 years who are already engaged in some social enterprise activities and wish to learn more about how to set up a community co-operative and how to participate in the circular, sustainable economy in line with gender mainstreaming principles.

Mphatheleni Makaulule is a custodian who draws on Indigenous wisdom and leadership to support Mupo or living systems. She is a custodian of the Luonde forest and a female leader. She is a Makhadzi (female leader), who is also linked to the royal lineage. As such, she shares totemic kinship with the sacred forest. Because she is connected with this lineage, she protects the sacred forest. She explains the responsibility to care for other sentient beings and their shared habitat and, in particular, to honour totemic relationships (Lethole *et al.*, 2021). She is also a Makhadzi and the holder of the elephant totem: this requires that as one who is related to the elephant, she must respect, protect, and abstain from eating the meat or piece of an elephant as it is part of her identity (Romm and Lethole, 2021: 88). Mutupo is actually more than a totem; English cannot explain the deeper meaning of Mutupo, for example, from dialogues when writing the profile of the sacred sites “Mutupo” (totem). It means a totem of a Vhongwaniwapo or Vhangona (indigenous) Clan which can be found in the Zwifho (Sacred Natural Sites). The meaning of Mutupo is deeper than a totem of an animal, it is the well-being of the whole of life in the Zwifho (Sacred Natural Sites) and it relates to the tshikhodo (praise) of the Clan. The totem holds the spiritual connection and health of a person from birth when growing up until death. Mutupo identifies the wellbeing of the Vhongwaniwapo or Vhangona (indigenous)

Clans. Mutupo has a praise of the clan of the sacred sites. This is explained in the profiles and glossary of Venda words compiled by Dzomo la Mupo while registering the declaration of Zwifho/ sacred sites (see the Vhutanda profile and Glossary of Venda words (2012) - submitted manuscripts to South African Heritage Resources Agency). In short, the Indigenous clans are called Vhongwaniwapo. (See also Ross, 2017: 11 and 193.)

The significance of the Makhadzi with totemic relationship to sacred forest (such as Makaulule) is to perform the sacred rites of the forest and the value of sacred forest is also vested in her position. She has a mediation role to play in making a spiritual connection between ancestors and their creator. Makhadzi is every female person in the Venda tradition, yet there are also different roles of Makhadzi. Makhadzi is not a name; it is a role (Ross, 2017: 102). There is also a role of sacred sites that is bestowed as a responsibility of certain Makhadzi. Each sacred site is identified by its totem, which is linked to the biodiversity of the sacred forest; it is not a place of human activities like harvesting fruits, fetching wood, and collecting medicinal plants. Its purpose is only for spiritual connection. The myths and taboos are linked to the protection and governance of biodiversity. According to Matshidze (2013: 4) Makhadzi display how women are highly regarded in the Venda community and are the sources of women's influential role in the spirituality, as she is a ritual leader. Makhadzi takes very important decisions in the family and in most communities she is the ritual leader. Sometimes, the source of women's influence in traditional life is spiritual. Women, Makhadzi in particular, are the ones who carry responsibilities for being the spirit mediums believed to be intermediaries between the physical and spiritual worlds.

As a defender of the Venda cultural knowledge, Makaulule explains that by sharing stories and drawing the ecological calendar, the young people learn that human beings are just a small part of the wider circle of life which they need to protect as custodians. According to Makaulule (2021):

“The knowledge is with elders. Children want a space of learning and elders want to remember their life time experiences so that they share the knowledge with youths and children. Teachers, too, want to teach about this knowledge. Learning from Amazon Columbia in 2006, 2008, and 2009, the ecological mapping become Dzomo la Mupo tool to learn mapping the indigenous knowledge. The process involves participatory methodology. It is a dialog where elders tell stories and youths and children map the knowledge in a form of pictures. Teachers' role is to learn and guide school learners during the mapping”.

Makaulule continued by explaining that the ecological calendar:

“Communicates cyclical time such as the movement of the moon, stars, and planets, the weather, cycles in Nature and biodiversity, and processes in agriculture and in culture (rituals, songs and dances) which are influenced by

the cycles of time... All the seasons also have names, which also have meaning. All the meanings of the seasons and moon are related to what is happening in Mupo³.

“The nwedzi (meaning month) explains the meaning of the ecological flow in a form of cycle and how that meaning also affects other species not only humans.Nwedzi ... is the cycle of the Moon according to climate and Moon movement. All the names have a meaning, which explains about what is happening in Mupo and what people expect to do. The cycle also shows the weather patterns. ...In all these seasons there are different wild fruits and food cultivations, including storing for food security all year round which goes according to different Nwedzi. In all Minwedzi there are also many changes on weather and what people do, including trees, plants, insects, and animals in rivers, on mountains, and on soil etc. The whole life system on the land and on the sky with all the life are changes of behaviour according to weather changes too which are brought by these Minwedzi when they change in sequence in a form of cyclical manner. This ecosystem flows if one looks on the land or soil....”

The calendar is taught through storytelling, dance, and questioning. It is mapped based on local knowledge that is in some ways similar to a form of rich picturing (Checkland and Scholes, 1991). The mission is to demonstrate to the South African government that Venda’s heritage is best protected by working with nature. By documenting and digitalizing the calendar, embedded in a website, the community is better able to demonstrate how they are not only addressing the UN development goals, but also re-generating the community through teaching local knowledge and ensuring that their voices are heard. It could fit well with the pathways to wellbeing to enable people to foster Ubuntu and to promote their approach to protecting the local environment. Makaulule learned the technique from her time spent with the elders in the Amazon.

The project will be monitored by the community to assess what works, why, and how to enhance local job creation. The aim of the community of practice is to assist the team through zoom and WhatsApp messaging and calls to enable local people to identify opportunities and to market their products. The data collection (or rather, the generation of data/data generation) focuses on narratives of what works, why, and how. By engaging participants, they are able to reflect on how they can turn personal issues, resources and skills into public resources through pooling resources to support social enterprises in a co-operative. The user-centric design enables the co-operative to grow through enabling people to find ways to help themselves and others.

Stories from self-selected participants will be used to explore the specific socio-cultural, economic, and environmental contexts of social enterprise and how best to support social engagement within a circular economy, which is the focus of the research. This is consistent with the sentiments of Mphatheleni Makaulule, whose role in the community we explained above, and with the expressions of Lethole *et al.*, (2021) where they explain the joint responsibility of

people to care for sentient beings along with the natural environment of which we are part (via totemic relationships). The figure below gives some indication of how the ecological calendar is utilised in the community, in line with the intention to protect and nurture the land. The U-Tube reference below can be referred to in order to understand:

When discussing how social enterprise differs from business as usual, a female member of a focus group on the 6th September, 2021 asked: “How does social enterprise differ from other enterprises?”

The responses stressed that the enterprise belongs to a group of people who bring different perspectives. Thus, it consists of different thinking from different people, for example. another person will be ploughing nuts, other crafting wooden spoon and maize grinding instruments. As a result, so many things will be sold

Researcher: How can social enterprise provide opportunities for people who are currently excluded?

“If we work together in peace and harmony, other people will become interested to work together with us. Again, when they witness the love we have for one another and working in harmony they will get interested to work with us. For our project to be sustained, loving one another is critical. The elders here showed us love by demonstrating it amongst themselves and we emulate them. To sustain the project and to attract more people we need to practice love and work hard to attract more people who will follow us because of love that is practiced amongst ourselves We need to have good heart and love others. We need to bind together with love and unity..... We need to use a different language which is inclusive, to show ubuntu. In ubuntu we need to use language of “we” not “I “. *people work together for the benefit of many because they take turns in helping one another.*

In Figure 1, young people are making presentations of the traditional ecological calendar: this is how intergenerational learning takes place in the process of ecological mapping as a storytelling.

4. Protecting the future of work and education in the digital era

Elon Musk (2021) has reported that his “Bot” will be able to do many manual tasks, but to what end are we creating tools that will make many human beings unemployed? In the video launch, the bot appears hooded, wearing a white suit, and looking like a hooded prisoner. But, ironically, humanity will lose freedoms when jobs are lost. How will states and markets perceive those whose working skills are obsolete? Will they receive a universal wage, or will they be seen as dispensable? But computers could develop super intelligence without consciousness. Harari (2016) states that this is a very scary thought!

Those who are fully employed may find that their work is more solitary. For example, a friend shared a story about his colleague in South Australia who relies on heavy farm machinery made

in the U.S.A. to harvest his crop – that requires expensive fertilizer and pesticides. If there is a problem with the machine, he rings the digital team based in the U.S..A for help. On a good day, the machine runs smoothly. On a bad day, the machine has a glitch and he is completely dependent on the digital team. He is also completely alone most of the time. He eats his lunch alone and remembers a time when lunch was a sociable meal shared with others. It is a lonely life as a farmer and the digital developments along with automation can be very isolating, which is bad for mental health.

Figure 1 - Participants share community knowledge in many ways, including storytelling and mapping an ecological calendar.



Source Makaulule, 2021 and <https://www.youtube.com/watch?v=IszP5Uq-X50>

Musk has also focused on alternative sources of power such as solar batteries which is a plus, but automation and artificial intelligence (AI) can lead to a dystopian future if designs protect the interests of some and not others. The rush to space by the elites seeking “off planet” options is a case in point. The notion of spending billions on technological solutions is questionable when so many simpler re-generative options are available to protect this planet.

4.1 A provocative question: Can a computer know us better than we know ourselves?

Harari appears to deliberately pose the provocative challenge of *what technology could do to us* if we do not change the narrative, but he does at times appear to reify technology and to suggest that technology *per se* begins to impose its own dynamic on human society. He also underestimates the many kinds of intelligence that underpin biodiversity as we know it today and that we are at risk of losing this diversity, *if we allow top-down designs to control our future*. Technology does not determine our future: We do!

Human beings are the designers and, unlike other living systems, we do have choices that can be expressed though our culture not only within one generation but within a few years as a result of our ability to invent and create tools. Some species of birds and primates can use culture and can make use of tools as detailed by Ackerman (2016) in the “Genius of Birds” and by De Waal (2009) in his several works on the ability of primates and other animals to know the difference between fair and unfair behaviour. Human beings, the so-called twice-wise - as Bela Banathy (1996, 2000) explained in “Designing social systems in a changing world” and “Guided evolution of society” - can think about their thinking. It behooves human beings to design and use technology in ways to protect many species. In resonance with this, the focus of the Venda project is to use digital technology and the pathways software to support storytelling, sharing, and learning from each other in ways that are not controlled by binary logic and codes, as mentioned above. The community of practice aims to design with the community to enable them to mobilize and to market their goods in ways that support green social enterprises.

Harari (2015; 2016; 2017; 2018; 2021a,b) ⁴ makes a case in “*Sapiens*” (2015) that human beings differ from other animals because they are able to tell stories, which enables forms of governance on a large scale based on shared beliefs. His later works stress that the technological designs have the potential to take control of history when they become sufficiently intelligent. At its most basic, an algorithm can be defined as:

“... a series of instructions that are followed, step by step, to do something useful or solve a problem. You could consider a cake recipe an algorithm for making a cake, for example.”

Harari suggests that we, human beings, *are* algorithms *in so far as we are decision makers* who have evolved to make rapid judgements prompted by our emotions. When we are fearful, we avoid risk; when we are courageous we take risks, based on assessments. Harari (2018; 2021a) then suggests that if we do not like the idea of being controlled by algorithms, then, we must change the narrative or the design. Harari (2016) uses the analogy that for the first time in history human beings are *not just using the internet for information, we are information* and, if we read a digital book (in the near future), it could be able to *read us* with face recognition and biometrics (Harari, 2021b).

Harari's strength lies in making sense of past and present history and drawing out the themes in bold strokes about broad trends and then posing questions about the implications for the future. One of the key themes he explains is that, in human beings, emotions are the embodiment of rationality, they help us to make rapid calculations, but we also have to think about our emotions in order to make the best decisions if we are not in an emergency. This point has also been made very clearly by Kahneman (2011) in his book "Thinking fast and slow" and by Greenfield (2000; 2015) who has stressed that anger or drugs can impede rational decisions, which is why we need the capability to think about our thinking in order to make better decisions. She also discusses the plasticity of the brain and how it responds to our relationships with others and the environment.

Human beings (along with other sentient beings) make decisions that are also influenced by feelings and emotions. Sometimes the emotions can result in passion or compassion as rapid responses in emergencies, but we also need to be able to think very carefully when we design new policies to address the big problems of the day, namely climate change, displacement of many species, poverty, conflict and pandemics. Human beings are designers, not merely algorithms, but we do need to accept that we have the potential to be part of the problem or part of the solution depending on whether we design with compassion and humility, informed by a systemic "ecology of mind" or if we continue to apply narrow anthropocentric designs. The ability of human beings to tell narratives that others are prepared to follow is a plus and a minus. It is a plus if the narratives protect the common good. It is a minus if they don't. It is a plus if the narratives are a basis for discussion around *possible action implications for the story in terms of protecting the common good*.

Anthropocentrism, however, assumes that we are different from other sentient beings – this rationalization is unacceptable on ethical and scientific grounds (De Waal, 2006 a,b; 2009; McIntyre-Mills, 2021a; Romm, and Lethole, 2021). Furthermore, Gaglioli *et al.*, (2018) have demonstrated that plants make decisions on the basis of information. Unlike Harari, Banathy (1996; 2000) stresses that human beings are *Homo Sapiens Sapiens*, the so-called "twice wise", who are more than "story tellers" as human beings have the potential to be active designers of their future. As a critical thinker, Banathy did not believe in the inevitability of technological change. Harari (2019) makes the point that *all living organisms survive based on decisions*. Plants, insects, animals, and human beings need to make decisions that shape their survival. Whilst we can agree that all living systems *make decisions*, we contest that living systems are *merely* algorithms. Plants and animals have intelligence, but many animals, *including human animals* (along with other mammals) rear their young and care for them. Harari explains that trees have intelligence and that computers are more like trees, except they have super intelligence. But we need to remember that computers are a human invention. Although intelligence is about solving problems, human intelligence is *also* guided by consciousness, which is about feeling things. Gregory Bateson (1972) stresses that a human "ecology of mind" is contextual, whilst his daughter Nora Bateson (2021) stresses that "warm data" "created through human interactions in context are vital for problem solving.

Nevertheless, human beings need to be aware of the dangers of top-down digital decision-making based on binary coded information. Harari (2016) suggests that human beings without the skills to thrive in a digital culture could be obsolete, or they could be subject to the powerful decisions made by algorithms that guide presidents and socio-economic systems to make decisions that could declare some dispensable. We need to retain the ability to think about our thinking and emotions, this is the basis of mindfulness. Without the capability to think about designs we are at risk of being the object of the designs made by others. The same point was made previously by Donna Haraway (1991). Joseph Stiglitz (2011) made the point in a well-known article that many of the decisions today are made in the interests of the 1%. This point was also made by Zuboff and Schwandt (2019) who coined the phrase “surveillance capitalism” and stressed that internet usage is turned into data in the interests of those who control data management systems.

The difference between human beings and other living systems is that we have had the power to shape the planet for better or worse, depending on our values and our ability to think through the consequences of our design choices.

4.2 Protecting nature and people

Nichol (1997: 311-3) explains how a member of the Karnai Nation who is a skilled software designer used animation to tell stories for future generations about how we human beings are related to nature: rivers, trees, and crows; stones and sand; wind and time. This is a very different approach to computing as it emphasises our link with nature rather than disconnecting from nature. This approach resonates with ongoing research *with indigenous people*, namely the members of Neporendi in South Australia and currently ongoing research in Venda and West Java (see Lethole *et al.*, 2021; McIntyre -Mills *et al.*, 2014; McIntyre-Mills, Wirawan and Widianingsih, 2019; 2021f,g).

Donna Haraway (1991) insists that those who are marginalized need to be the designers, not the object of other people’s designs. Her recent works on “Staying with the trouble” (Haraway, 2016) stress that we are part of a wider system with which we need to recognize our kinship. From this precept we can assume that:

- If purposeful designs are created to protect living systems, this could be a positive ecology of mind (Bateson, 1972).
- If purposeful designs are created to protect the life chances *of some* (rather than others), then, this is a *negative consequence of an ecology* of mind.

Nichol (1997: 311) refers to Gregory Bateson’s “ecology of mind” and emphasizes the positive and negative aspects. The pathologies of assuming that algorithms can predict based on simple binary logic that is de-linked from embodied warm human beings is the greatest challenge. His daughter, Nora Bateson (2021) therefore refers to warm data, based on stories. If we spend

too much time in front of computers and strive to saturate ourselves in cyberspace, it will have consequences (Gergen,1991; Greenfield, 2008; 2015).

Nichol (1997: 349-50) cites several authors such as Heim (1993) and David Bohm⁵ to explain that if we rely on the “apertures” created by binary logic to shape patterns that are fed to us as algorithms to guide our decisions, then, we will become increasingly misinformed about the world. The binary logic has also been criticized by many indigenous authors – e.g., Chilisa (2012; 2020) and Wilson (2008).

This is not to deny the place for computing, but we should use technology as tools that we design for specific purposes and remain in touch with the environment and the flesh and blood people with whom we relate. Nichol also explains that our memories are based on our senses and our experiences over time and that our perceptions shape who we are as a result of our memories. So remembering is drawing on these stored perceptions that were grounded in felt experience. The Indigenous wisdom and knowledge systems need to be protected through appropriate curricula (Odora Hoppers, 2013) as detailed in Transformative Education for Regeneration (McIntyre-Mills, Corcoran Nantes and Wirawan, forthcoming, 2021) in which Lethole (2021) together with the team discusses the roles of Indigenous knowledge coordination to protect environmental heritage with communities around Vhembe District/ Venda as part of a community of practice. This is a “training”/Action learning project in which we plan to assess whether zoom can be an effective way to inspire an understanding of how to set up community-based social enterprises in line with the circular economy. The facilitators will not be involved in giving any specific advice on any projects and this community-engaged research project is delivered *pro bono* – in this sense, it can be called “impartial”. Nevertheless, the facilitators and research team (and community leader) all are committed to support the development of a circular economy (rather than “business as usual”) and thus are what Gergen (2020: 19) calls “value-invested”. This is also in line with Indigenous methodologists who suggest that researchers should not purport to “take distance” via an assumed value-free position (e.g., Chilisa, 2009, 2020; Chilisa, Major, and Khudu-Peterson, 2017). We have explained above how indeed this project includes ethical integrity that goes beyond conventional approaches to ethics (as also discussed in Romm, 2015; 2018).

4.3 Narratives can be shaped without technology – but the rate of transmission is faster with social media

Harari stresses that human beings are unique in their ability to use narratives to mobilize. We can use narratives in positive or negative ways and we do not need advanced technology, although technology can accelerate the sharing of narratives. He uses the examples of the invention of the Guttenberg printing press and points out unfortunately one of the most widely disseminated books was the most harmful to women, namely the “Hammer of the Witches”,⁶ whilst the “Salem Witch Trials” needed only rumour and gossip, not social media to persecute women. The point we are making is that values are the most important determinant of social change

and we can make design choices. Technology does not decide our fate, sentient designers (who write computer codes) decide our fate and they can be guided by ethical or unethical decisions.

Hitler used film and newspapers to push his agenda. Today, social media circulate positive and negative narratives. During the COVID-19 pandemic, conspiracy theories have been circulated using on-line media, which has undermined the uptake of vaccines in many parts of the world, but online education supported by communities of practice could develop positive narratives and new architectures for education supporting eco-villages. Such villages could be scaled up to ecovillages, link products, markets, and de-centralized systems of learning through caring and growing a future together. Anthropocentric culture mistakenly gave dominion over plants, animals, and some people who were colonized and discriminated against as a result of being “other” in some way. Anthropocentric bias towards supporting the interests of only some species at the expense of others raises the question what will a post humanist world be like? Do we want a world in which only some species (if any) are valued? Has this anthropocentrism created conditions that make animals and humans ill? This is why we need with foresight to take into account the non-anthropocentric views as, for example, expressed in the ecological calendar, which shows the importance of respecting all forms of life and not regarding ourselves as central as humans. Table 1 summarizes the new approach to systemic ethics (McIntyre-Mills, 2014) which elaborates the importance of “recognizing our hybridity and interconnectedness” (McIntyre-Mills (2017a,b) and the importance of extending solidarity to all sentient beings and the environment.

<i>Table 1 - Scaling up narratives with and without technology</i>		
Printing Press in Gutenberg	1440	Hammer of the Witches – one of the most popular books
Salem Witch Trials word of mouth networks linked with power a	1692-1693	Gossip, innuendo, and printed pamphlets
Nazi propaganda	1933-1945	Rallies, social theatre, film, and printed media
Refusal to accept top-down modelling by Club of Rome (Christakis, 2006, 2014; Christakis and Kakoulaki, 2021; Christakis and McIntyre-Mills, 2021)	1970 onwards	Multiple media
COVID conspiracy theories	2021 ----	Social media spread by smart phones and computers

<p>Pandemic causes</p> <p>Goodall (2021) purports that pandemics are the result of habitat loss and the way animals that have never been in contact are thrust together through the way they are farmed, trafficked or contained. Gorbalenya <i>et al.</i>, (2020) also stress that cross-species infections are the root of the corona pandemic.</p> <p>Defending ourselves and nature (Chief Raoni, Nobel-peace prize nominee, 2020) requires protecting the idea of his meeting to develop a manifesto he speaks of defending a way of life and that deforestation is accelerating.</p> <p>Narratives connecting mindfulness and wellbeing with the global commons (McIntyre-Mills, 2010) are overdue along with understanding natural inclusion (Rayner, 2010) and remembering kinship with other species and our sense of interdependency on nature (McIntyre-Mills, 2021a-d), expressed as totemic kinship (Romm and Lethole, 2021) and as an ecological calendar (Makaulule, 2021) that can be used to support pathways to wellbeing drawing on structured dialogue (Christakis 2006; Christakis and Kakoulaki, 2021) to help decision making.</p> <p>These sorts of approaches could be used to transform architectures of governance and democracy to support post national wellbeing stocks (Stiglitz <i>et al.</i>, 2010).</p>	<p>Old stories need to be re-membered and shared</p>	<p>Custodians of sacred spaces, such as the Thathe Forest in Venda (Lethole <i>et al.</i>, 2021) and the Tolon region, Uganda (Addae and McIntyre-Mills, 2021).</p> <p>Democracy cannot be sustained without well-informed citizens and global citizens who are concerned not only with the fate of nation states, but the fate of the global commons, the shared fabric of life on which we all depend. Elsewhere, McIntyre-Mills has made the case for balancing individual and collective needs from below – based on an expanded version of the Aarhus Convention that supports local engagement by all the residents within a post national region-- to protect social and environmental justice (see Florini, 2003; McIntyre-Mills, 2017; McIntyre-Mills <i>et al.</i>, 2019, 2021).</p> <p>Multiple species and the commons ought to be protected based on a law, such as the Ecocide Law (Higgins <i>et a.</i>, 2013) supported by ongoing monitoring from below by residents with the right and responsibility to access information on the environment. Both national and post-national laws need to work in unison to protect bio-regions in response to the recent IPPC report (2021).</p>
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Sources: Harari (2016; 2021a,b,c); McIntyre-Mills (2021a,b,c); and McIntyre-Mills and Christakis (2021), in which the potential for structured dialogue to support pathways to wellbeing is discussed.

5. Mapping progress towards supporting wellbeing stocks

In the pathways to wellbeing prototype (McIntyre-Mills *et al.*, 2014), people were asked to explore what they have, what they need, what they are willing to add or discard in order to move away from *Business as usual* and to take small (regular and progressive steps) towards

supporting what Joseph Stiglitz *et al.*, (2010) call “Wellbeing Stocks”.¹⁰ They are asked to express their thoughts and perceptions based on their own feelings and opinions

In the current design we hope to enable local residents to map and monitor local wellbeing stocks and, in particular, environmental wellbeing on which everything else depends.

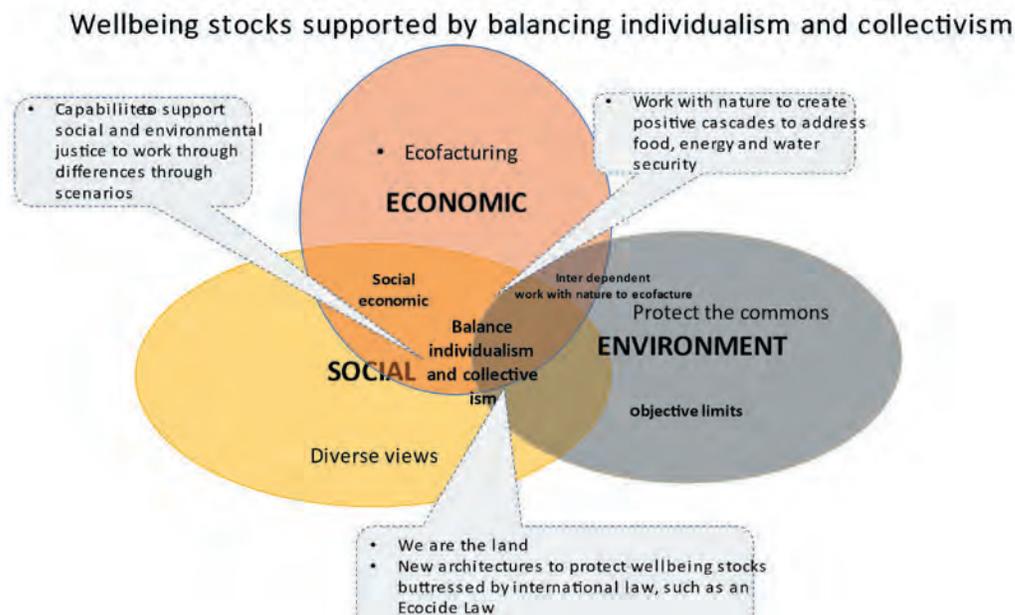
5.1 Mapping progress from below: Towards supporting wellbeing stocks

Nichol (1997: 345) refers to the way in which the system can select or “sieve” what is regarded as relevant for a particular purpose and described as “high speed Venn Diagrams” that determine the way we see the world. If the designs are to protect water, food, and energy security, then, we need to ensure that the programs consider the issues of where the boundaries are drawn and why, who are included in the decisions, and how the policies are made. By working with some of the indigenous leaders to frame new forms of community engagement to support community-owned enterprises in line with South African law in the case of the Venda project and in line with Jakowi’s One village, One Enterprise approach in the case of Indonesia, local knowledge is placed at the heart of decision making so that local heritage, including plants, animals, and insects determines decision-making.

In Venda, community custodians known as Makhadzi protect the spiritual heritage of the sacred sites in Venda (Lethole *et al.*, 2021, forthcoming). Democracy needs to mean protecting current and future generations and emphasizing responsibilities based on norms and indicators within context. Governance and democracy should support freedoms to the extent that our freedoms do not undermine the rights of others in this generation and the next. Figure 2 is a pictorial of wellbeing stocks supported by balancing individualism and collectivism.

Systemic ethical decisions honour freedom and diversity to the extent that freedom and diversity are not undermined by power imbalances. Joanna Macy *et al.*, (2014) in “Coming Back to Life” stress the importance of a new vision and a new non-anthropocentric focus. Consciousness or conscience is the ability to think critically about causes and effects to enable expanded pragmatism, which enables us to think about the consequences of our decisions in social, economic, and environmental terms. This constitutes a new form of accounting and accountability which can be implemented through managing the size of our carbon footprint. Elsewhere (McIntyre-Mills *et al.*, 2014, 2019, 2021) discuss an alternative cyclical economy based on eco-villages supporting urban hubs to re-generate rural-urban balance based on eco-facturing, using the important Gunther Pauli’s concept. The development of eco-facturing using local products such as cassava for bioplastics, bamboo for biochar, fair trade coffee, mushroom production using the coffee grains, and honey are discussed as examples of eco-facturing that are currently being developed in Indonesia as well as pilot projects in South Africa.

Figure 2 – Wellbeing stocks supported by balancing individualism and collectivism



Source: McIntyre-Mills in conversation with Wirawan, Flanagan and Finlayson, 2021, forthcoming.

Core design principles are suggested, namely, salience, trust, and engagement to protect living systems and the people who are affected (McIntyre-Mills and Christakis, 2021e). These principles need to underpin the decision-making process together with the importance of ‘being the change’ through expanding pragmatism to consider the social, economic, and environmental implications of choices. Transformative education (McIntyre-Mills *et al.*, 2021) makes the case that we need a new structure, process and content which ensures that people understand their place within nature and the need to protect the fabric of life.

6. A way forward for integrated policy through re-designing the way in which we live our lives

A credible hypothesis is that COVID-19 is partly the result of the way in which habitat is lost through deforestation and bush clearance (Goodall, 2020; Gorbalenya *et al.*, 2020) and that corona viruses that occur in many species will be transmitted when animals that are not usually in contact are thrust together. Commodified animals have resulted in sickness and pandemics, such as SARS, MERS, and the swine flu. Containing and trafficking animals in ways that deny them a life worth living has resulted in the morbidity and mortality of both humans and the creatures they abuse through the way animals are contained, trafficked, and reified without

respect for their rights. Our kinship and dependency on other species and our responsibility as stewards is overdue (McIntyre Mills, 2021a-i).

Table 2 - Values underpinning control in decision making continue to co-exist

	Ethics	Industry and tools	Governance	Economics	Attitude towards nature
“Deus authority” (Harari, 2016)	Laws determined by religious authorities and decreed in the name of a religion	Agricultural and limited mechanization prior to mid-17 th Century	Laws from religious texts: Varies across religions	Varies across religions but the notion of sharing and prevention of greed is common	Varies across religions
Humanist authority	Laws made by human beings based on their decisions	Industrial revolution from mid-17 Century	Rights and responsibilities of people Rights and perhaps less emphasis on responsibility	Liberal notions which focus on human rights	Varies across nation states but overall anthropocentric
Digital authority, dataism (Harari, 2021) and the creation of inorganic life	Who decides on the program?	Computers and digital entities who rely on information based on binary logic starting with the proliferation of computers in the 1980’s.	Potential for control of some at the expense of others. Algorithms will decide.	Potential for negative outcomes	Depends on the design and the authority of the designer

<p>Ecology of mind (Bateson, 1972) and notion that we are the boundaries (Haraway, 1991; Quan Baffour et al., 2019; Makaulule 2021, on ecological maps drawing on Amazonian and African Indigenous Wisdom as a result of her time spent with Indigenous Amazonian leaders. Forsetto (2021) as an anthropologist documents the voice of Nobel Peace Prize Nominee Chief Raoni Metuktire (2020) and the Piara¹¹çu Manifesto</p>	<p>Need to consider multiple variables to address wicked, complex problems that are perceived differently by different stakeholders with different values and agendas (Mertens, 2022).</p>	<p>Apply design to protect living systems of which we are a strand – limited awareness since the Club of Rome Reports in 1970's, increasing with the IPPC reports from 2018</p>	<p>Environment on which we all depend: Decisions based on common good</p>	<p>Think of consequences for all living systems (McIntyre-Mills, et al 2014, 2019, 2021) to protect wellbeing stocks Stiglitz et al. 2010)</p>	<p>Designs based on the axiom – we can be free and diverse to the extent that our freedom and diversity does not undermine current and future generations of life</p>
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Sentient rights and rights to a habitat	Trees, plants ¹² and computers make decisions based on information.	Rights and responsibility to extend solidarity to all living beings (Harris and Wasilewski 2004; Higgins et al., 2013; Osuji 2018; Higgins et al., 2013; McIntyre-Mills, 2021 a,-i; Romm and Lethole 2021).	Organic and inorganic cycle is sacred. Decisions based on common good (Magill, 2018) and respect for all forms of life.	Think of consequences for all living systems and understand the continuity of consciousness through scenarios to foster regenerative living.	Designs based on the axiom – we can be free and diverse to the extent that our freedom and diversity does not undermine current and future generations of life.
(Open Letter by Indigenous Peoples on surviving Covid,2020)	Sentient beings make decisions based on feelings and rights need to be extended to all sentient beings. Ethical decisions that respect multiple species need to underpin better architectures of education, democracy and governance.				

Sources: Harari (2021); Bateson (1972); Haraway (1991, 2016); Higgins et al., (2013)

The final row of Table 2 offers a set of values to foster modes of regenerative living which respect and strive to connect with “all that exists” (as named by Chilisa, 2020), namely, the “living and the nonliving, the land, the earth, the animals, and others beings” (p. 24).

Unlike Nussbaum (2014) who limits her capabilities approach to exclude ecosystems (see Romm, 2021), this approach extends solidarity to all sentients as well as the ecosystem as stressed by Higgins *et al.*, (2013). The right to eat certain species and the responsibility to ensure the rights of sentient beings to a life worth living is an area of research that is overdue. This is an area of concern that is traditionally addressed through recognising kinship with other species through conferring sacred totemic relationships within society that place an onus of responsibility and stewardship on those who share specific relationships with plants, animals, and places (Chief Raoni Metuktire, 2020; Makaulele, 2021). Ikuenobe (2006) cited in Osuji (2018) stresses the continuity of energy and that in African culture organic and inorganic cycle is sacred. The continuum of all life needs to be recognized as consciousness is a continuum as stressed in many philosophies (Bohm and Dalai Lama, 2018;¹³ McIntyre -Mills, 2000).

The central argument in this (and previous work to date) is that democracy and governance need to be underpinned by individual and collective norms and values supported by governance systems that enable the balancing of interests for current and future generations of living systems. Interspecies relationships to food, water, and energy are central to life. We take some insights from Nussbaum (2006) as idealist and from the pragmatist Singer, who both support

rights for animals (*albeit* from different ethical approaches), but this approach *extends solidarity with ecosystems*. It does, nevertheless, open us to a slippery slope; however, once one accepts rights for organic and inorganic life it introduces a concern for inorganic intelligent designs. This may not, however, be a problem if the designs explicitly support social and environmental justice based on the axiom that we can be free and diverse to the extent that freedom and diversity do not undermine the rights of others or the environment in this generation or the next.

As Harari stresses, if we do not like the scenario that “the organism is an algorithm”¹⁴ then we can rewrite it, as human beings are designers. This is true, *but only within certain environmental limits within which we need to operate* (Meadows and Randers, 1992). Currently we are living beyond our limits and the design is unsustainable. Harari (2021) makes the point that if we continue down the current track, whole many populations will become extinct and human beings as we currently know them are likely to evolve into some form of hybrid cyborg. If we do not like the prospect of this scenario, then, it is vital that we make an effort to protect living systems. Big is not better – big buildings and big plantations built on old principles and petro-carbon for material and fertilizer. The circular economy¹⁵ currently emphasizes re-using and recycling, but we also need to replace industries and products. Manufacturing more petrochemical plastic should be banned and replaced with organic, bioplastics. But all materials need to be carefully used so that they are not wasted and so that they do not become pollution for land, rivers and oceans, as also stressed by Makaulule (2021). Values need to be discussed and “religion, morality, politics, and aesthetics” need to be acknowledged when making critical systemic decisions (Churchman, 1980). Thus we need “Requisite Variety” (Ashby, 1956) to test out ideas that should be made at the lowest level possible (principle of subsidiarity). But, we need to be guided by the axiom “A is better when B is better” (Von Foerster, 1991) with the caveat that provided B does not undermine freedom and diversity in this generation or the next.

Arguably, a pandemic occurs when we do not understand enough about living systems, encroach on the habitat of animals, and put people together in too densely populated contexts. The custodians in Venda support these values and understand the importance of circular economies that protect habitat for other species. The community of practice aims to support social enterprise to enable the participants to move away from profit towards supporting multi species relationships as detailed elsewhere on the need to recognize our hybridity and interconnectedness (McIntyre-Mills, 2017a). This is also the overall theme of the collected cases studies in “Balancing Individualism and Collectivism” (McIntyre-Mills *et al.*, 2018). Similarly a case is made for transformative research to protect the commons, citing examples of projects using multiple mixed methods, drawing on Indigenous wisdom (McIntyre-Mills *et al.*, 2019a,b). Whilst a case is developed for a new form of systemic ethics (McIntyre-Mills, 2014) and new architectures for a planetary passport (McIntyre-Mills, 2017), this is extended through an edited volume in which several contributors make a case to protect multiple species and the environment on which we depend (McIntyre-Mills and Corcoran Nantes, 2021).

Wellbeing stocks (Stiglitz *et al.*, 2010) can be facilitated by means of ecological mapping and supporting pathways to wellbeing based on social, economic, and environmental indicators in practical pilots¹⁶, which provide the basis for exploring policy implications¹⁷ and new architectures¹⁸. It avoids the merely technocratic response to poverty based on growing the size of the economic pie, which can be problematic, particularly if it merely supports the values of business as usual. Instead, we apply critical systemic thinking to change the design of the economic pie and the way it is distributed. This requires mobilizing people to think about what they value and why we need to value living systems. A way forward is through capacity-building in regenerative approaches to working with nature (adapted from Pauli, 2010).

6.1 Steps for community mapping of issues

In the focus group discussions with the participants in the Venda project, the researcher/facilitator (Patricia Lethole) introduced the discussion by stating (in Venda) that “I am going to ask questions, what you need to know is that there is no stupid response. Every response is important. We are not going to identify ourselves by using our real name. Unless if you want it to be known that you participated in this study. We can also use our totems to identify ourselves. Because you are almost of the same clan and sharing the totems, it will be done in this way; If we have 3 Lions, you will identify yourself as Lion 1 or Lion 2 and Lion 3. For you not forget your number write it on paper”.

1. Enter demographic data.
2. Hold focus group discussions – data to be entered into Qualtrics.
3. Follow up by telling stories about pathways to wellbeing in terms of social, economic, and environmental indicators.
4. Create rich pictures about what we have/need, willing to add/discard, barriers, turning points for better and worse, material and non-material assets.
5. Soft systems maps to link warm/contextual data based on stories, the ecological calendar, singing, and dancing as a way to convey and store knowledge through structured dialogue that enables supporting one another.
6. Make sense of the data in terms of social, economic. and environmental indicators.
7. Link the data to create tabulations across demographics, in terms of social, economic, and environmental indicators with a focus on social enterprise activities in Venda.

The above steps provide data on social enterprises, whilst the digital diary commitments (see proforma below) will enable linking the ecological calendar, and commitments to work with others on social enterprises. Human beings are able to think about their thinking, hence,

they are called the “twice wise”. Critical systemic thinking can help us to design our inquiry (Churchman, 1972) and to prompt us to think about our thinking. Werner Ulrich, a colleague of West Churchman, has summarised his approach as 12 questions which help to explore the boundaries of an area of policy concern (Ulrich and Reynolds, 2010: 244).

6.2. Proforma

Critical systemic research explores wicked problems in terms of 12 is/ought questions (Ulrich and Reynolds, 2010) which need to consider social, economic, and environmental dimensions together with those who are affected and involved. The data can be entered at the following link and it enables participants to think through opportunities. McIntyre-Mills, as first author of this chapter, has provided examples below in italics of the sorts of things people could say:

We have the following things in our community:

Sharing experience about social enterprise, for example: We can develop ourselves by cultivating indigenous vegetables like pumpkin and we can dry vegetables from pumpkin flowers and leaves. We can also cook and mix dry pumpkin and leaves for drying purposes. We can plant the different types of pumpkins to produce calabashes. We can also plant another type of pumpkins called Maranga. All these products we can eat and also sell to other people. Today, it rained and we put fertilizer on our crops, meanwhile others were collecting bamboo to make a fence to protect the chickens. The chicken manure is helpful for the vegetables.

The skill that I know which is found at Tshidzivhe is the traditional dancing such as tshigombela, and malende, this is what at Tshidzivhe we excel at. However, we are getting old but we are teaching the youth. Even if you can tell us to do that dance now, we can perform that because we have all the material for dancing purposes like drums.

There is no country that can be compared with Tshidzivhe in terms of the fertility of the soil. Tshidzivhe is like Canaan because all natural plants grow well there. This is where a lot of various wild vegetables and wild fruits like nombelo, mbubulu, thawi, and phone are found (F 60YRS)

We are also collecting seeds from trees and planting them in the nursery, which is in the garden enclosure.

We have the following difficulties; we need to protect the vegetables from birds and we must find netting to place over the vegetables.

Date by when new action will be completed.

We need the following to help our social enterprise.

Sharing experience about social enterprise, for example:

We need a sewing machine to make masks so that we can teach the young ones how to sew and we can also sell the masks to cover the costs and make a small profit, which can be used for buying netting for the vegetables and collected as a fund to support our on line data costs.....

We need to be trained in how to do book keeping and ask for on line training or a program where we can run the books for each of our social enterprises.

Each little sub-business needs to be managed as part of the co-operative.

Date by when new action will be completed.

We will add to our social enterprise – more community supports from a range of services and/ or more community engagement to lobby for resources, more connection to nature

When we use bamboo, we can produce the furniture, revive the cultivation of indigenous ground nuts, and different beans. From bean leaves, we shall dry them and make dried beans leaves vegetable

Sharing experience about social enterprise:

What grows well together is maize with pumpkins vegetable, finger millet, beans and legumes. and squashes that make calabashes. Group response: [We can grow] na nduhu (ground peanuts)...The other things that can be planted in combination is Venda sugar cane, and real peanuts and sesame. All these can be combined with mealies. The other things that can be planted in combination is Venda sugar cane, and real peanuts.

*A review of the data so far show that participants need training in book keeping, marketing, and gender mainstreaming, women's rights: "...I am still on that question of gender inequality. Like hey would say you are a girl stay at home while the brother will be seeking employment at Tshikondeni mine. You as a girl you should stay at home whilst your brother attends school. Girl should not herd cattle whilst a boy can do so. It means now, there is no longer work which is only suitable for men only or women only. This is the opportunity to learn about gender equalities. Let us learn here that we are equals. It is well understood, and it is *hitting on the head* (emphasis of well understood) Thus, no female will be returned by the in-laws because she cannot cook. This is well explained and we now understand. The woman cannot cook (and returned back to her parents) but she is able to buy a car which add value onto the homestead."*

Date by when new action will be completed.

We will discard— a sense of hopelessness and waste.

Sharing experience about social enterprise:

Bamboo will be used for many productive purposes. We will discard the idea that women cannot do certain things, we can work well together and with the men in our community if we learn about gender mainstreaming,

Date by when new action will be completed.

Self-reflection on *the turning points* for the better or worse – hope that consumption can be replaced with greater sense of attachment to others and the environment

Sharing experience about social enterprise:

We need to collect the rain water more efficiently and we need to buy a large storage tank. We can make pipes and gutters out of bamboo.

So we need to have careful bookkeeping so that the Co-op can buy rain tanks for our vegetables that will grow within the bamboo enclosures near each house.

Date by when new action will be completed.

Consideration of the barriers that currently exist and consideration of what could be done to set up social enterprise

Sharing experience about social enterprise.

Lifelong learning, sharing and growing partnerships will enable us to overcome the barriers.

Date by when new action will be completed.

When the material is entered on line we aim to develop an on line self-help space for members linked with a blog and WhatsApp. See link Venda: https://www.wirasoftfoundation.org/en_GB/web/ecovillage/venda1

6.3 Let us be strong and resilient like bamboo!

All co-ops need a story and a vision for the future.

What is your story and vision?

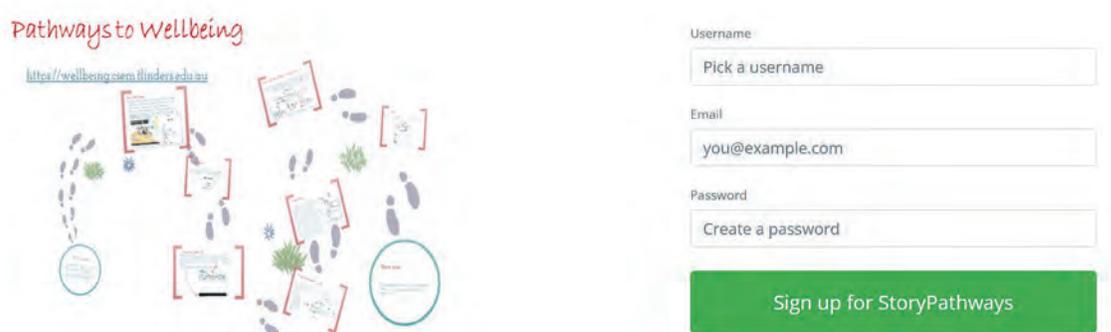
Could it be that you will be strong and able to bend, not break when you face storms and troubles?

Can you be strong by working with social and biological diversity?

All the people – old, young, people of all genders, and people with different skills, talents and personalities can work well together if they are given an opportunity to shine.

The ecological calendar can be followed to protect Mupo and also to help work with nature to create many enterprises – such as vegetables, eggs, mushrooms, arts and crafts

Figure 3 – Pictorial of the pathways to wellbeing



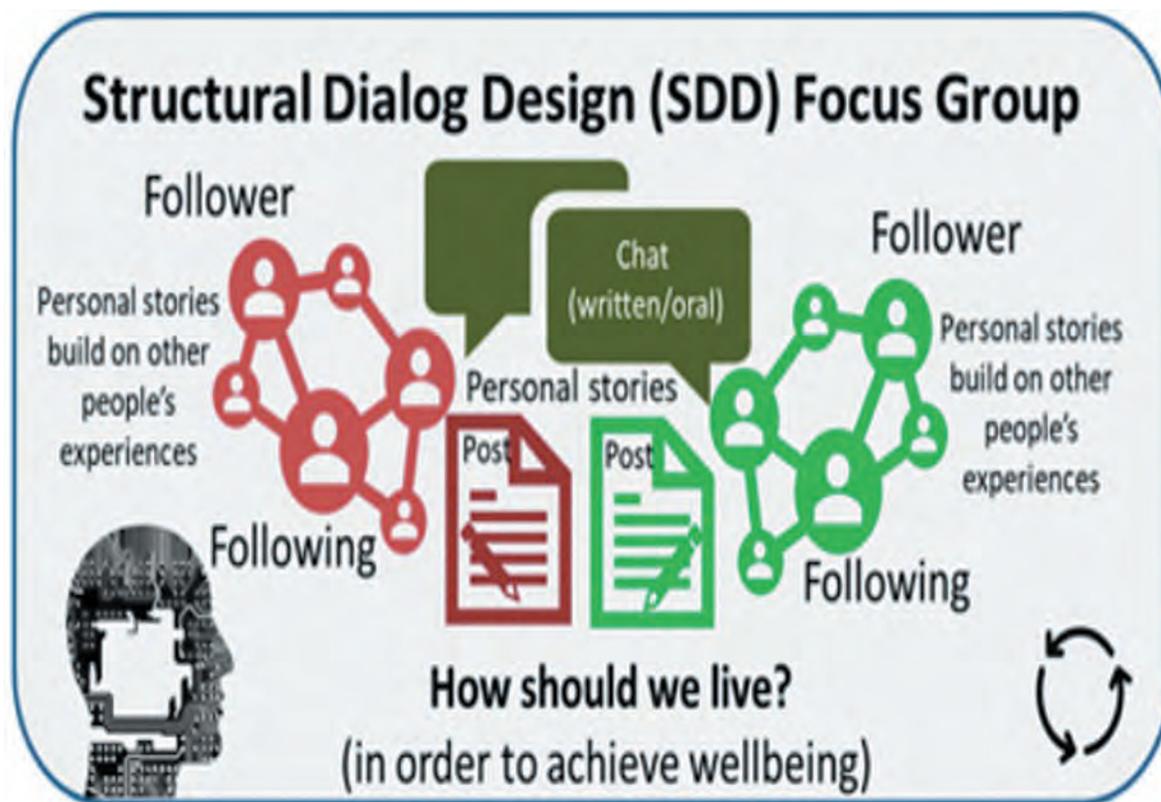
As academics, teachers and policy makers we need critical systemic thinking capabilities to protect and regenerate “wellbeing stocks”. Mphatheleni Makaulule, for example, has used her role as a Makhadzi to defend water sources¹⁹ from contamination by chemicals, defend the Thathe forest and sacred lake from Coal²⁰ and from corporate agricultural takeover²¹, in the words of Mphatheleni:

“The real role of women is in the seed. It is the women who harvest, select, store, and tis the symbol of the continuity of life. Seed is not just about the crops. Seed is about the soil, about the water, and about the forest.

When we plant our seeds, we don’t just plant them anytime or anywhere. We listen to our elders, who teach us about the ecological calendar. The seed follows this natural ecological flow. When it bears another seed, that one is planted and the cycle continues.

If you cut the cycle of the seed, you cut the cycle of life. We do not understand how something [like genetically modified and chemically treated seeds] can be called seeds if they cannot continue the cycle of life.”

Figure 4 – Architecture of a structural dialog design focus group



Cultural survival requires understanding our place within Mupo²²:

“The word Mupo describes the origin of creation, the creation of the whole Universe. When we look at nature, we see Mupo. When we look at the sky, we see Mupo. Mupo means all that is not man-made. Mupo gives everybody a space: men have their own space, children have their own space, women have their own space. Our role as women is to accompany all—from family, clan, community—to go back to that order. That is where we come to the name Makhadzi. Makhadzi is the name for VhaVenda women elders, but it literally means ‘the space of a woman’s role.’”

Democracy is not about rights at the expense of responsibility for others; to sum up, policy needs to support the common good, so we need designers and story tellers that create narratives and share these narratives. In “From Polarisation to Multispecies Relationships” (McIntyre-Mills, Wirawan and Widianingsih, 2021f,g), we suggest the potential of eco-villages supporting urban hubs based on eco-facturing, to use Gunter Pauli’s concept and the potential of scaling up the villages based on Indonesia’s One Village, One /Many Products. The data collected from the focus group discussions and on line narratives collected at the following site https://www.wirasoftfoundation.org/en_GB/web/ecovillage/vendal

This could then be used to map and model our progress towards protecting wellbeing stocks, in terms of social, economic, and environmental indicators. Wicked problems by definition are complex with many interrelated variables that are perceived differently by different stakeholders with the right and the responsibility to participate and to have a voice. In the context of the Venda project, the members of the community are engaged by two senior women (with the support of the chief) to participate in social enterprise in the form of a co-operative, either as members or as partners. By collecting social, economic, and environmental data and using it to populate a software program, data will be explored to establish pathways to protecting wellbeing stocks (Stiglitz *et al.*, 2010). To protect democracy, we need to ensure that the capabilities for a life worth living are protected. Nussbaum's (2011) ten capabilities are directly concerned with wellbeing, a life worth living, and the extent to which these can be addressed. They include:

“(1) Living a life that is not cut short prematurely; (2) Bodily health; (3) Bodily integrity; (4) Sense, imagination, and thoughts; (5) Emotions; (6) Practical reason; (7) Affiliation; (8) Links to other species; (9) Play; and (10) Control over one's environment.”

Nussbaum, however, extends these capabilities *to all sentient beings* and recognizes that human beings share sentients with other species (Nussbaum, 2006), and she stresses the need for the development of human capabilities. In fact these capabilities already exist in many traditional cultures and need to be remembered²³ through protecting wellbeing stocks through ecological mapping, narratives, and the use of digital mapping. We need to think about the policy implications of protecting many other species to which we are linked as well as the members of our own species who are vulnerable, including the marginalized, the disabled, and those who are asylum seekers or refugees.

The ability to assess what is good remains a central concern. Balancing individualism and collectivism needs to be based on:

- *A priori* norms - values; and
- *A posteriori* social, economic, and environmental indicators of wellbeing.²⁴

We cannot allow or hand over decisions to top-down algorithms. We must decide the nature of goodness based on considering the consequences of decisions for ourselves, others, and the environment by balancing individual and collective concerns.

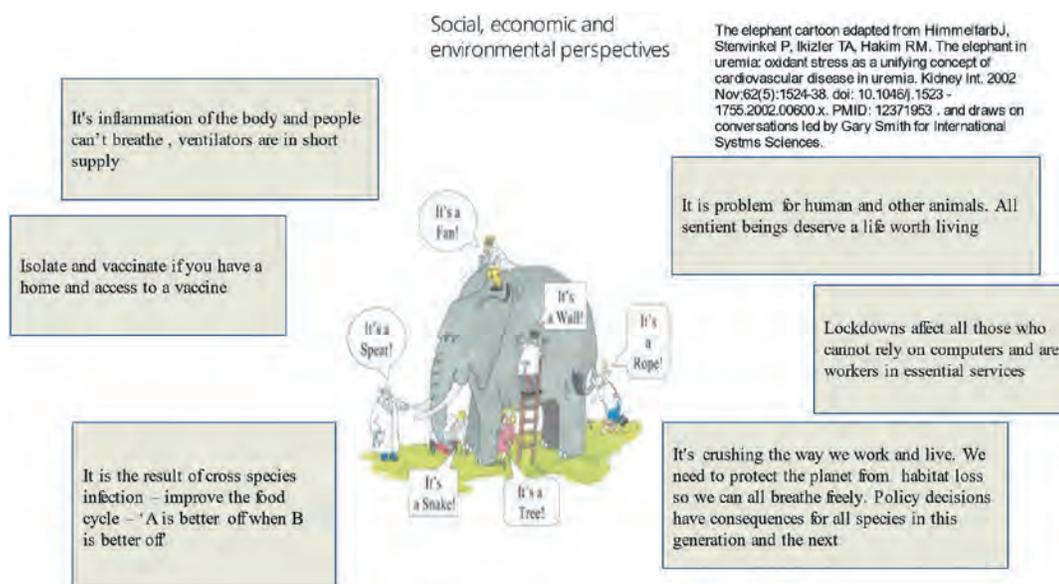
So a sense of the sacred, of the common good - and not only humanity at the expense of other species - is vital. We need conceptual decision making tools and the creative ability to formulate narratives that are coherent and that create a virtuous circle that protects an ecology of mind (Bateson, 1972) in harmony with nature, plants, birds, insects, and animals. Thus, we need capabilities to think about our thinking to protect our own wellbeing and the wellbeing of living systems.

7. Further discussion on COVID: Social, economic, and environmental implications

COVID-19 (and its variants) need to be understood as a multifaceted and wicked problem that needs to be understood in relational terms and informed by many disciplines and also by the many people who have been impacted in different ways (McIntyre-Mills, 2021i) during the pandemic. For those who work in hands-on service industries, the luxury of working from home was impossible and access to the basics such as face masks, soap and water for washing can be a struggle for many living in informal housing.

COVID-19 also brings the digital divide to the fore, which is why this community of practice tries to work with facilitators to extend access to a rural community by combining on-line with face-to-face communication, try to run train-the-trainer workshops, and increase access to computing equipment by buying a computer for the use of project participants.

Figure 5 - Social economic and environmental perspectives on the pandemic



Source: The above diagram draws on Gary Smith and Felix Tretter's inputs in collaboration with McIntyre-Mills (2021 in progress). Current approaches are misdirected (Ackoff and Pourdehnan, 2001). The source of the diagram is provided in the top right-hand corner and was adapted in conversation and iterative feedback.

Other versions will appear in a forthcoming paper by Tretter et al., (2021)²⁵.

The metaphor of an elephant resonates in some ways with the Makhadzi of Venda as Lethole is a protector of the elephants with whom she shares totemic kinship. Can Covid 19 also be seen as a metaphor? Inspired by Tretter's understanding of systems and conversations with colleagues linked with the International Systems Sciences, led by Gary Smith the following insights were drawn:

Too much carbon is perhaps like too much sugar for the body, leading to inflammation. Managing inflammation (climate change) requires achieving balance through improving communication/circulation, managing addictions, diet, laws to balance micro, meso and macro levels from the individual to the social and environmental level. It also requires balancing the individual and the collective in such a way that current and future generations of living systems are protected.

The challenge is to find ways to prevent pandemics through mitigating climate change and understanding our relationships to other species and the environment. Human beings have been living in ways that are out-of-balance with the natural world and this has resulted in creating an unhealthy environment. Just as overuse of carbon has resulted in climate change, the imbalance in habitat for multiple species has resulted in sicknesses in human beings and animals expressed as a pandemic.

Table 3 - New Narrative to protect multiple species based on balancing individualism and collectivism	
<ul style="list-style-type: none"> • Multi-species relationships across organic and inorganic cycle need to be protected through regenerative agriculture 	<ul style="list-style-type: none"> • Gaia/Mupo to protect habitat for multiple species
<ul style="list-style-type: none"> • Multiple species make up living systems, ²⁶which need to be protected through custodianship and the recognition of Indigenous heritage supported by UNRIP (2008) and extending stewardship praxis to protect habitats for multiple species 	<ul style="list-style-type: none"> • Planetary health guided by pathways to wellbeing underpinned by values and systemic ethics, buttressed in laws spanning biospheres.
The nervous system/ Neurons/circulation	Communication
<ol style="list-style-type: none"> 1. Circulation /flow 	<ol style="list-style-type: none"> 1. Caring based on systemic ethics and laws to ensure social, economic, and environmental decisions support balance 2. We need to be guided by the axiom “A is better when B is better “(Von Foerster, 1991) with the caveat that “provided B does not undermine freedom and diversity in this generation or the next”

Pathology	
<ul style="list-style-type: none"> • Body and brain • Inflammation linked with sugar, diabetes, obesity, heart disease, aging affecting cells in the human body, resulting in depression, brain fog, and symptoms similar to those of Alzheimer's, associated with long COVID 	<ul style="list-style-type: none"> • Climate change, extreme forms of social and environmental exploitation resulting in habitat loss, species loss, poverty, food insecurity, competition for scarce resources. These are symptoms of an underlying cause, namely an imbalance in our social, economic, and environmental systems and denial of the addiction to carbon and 'doing the wrong things right' (Ackoff and Pourdehnan, 2001)
Interventions to prevent, treat/re-generate	
<ul style="list-style-type: none"> • Management of inflammation, circulation, oxygen flow. • When systems are out of balance they need to be brought into equilibrium by making adjustments (Tretter, 2021) This applies across all living systems. 	<ul style="list-style-type: none"> • Non-anthropocentric governance at the micro, meso and macro level supported by laws to prevent ecocide as defined by Higgins <i>et al.</i>, (2013) need to be mindful of "Requisite Variety" (Ashby, 1957) when addressing governance to protect the wellbeing of the planet. (See McIntyre-Mills, 2017, drawing on Allena Leonard, 1994; Stafford Beer, 1974, 1994; Christakis and Bausch, 2006; and Flanagan and Christakis, 2010.)

<ul style="list-style-type: none"> • Vaccination as a circuit breaker, but also need long-term interventions to prevent future pandemics, which requires wide ranging policy transformation at a national and international level to lower emissions, protect habitat, and ensure that cross species infections are minimized through ensuring that agricultural animals are protected. The inhumane trafficking and containment of animals that usually do not come into contact with one another is one of the ways that the health of multiple species can be protected (Goodall, 2020, Gorbalenya <i>et al.</i>, 2020) 	<ul style="list-style-type: none"> • Overall systems balance achieved through interventions from the local to the regional and post national regional level to enhance flows to manage equilibrium. • Action is needed to address food, water and energy security because this is what people care about through the interventions at local, national, and international level ... co-operatives and local governments enable small steps towards transformation but we also need laws at a national, post-national level in Africa buttressed in international laws to ensure that social, economic, and environmental indicators – that support the Sustainable Development Goals and United Nations policy on risk (Sendai Risk Platform), the IPCC (2021), food security, high rate of urbanization and the rights of Indigenous people to protect their indigenous habitats and supporting wellbeing stocks (Stiglitz <i>et al.</i>, 2010) for current and future generations. Old style economies (or business as usual) that supports carbon-based growth economics, instead of balancing individual and collective needs are no longer viable.
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Clearly, we need to work at multiple levels when we try to prevent COVID-19. This means working from the individual level to the community level in such a way that we address the needs of all living systems. When we keep all the systems in balance, we are more likely to be healthy. Mphatheleni sums this up as follows:

“I like circular economy and sustainability. Understanding [the] ecological calendar brings back [our] understanding of the interconnectedness of life and that it is not about human life alone to be saved. This brought my thinking that religious principles should also revisited. the role of interconnectedness as in the bible when in genesis it is said human beings should govern all other live communities, it was not that they should dominate or be above rights of other life

on Earth. [e.g. Thomas Berry (2006:105) wrote in his book “Evening Thoughts Reflecting on Earth as Sacred Community” emphasized that human beings cannot be well on a sick planet and that every component of the Earth community has rights. Rivers have river rights, insects have rights (2006:109-1)].

The essence of the policy advice given by Donna Haraway (1991) is: “*Be a designer, not the object of other people’s designs*”. This prompted the first researcher to work with computer designers to ensure that marginalized groups have a say in designs to address complex health, housing, social inclusion (McIntyre-Mills, 2008), mitigation, and adaptation to climate change (McIntyre-Mills *et al.*, 2014) and ways to transform the education system to protect the global commons by ‘earning, learning and growing a future.’ (McIntyre-Mills *et al.*, 2021, forthcoming). The stories we need to tell are stories of how we are dependent on nature and how we need to act as stewards not as exploiters. We cannot separate god/sense of awe or the sacred, humanity, and digital, they need to serve the common good or living systems in this generation and the next. This requires changing the way we live our lives.

The potential to do things differently is being explored by forming a community of practice linked across universities and communities to pilot alternative ways of earning a living. New systems of education, governance, and economics based on an “ecology of mind” (Bateson, 1972) need to support more rural campuses linked with community outreach to support ecofacturing (Pauli, 2010, McIntyre-Mills *et al.*, 2019, 2021 d, e)²⁷ by working with nature. Lessons are learned (and shared) from small community-based projects such as the Organic Farm in Ocean View, Cape Town (Swanapoel, 2021), Alam Endah in West Java (McIntyre-Mills *et al.* 2019), and Thathe Forest and environs (Makaulule, 2021) through leadership and engagement to protect the habitat.

8. Conclusion: The digital era could serve the common good and the global commons

Schools, universities, and vocational education and training need to protect local environments, and places of learning should focus on rural urban balance. Do we want a future that is devoid of a diversity of living systems? We need designs that enable local people to monitor social, economic, and environmental indicators of wellbeing so that they are not entirely subject to the whims of corporations. We may need international laws to protect the planet from ecocide, but we will need the means to govern the governors, to hold social, economic, and environmental decision makers to account. We need to emphasize positive narratives and positive choices to create positive, not negative, cascades:

“It is our time to decide which cascades we want to maintain and which ones should be avoided by correcting the processes that produce them. A solution is to apply from the beginning regenerative processes that eliminate any possible damage of the original natural conditions and that support the life of all native multiple species. Intelligent and responsible foresight is always needed. And this

kind of foresight must be an indispensable purpose of transformative education. There are more questions to be addressed by learners than the ones their teachers could imagine or suggest” (Reynaldo Trevino in conversation with Janet McIntyre-Mills, 2021, forthcoming)

In the COVID and post-COVID era, this foresight suggests that we need to draw on many ways of knowing including natural, social sciences, and Indigenous knowledge systems to regenerate and protect the cycle of life. New systems of education are overdue as we are facing not separate but linked social, economic, and environmental challenges that are the result of current linear systems of economics and fragmented understanding of our place in the world. The cascading problems are a result of human-induced climate change, loss of habitat, displacement of people, plants and animals, and increased competition for scarce resources. The Ubuntu approach of working with people and the environment recognises the need for a new form of education that supports a better (relational) communication across the sciences and a circular, rather than a linear, economy that re-generates and protects through nurturing future generations of life, rather than degenerating and depleting the environment on which we all depend.

References

- Ackerman J (2016). “The Genius of Birds”. London: Scribe
- Ackoff RL and Pourdehnan J (2001). “On misdirected systems”. *Systems Research and Behavioral Science* **18**(3): 199-205.
- Addae D and McIntyre-Mills J (2021). “Chapter 18: Sacred groves of the Tolon District of the Northern Region, Ghana: Where spirituality meets education for sustainable development”. In JJ McIntyre-Mills, Y Corcoran-Nantes and R Wirawan (Eds.), *Transformative Education for Re-generative Development*. Edward Elgar, in production.
- Berry B (2006). “*Evening Thoughts Reflecting on Earth as Sacred Community*”. San Francisco: Sierra Club Books.
- Banathy B (1996). “*Designing Social Systems in a Changing World*”. London: Plenum.
- Banathy B (2000). “*Guided Evolution of Society: A Systems View*”. London: Kluwer/Plenum
- Barrett M (2000). “*Virginia Woolf: A room of one’s own*” (first published in 1928 by Hogarth and Three Guineas). London: Penguin Classics
- Bateson N (2021). “Plenary International Systems Sciences” <https://norabateson.wordpress.com/2017/05/28/warm-data/> Nora Bateson Plenary, July 12th International Systems Sciences https://zoom.us/rec/play/oe07ngyKljHXqZxIaT5nBr_c95ReZ2KWOWXCrYw7uIK6rKfJRUPtUH_urEVNtlI9m1WDZbqZFxJ8k7i.po_IqnXsYX9swRJR?continueMode=true&_x_zm_rtaid=u3XXrLmPQCaoiZM3sR9LHA.1626085969999.920d3aa8d2c700ad3a46aaaca293852c&_x_zm_rtaid=301
- Beer S (1974). “*Designing Freedom*”. Chichester: Wiley.
- Beer S (1975). “*Platform for Change*”. Chichester: Wiley.

- Beer S (1994). "Governance or government". In S. Beer (Ed.), *Beyond Dispute: The Invention Of Team Syntegrit*. Chichester: Wiley.
- Bohm D (2002). *"Wholeness and the Implicate Order"*. London and New York: Routledge.
- Bostrom N (2011). ["Existential risk prevention as the most important task for humanity."](http://www.existential-risk.org) www.existential-risk.org.
- Bohm D and Dalai Lama HH (2018). ["From fragmentation to wholeness: David Bohm and Dalai Lama life and mind enfolded in everything"](https://www.youtube.com/watch?v=V2He4oU32sg). <https://www.youtube.com/watch?v=V2He4oU32sg>.
- Burke J (2021). "Damage from pandemic could quash ambitions, exacerbate tensions, and deepen repression in parts of continent" <https://www.theguardian.com/world/2021/aug/13/an-economic-calamity-africa-faces-years-of-post-covid-instability>
- Checkland P and Scholes J (1991). *"Soft Systems Methodology in Action"*. Chichester: Wiley.
- Chilisa B (2009). "Indigenous African-centered ethics: Contesting and complementing dominant models." In MD Mertens and PE Ginsberg (Eds.), *The Handbook of Social Research Ethics* (pp. 407–26). London: Sage.
- Chilisa B (2012). *"Indigenous Research Methodologies"* (1st ed.). London: Sage.
- Chilisa B (2017). "Decolonizing T\transdisciplinary research approaches: An African perspective for enhancing knowledge integration in sustainability science." *Sustainability Science* **12**(5): 813–
- Chilisa B (2020). *"Indigenous Research Methodologies"* (2nd ed.). London. Sage.
- Christakis AN and Kakoulaki M (2021). "Objectifying intersubjectivity through inclusion for a scientific [R]evolution". In JJ McIntyre-Mills and Y Corcoran Nantes and (Eds.), *From Polarization to Multispecies Relationships: Re-generation of the Commons in the Era of Mass Extinctions* (pp. 699-728). New York: Springer.
- Christakis AN and Bausch K (2006). *"How people harness their collective wisdom and power to construct the future in co-laboratories of democracy"*. Information Age Publishing.
- Christakis AN (1988). "The Club of Rome revisited in: General systems". In J Reckmeyer (Ed.), *International Society for the Systems Sciences* (Vol. XXXI, pp. 35–38): New York.
- Christakis AN (2006) "A retrospective structural inquiry of the predicament of humankind". In JP van Gigch and JJ McIntyre-Mills (Eds.) *Volume 1: Rescuing the Enlightenment from Itself*. Boston, MA: Springer.
- Churchman CW (1979). *"The Systems Approach and Its Enemies."* New York: Basic Books.
- Churchman CW (1982). *"Thought and Wisdom"*. Californian: Intersystems Publications.
- Damasio A (2017). *"We Must Not Accept an Algorithmic Account of Human Life"* https://www.huffpost.com/entry/algorithmic-human-life_b_10699712 and in *New Perspectives Quarterly* First published: 27 July 2016 <https://doi.org/10.1111/npqu.12049>
- De Waal F (2006a). "Part 3: The tower of morality". In S Mace and J Ober (Eds.), *Primates and Philosophers: How Morality Evolved*. Princeton, NJ: Princeton University Press.
- De Waal F (2006b). "Part 1: Morally evolved". In S Mace and J Ober and (Eds.), *Primates and Philosophers: How Morality Evolved*. Princeton, NJ: Princeton University Press.
- De Waal F (2009). *"The Age of Empathy: Nature's Lessons for a Kinder Society"*. New York: Harmony Books.

- Flanagan T and Christakis AN (2010). “*The Talking Point: Creating an Environment for Exploring Complex Meaning*”. Information Age Publishing. <https://www.amazon.com/Talking-Point-Creating-Environment-Exploring/dp/1607523620>
- Florini A (2003). “*The Coming Democracy*”. Washington DC: Island Press.
- Forsetto R (2020) Chief Raoni, Nobel Peace Prize nominee, presides over historic meeting with over 600 indigenous leaders in Brazil, on 5 February, 2020.
- Gagliano M, Abramson C, and Depczynski M (2018). “Plants learn and remember: Let’s get used to it.” *Oecologia*, **186**: 29–31. <https://doi.org/10.1007/s00442-017-4029-7>.
- Gergen K (1991). “*The Saturated Self: Dilemmas of Identity in Contemporary Life*”. New York: Basic Books.
- Gergen MM (2020). “Practices of inquiry: Invitation to innovation” In S McNamee, MM Gergen, C Camargo-Borges, E Rasera (Eds.), *The Sage Handbook of Social Constructionist Practice* (pp 17-23). London: Sage.
- Ghosh J (2021). “*Time is Running Out for a New Agricultural Model for the Global South*”. <https://socialeurope.eu/time-is-running-out-for-a-new-agricultural-model-for-the-global-south> (on 20th September).
- Goodall J (2020). <https://www.cnn.com/videos/us/2020/03/19/coronavirus-jane-goodall-acfcfull-episode-vpx.cnn>.
- Gorbalenya, AE, Baker SC., Baric RS, *et al.* (2020). “The species severe acute respiratory syndrome-related coronavirus: Classifying 2019-nCoV and naming it SARS-CoV2”. *Nature Microbiology* **5**: 536–44. <https://doi.org/10.1038/s41564-020-0695-z>.
- Haraway DJ (1991). “*Cyborgs, Simians, and Women: The Reinvention of Nature*”. London: Free Association Books.
- Harari YN (2015). “*Sapiens: A Brief History of Humankind*.” New York: Harper.
- Harari YN (2016). “*Homo Deus*”. London: Harvill Secker.
- Harari YN (2017). “*Homo Deus: A Brief History of Tomorrow with Yuval Noah Harari*” <https://www.youtube.com/watch?v=4ChHc5jhZxs>
- Harari Y (2019) <https://www.cfhu.org/news/hus-yuval-noah-harari-still-time-to-stop-rule-by-computer-algorithms/>
- Harari YN (2019). “Human history will end when men become gods. A conversation with Harari”. *New Perspectives Quarterly* **3** (4): 6-13.
- Harari YN (2020) “Organisms are Algorithms. Body is calculator.” Answer = Sensation~Feeling~Vedanā. <https://www.youtube.com/watch?v=GrQ7nY-vevY> 14 Jun 2020
- Harari YN (2021). “How Human Can Be Hacked”. <https://www.youtube.com/watch?v=eZuJ4WyJNGQ> 16 May 2021
- Harari YN, Kahneman D, and Swisher K (2021) “Daniel Kahneman and Yuval Noah Harari in Conversation”
- Harari YN <https://www.youtube.com/watch?v=7yhg7NmTeVg>
<https://www.thinkautomation.com/eli5/what-is-an-algorithm-an-in-a-nutshell-explanation/>
- Harris LD and Wasilewski J (2004). “Indigeneity, an alternative worldview: Four R’s (Relationship, Responsibility, Reciprocity, Redistribution) vs. two P’s (Power and Profit). Sharing the

- journey toward conscious evolution". *Systems Research and Behavioral Science* **21**(5): 489–503.
- Heim, M (1993). *"The Metaphysics of Virtual Reality"*. New York. Oxford University Press.
- IPCC (2021). "Summary for policymakers". In: *Climate Change 2021: The Physical Science Basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change" [VP Masson- Delmotte, A Zhai and SL Pirani] <https://www.wri.org/insights/ipcc-climate-report>
- Kahneman D (2011). *"Thinking, Fast, and Slow"*. New York: Farrar, Straus and Giroux.
- Lee B (2021). *"Who Gets to be Smart: Privilege, Power and Knowledge"*. Victoria: Allen and Unwin
- Leonard A (1994). "The very model of a modern major general". In S Beer (Ed.), *Beyond Dispute: The Invention of Team Syntegrity* (pp. 333-45). Chichester: Wiley.
- Lethole P, McIntyre-Mills JJ, Wirawan R, and Makaulule M (2021 forthcoming). "Chapter 19: Aa!! Venda women and social enterprise: Stepwise progress to regenerative and sustainable living". In JJ McIntyre-Mills, Y Corcoran Nantes and R Wirawan (Eds.), *Transformative Education for Re-generative Development*. Edward Elgar, in progress.
- Lincoln YS and Guba E (1985). *"Naturalistic Inquiry"*. London: Sage
- Macy J, Young-Brown M, and Fox M (2014). *"Coming Back to Life: The Updated Guide to the Work That Reconnects"*. Gabriola Island: New Society Publish.
- Magill G (2018). "Pivotal perspectives on integral ecology". In G. Magill and J. Potter (Eds.), *Integral Ecology: Protecting Our Common Home* (pp. 2-7). Newcastle Upon Tyne: Cambridge Scholars Publishing.
- Makaulule M (2021). "The ecological cultural calendar mapping as a tool for story telling". Slides presented to social enterprise planning group for community engagement project on 5th October 2021.
- Matshidze PE (2013). *"The Role of Makhadzi in Traditional Leadership in Venda"*. University of Zululand: South Africa.
- McIntyre-Mills JJ (2009). *"User-centric Policy Design to Address Complex Needs"*. New York: Nova Science.
- McIntyre-Mills JJ (2010). "Wellbeing, mindfulness and the global commons". *Journal of Consciousness Studies* **17**(7–8): 44–72.
- McIntyre-Mills JJ (2014). *"Systemic Ethics"*. New York: Springer.
- McIntyre-Mills JJ, with De Vries D, and Binchai N (2014). *"Transformation from Wall Street to Wellbeing: Joining-up the Dots Through Participatory Democracy and Governance to Mitigate the Causes and Adapt to the Effects of Climate Change"* (pp. 193-8). New York: Springer (Second and third authors provided the appendix on software user guide).
- McIntyre-Mills JJ (2017a). *"Planetary Passport for Representation, Accountability and Re-Generation"*. Contemporary Systems Series, Cham, Switzerland: Springer.
- McIntyre-Mills JJ (2017b). "Recognizing our hybridity and interconnectedness: Implications for social and environmental justice". *Current Sociology* <https://uk.sagepub.com/en-gb/journals-permissions>

- McIntyre-Mills JJ, Romm N, and Corcoran-Nantes Y (2018 Eds.), *“Balancing Individualism and Collectivism: Social and Environmental Justice”*. Cham: Springer.
- McIntyre-Mills JJ (2018). “Policy design for non-anthropocentric pathways to protect biodiversity and regenerate the Lnd”. *International Journal of Educational Development in Africa* <https://doi.org/10.25159/2312-3540/2865>.
- McIntyre-Mills JJ (2018) [“Human Research Ethics ‘Living Virtuously and Well’](#) 7213 (approval number)
- McIntyre-Mills JJ Corcoran-Nantes Y, Widianingsih I, and Wirawan R (2019). Chapter 7. “Alam Endah: Rural Camelot in West Java—A case study of empowerment and integrated rural development”. In JJ McIntyre-Mills, NRA Romm, and Y Corcoran Nantes (2019). *“Democracy and Governance for Resourcing the Commons: Theory and Practice on Rural-Urban Balance”* (pp.179-92). Cham: Springer.
- McIntyre-Mills JJ, Romm NRA, and Corcoran Nantes Y (Eds.) (2019). *“Democracy and Governance for Resourcing the Commons: Theory and Practice on Rural-Urban Balance”*. Cham: Springer
- McIntyre-Mills JJ (2021a). “Prologue: No longer top predator”. In JJ McIntyre-Mills and Y Corcoran-Nantes (Eds.), *From Polarization to Multispecies Relationships in the Age of Mass Extinctions* (pp. xiii-xxxiv). Springer Nature Singapore.
- McIntyre-Mills JJ (2021b). “Why thinking matters: Constructivism, relationships and the performative universe”. In JJ McIntyre-Mills and Y Corcoran –Nantes (Eds.), *From Polarization to Multispecies Relationships in the Age of Mass Extinctions* (pp. 213-22). Singapore: Springer Nature.
- McIntyre-Mills JJ in conversation with Rudolf Wirawan, Dennis Finlayson and Tom Flanagan (2021c). “Architectures to protect the commons: A community of practice to inspire agency and hope”, International Systems Sciences, Paper delivered 65th Annual Meeting of the International Society for the Systems Sciences, *“The Art and Science of the Impossible: The Human Experience”* <https://www.iss.org/online-2021/>
- McIntyre-Mills J (2021d). “Biopolitics and food security to protect social and environmental justice”. In JJ McIntyre-Mills and Y Corcoran-Nantes (Ed.), *From Polarization to Multispecies Relationships in the Age of Mass Extinctions* (pp.575-602.), Singapore: Springer Nature.
- McIntyre-Mills JJ and Christakis AN (2021e). “Social and environmental justice: The legacy of structured democratic dialogue and the potential of pathways to wellbeing”. In JJ McIntyre-Mills and Y Corcoran –Nantes (Eds.), *From Polarization to Multispecies Relationships in the Age of Mass Extinctions* (pp. 283-328). Singapore: Springer Nature.
- McIntyre-Mills JJ with Corcoran-Nantes Y, Wirawan R, and Widiansingh I (2021f). “The potential of eco-facturing: Towards social and environmental justice through vocational education and training.” In JJ McIntyre-Mills and Y Corcoran –Nantes (Eds.), *From Polarization to Multispecies Relationships in the Age of Mass Extinctions* (pp. 391-424). Singapore: Springer Nature.
- McIntyre-Mills JJ and Wirawan R (2021g). “From education as usual to creating a post national learning community.” In JJ McIntyre-Mills and Y Corcoran-Nantes (Eds.), *From*

- Polarization to Multispecies Relationships in the Age of Mass Extinctions* (pp. 425-50). Singapore: Springer Nature.
- McIntyre-Mills JJ (2021h). “The importance of relationality: A note on co-determinism, multispecies relationships and implications for COVID-19.” *Systems Research and Behavioural Science*, 1–15. <https://doi.org/10.1002/sres.2817>.
- McIntyre-Mills J.J (2021i). “Communication and culture: A multispecies endeavor within a shared habitat.” Year book for International Society for Systems Sciences, *Systems Research and Behavioral Science* 1-14 <https://doi.org/10.1002/sres.2810>.
- McIntyre-Mills JJ, Corcoran Nantes Y, and Wirawan R (forthcoming). “Transformative education for re-generative development: Pathways to sustainable environments”. Contracted and in preparation Edward Elgar.
- Meadows D and Randers J (1992). “*Beyond the Limits: Global Collapse of a Sustainable Future*”. London: Earthscan Publications.
- Mertens DM (2017). “Transformative research: Personal and societal”. *International Journal for Transformative Research* 4(1):18-24.
- Mertens DM (2019). “Preface: Transformative mixed methods in troubling times”. In JJ McIntyre-Mills, NRA Romm and Y Corcoran-Nantes (Eds.). *Mixed Methods and Cross Disciplinary Research: Towards Cultivating Eco-systemic Living* (pp. xi- xx). Cham: Springer.
- Mertens DM (2022). “Designing mixed methods studies to contribute to social, economic, and environmental justice: Implications for Library and Information Sciences.” In P. Ngulube (Ed.), *Handbook of Research on Mixed Methods Research in Information Science* (pp. 173-89). Hershey, PA IGI Global.
- Nussbaum MC (2011). “*Creating capabilities: The Human Development Approach*”. Cambridge: Belknap Press of Harvard University Press.
- Neyland D (2019). “*The Everyday Life of an Algorithm*,” https://doi.org/10.1007/978-3-030-00578-8_5
- Nichol L (1997). “Bracketed bodies, pivotal bodies: Trajectories of the postmodern self”. In *Tarhang Tulku Light of Knowledge: Essays on the Interplay of Knowledge, Time and Space* (pp. 311-72). Berkley: Dhama Publishing.
- Odora-Hoppers C (2013), “Community engagement, globalization, and restorative action: Approaching systems and research in the Universities.” *Journal of Adult and Continuing Education* 19(2) Autumn 2013: 94-102.
- Open Letter by Indigenous Peoples to Indigenous Peoples in Brazil on Surviving COVID-19 (2021) with Preface by Eliane Potiguara <https://www.culturalsurvival.org/news/open-letter-indigenous-peoples-indigenous-peoples-brazil-surviving-covid-19>, 7th January
- Ostrom E (2008). “Design principles of robust property-rights institutions: What have we learned?” *Elinor Ostrom Workshop in Political Theory and Policy Analysis*, Indiana University Center for the Study of Institutional Diversity Arizona State University <http://www.indiana.edu/~workshop>
- Ostrom E (2010). “Elinor Ostrom Nobel Prize in Economics Lecture”. <https://www.youtube.com/watch?v=T6OgRki5SgM> gives an update on the 2009 lecture.

- Osuji P (2018). “Laudato Si’ and traditional African environmental ethics”. In G Magill and J Potter (Eds.), *Integral Ecology: Protecting Our Common Home* (pp. 184-208). Newcastle Upon Tyne: Cambridge Scholars Publishing.
- Pauli G (2010). *The Blue Economy: Report to the Club of Rome*. Paradigm Publications.
- Quan-Baffour KP, Romm NRA, and McIntyre-Mills JJ (2019). “Ubuntu: A Dialog on connectedness, environmental protection, and education”. In JJ McIntyre-Mills and NRA Romm (Eds.), *Mixed Methods and Cross-disciplinary Research* (pp. 221–250). Cham: Springer.
- Raworth K (2017). *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist*. Vermont, USA: Chelsea Green Publishing. <http://www.kateraworth.com/doughnut/>
- Rayner ADM (2010). “Inclusionality and sustainability – Attuning with the currency of natural energy flow and how this contrasts with abstract economic rationality”. *Environmental Economics* 1: 98-108.
- Romm NRA (2015). “Reviewing the transformative paradigm: A critical systemic and relational (Indigenous) lens”. *Systemic Practice and Action Research* 28(5):411–27.
- Romm NRA (2017). “Researching Indigenous ways of knowing-and-being: Revitalizing relational quality of Lliving.” In P Ngulube (Ed.), *Handbook of Research on Theoretical Perspectives in Indigenous Knowledge Systems in Developing Countries* (pp. 22–48). Hershey, PA: IGI Global.
- Romm NRA (2018). *Responsible Research Practice: Revisiting Transformative Paradigm in Social Research*. Cham: Springer.
- Romm NRA (2020). “Justifying research as conscious intervention in social and educational life: Activating transformative potential”. *Educational Research for Social Change* 9(2):1-15.
- Romm NRA (2021). “Responsibly and performatively researching multi-species relationality”. In JJ McIntyre-Mills and Y Corcoran-Nantes (Eds.), *From Polarization to Multispecies Relationships: Regeneration of the Commons in an Era of Mass Extinctions* (pp. 223-60). Cham: Springer.
- Romm NRA and Lethole PV (2021). “Prospects for sustainable living with focus on interrelatedness, interdependence and mutuality: Some African perspectives”. In JJ McIntyre-Mills and Y Corcoran-Nantes (Eds.), *From Polarization to Multispecies Relationships: Regeneration of the Commons in an Era of Mass Extinctions* (pp. 87-114) Singapore: Springer
- Ross KB (2017). *Traditional Terrain: Land, Gender, and Cultural Biodiversity Preservation in Venda, South Africa*. PhD Thesis, Dept of African American and African Studies, Michigan State University.
- Rostow WW (1960). *The Stages of Economic Growth: A non-Communist Manifesto*. Cambridge, England: University Press.
- Senge PM (2006). *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Random House.
- Shiva V (1991). *The Violence of the Green Revolution: Third World Agriculture, Ecology, and Politics*. London: Zed Books.
- Shiva V (2012a). *Monocultures of the Mind*. Penang: Third World Network

- United Nations (2021). *Glasgow Climate Change Conference* <https://unfccc.int/process-and-meetings/conferences/glasgow-climate-change-conference>
- United Nations (2017). *Sustainable Development Goals*. <https://www.un.org/development/desa/publications/sdg-report-2017.html>
- Verkaik R (2019). *“Posh Boys, How English Public Schools Ruin Britain”*. London: Oneworld.
- Vidal J (2020) *“Tip of the Iceberg’: Is Our destruction of Nature Responsible for COVID-19?”* <https://www.theguardian.com/environment/2020/mar/18/tip-of-the-iceberg-is-our-destruction-of-nature-responsible-for-covid-19-aoe>
- Vhutanda Profile and Glossary (2012). Venda: Dzomo la Mupo.
- Wise TA (2021). *“Africa’s Green Revolution Initiative Has Faltered: Why Other Ways Must Be Found”*. <https://theconversation.com/africas-green-revolution-initiative-has-faltered-why-other-ways-must-be-found-167624>
- Zuboff S and Schwandt K (2019). *“The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power”*. London: Profile Books.
- Zuboff S (2019). *“What is Surveillance Capitalism?”* <https://www.youtube.com/watch?v=pD3Gw8rvcJ81907>.

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MPHATHELENI MAKKAULULE is Indigenous Knowledge Project coordinator of environmental heritage with communities around Vhembe District/Venda. Mphatheleni “Mphathe” Makaulule is the winner of the 2013 Global Leadership Award, founded Mupo Foundation in 2007, established registered Dzomo la Mupo (Voice of the Earth) as a Community-Based Organization in 2015. For almost 30 years, Mphatheleni has been recording the indigenous knowledge of local elders. In 1998, Mphatheleni finished her teaching degree from University of Venda, then went straight back to her communities to learn from elders about the culture: forests, rivers, and rituals and in that learning she worked with school children and teachers to transfer the indigenous knowledge. In 2000, she established Luvhola Cultural Village, and in 2007 she founded Mupo Foundation and co-founded Dzomo la Mupo (“Voice of Mupo”), a community-based organization, based on the work she was doing with communities - including working with the VhaVenda - to revive their confidence and stand firm against some of the threats to their land, culture and livelihoods, such as destruction of sacred sites, threats of mining projects in

the region. Dzomo la Mupo is the voice of rivers, mountains, insects, and wildlife. They are the voice of clouds, stars, and cosmos. They are the voice of Mother Earth and her communities. In 2006, Mphatheleni met with the African Biodiversity Network and The Gaia Foundation (until 2014) who have been working together to seek African solutions to the ecological and socio-economic challenges that face the continent. Presently Mphatheleni is working via Dzomo la Mupo to carry on this same vision and activities. The protection of sacred natural sites is at the core of the work and Mupo is part of the growing global network of communities and their allies saying Zwifho are “No Go Zone Areas” and instead “Yes to Life, No to Mining!”. Mphatheleni is also pursuing her Master’s degree at University of Venda on African Studies focusing on indigenous knowledge systems.

Endnotes

- 1 A presentation on this by McIntyre-Mills and Wirawan was given at the joint Society for the Advancement of Science in Africa (SASA) and Ministry of Health (MOH, Uganda) conference in 2020, parts of which will appear as a chapter in a book being edited entitled “Transformative Education” to be published by Edward Elgar (forthcoming).
- 2 https://unfccc.int/sites/default/files/resource/July%20Minsterial_Chair%27s%20Summary.pdf
- 3 It is a living universe in which human beings are a strand.
- 4 Q&A - The Future of Humanity - with Yuval Noah Harari <https://www.youtube.com/watch?v=Lt7votAzI78>
- 5 A physicist with an interest in spirituality, who was regarded by HH Dalai Lama as his science teacher.
- 6 Lovelace wrote the introduction to the online versions stressed that “hundreds of thousands of men, women, and even children... suffered, and [died, at the hands of the Inquisitors](http://www.malleusmaleficarum.org/downloads/MalleusAcrobat.pdf) <http://www.malleusmaleficarum.org/downloads/MalleusAcrobat.pdf> Accessed 19/12/2019
- 7 <https://news.mongabay.com/2020/02/chief-raoni-nobel-peace-prize-nominee-presides-historic-meeting-with-over-600-indigenous-leaders-in-brazil/>
- 8 https://www.youtube.com/watch?v=rgW2zq8_xu0
- 9 Mphatheleni Makaulule sums up: “I like circular economy and sustainability. Understanding ecological calendar brings back understanding the interconnected of life and that it is not about human life alone to be saved. This brought my thinking that religious principles should also revisit the role of interconnectedness as in the bible when in genesis it is said human being should govern all other lives communities, it was not that they should dominate or be above rights of other life on Earth. For example, Thomas Berry (2006:105) in Evening Thoughts Reflecting on Earth as Sacred Community emphasised that human beings cannot be well on a sick planet and that every component of the Earth community has rights. Rivers have river rights, insects have rights (2006: 109-111).
- 10 The definition is as follows: “1. Material living standards (income, consumption and wealth), 2. Health, 3. Education, 4. Personal activities including work, 5. Political voice and governance, 6. Social connections and relationships, 7. Environment (present and future conditions), 8. Insecurity, of an economy as well as a physical nature”. This definition of wellbeing stocks fits well with the way in which both Indigenous and Non-Indigenous Australians connect with Country in Australia and elsewhere and the way in which critical systems thinkers and complexity theorists understand.
- 11 Forsetto cites the landmark event with the Mebengokre Peoples of Brazil and indigenous peoples and leaders as follows: “The landmark debates lasted for four days and, after extensive review, resulted in the Piraçu Manifesto, a four-page document denouncing the Brazilian government for its role in putting indigenous peoples at risk. The manifesto not only demands respect from President Bolsonaro and the government, but also clearly states that environmentally disastrous projects have no place on indigenous lands or anywhere else. “We do not accept gold digging, mining, agribusiness and leasing of our lands, we do not accept loggers, illegal fishermen, hydroelectric plants and other projects, such as the Ferrogrão, that will impact us in a direct and irreversible way”.
- 12 “Open Letter by Indigenous Peoples to Indigenous Peoples in Brazil on Surviving COVID-19 (2021) with preface by Eliane Potiguara
- 13 <https://www.youtube.com/watch?v=V2He4oU32sg>
- 14 n an interview with New Perspectives Quarterly (2019) Harari is asked to comment on the following prompt during the conversation: “When big data is married to biology—happening as we speak—you (Harari) worry that it will reduce the biological organism to a set of information ... and that, if computers can process and

- place into patterns more information than the human brain can, then we can also create a new nonbiological species—artificial intelligence....”
- 15 <https://theconversation.com/explainer-what-is-a-circular-economy-29666>
 - 16 McIntyre-Mills, Corcoran-Nantes, Widianingsih, I and Wirawan, R (2019). Chapter 7. Alam Endah: Rural Camelot in West Java—A Case Study of Empowerment and Integrated Rural Development In JJ, McIntyre-Mills, NRA Romm, and Y Corcoran Nantes (2019). *Democracy and Governance for Resourcing the Commons: Theory and Practice on Rural-Urban Balance*. Cham: Springer (pp.179-192). Ethical clearance received by McIntyre-Mills for “Human Research Ethics living virtuously and well 7213”.
 - 17 McIntyre-Mills (2018). “Policy Design for Non-anthropocentric Pathways to Protect Biodiversity and Regenerate the Land”. *International Journal of Educational Development in Africa* <https://doi.org/10.25159/2312-3540/2865>
 - 18 McIntyre-Mills, in conversation with Rudolf Wirawan, Dennis Finlayson and Tom Flanagan (2021). *Architectures to protect the commons: a community of practice to inspire agency and hope*, *International Systems Sciences*, Paper delivered 65th Annual Meeting of the International Society for the Systems Sciences, “The Art and Science of the Impossible: The Human Experience”. <https://www.iss.org/online-2021/>
 - 19 <https://www.youtube.com/watch?v=IszP5Uq-X50>
 - 20 <https://www.youtube.com/watch?v=CI2EebpiqNM>
 - 21 <https://towardfreedom.org/story/archives/africa-archives/african-women-organize-to-reclaim-agriculture-against-corporate-takeover/>
 - 22 <https://www.culturalsurvival.org/publications/cultural-survival-quarterly/there-no-longer-time-mphatheleni-makaulule-agency-and>
 - 23 The notion that human beings have the right to commodify plants has been disputed by Vandana Shiva, whilst the notion that human beings have the right to commodify animals has been clearly challenged by Martha Nussbaum (2006) in her work on the need to extend the ‘Frontiers of Social Justice’ to protect voiceless sentient beings who live lives that are not worth living. She developed the capabilities approach that stresses the need for all animals to have a right to live lives in which they can express their species-specific capabilities to the full. Her contribution to an essentialist approach that stresses that sentient beings have a priori rights—simply because they exist—resonates with the contributors to this volume, nevertheless the a posteriori responsibilities and consequences of development decisions need to be measured by social, economic and environmental indicators to protect all sentient beings.
 - 24 See https://www.wirasoftfoundation.org/en_GB/web/biac-sig Old prototype [A demonstration of the prototype can be found at: https://archive.org/details/pathway_DEMO_1](#). The prototype software is explained at this website hosted by Wirasoft: http://wirasoftfoundation.org/en_GB/web/smartenergy/wirasoft.
 - 25 This question was posed to the Covid 19 research group linked with International Society for Systems Sciences (ISSS) and was inspired by an ISSS plenary given by Tretter (2021) and collaborative conversations in which the first author participated with Gary Smith and a number of ISSS colleagues. The above elephant was developed drawing on Gary’s previous work as detailed in Tretter et al., (2021, forthcoming).
 - 26 The argument is developed that human beings need to understand their place in nature as they are “No longer top predator” (McIntyre-Mills, 2021: pp xiii-xxxiv, 2021h) and that a transformation “from old to new taxonomies of rights, relationships and responsibilities to protect habitat” (2021, Chapter 3 pp. 31-54) is needed based on moving away from binary logic to support new relational thinking as detailed in “From Polarization to Multispecies Relationships: Remembering relationships. (Chapter 10: pp. 173-212). The way we think matters and this is why “why we need to address “Constructivism, Relationships and the Performative Universe” (Chapter 11: pp. 213-222). This also has implications for our understanding of “Biopolitics and food security to protect social and environmental justice” (Chapter 26: pp. 575-602)
 - 27 McIntyre-Mills, with Corcoran-Nantes, Wirawan, and Widiansingh, (2021d). “The potential of eco-facturing: Towards social and environmental justice through vocational education and training.”. In *From Polarization to Multispecies Relationships in the Age of Mass Extinctions* (pp. 391-424). McIntyre-Mills and Wirawan (2021f). “From Education as usual to creating a post national learning community”. In *From Polarization to Multispecies Relationships in the Age of Mass Extinctions* (pp.425-450).

Chapter Fifteen

Education transformation (post) COVID-19: Significance for indigenous knowledge in Uganda — The conversational approach

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Abstract - In this chapter, I will discuss the dilemma of formal and indigenous education during COVID-19. Conversationally, I will paint a rough picture of COVID-19 pandemic occurrence in Africa and the bearings on formal and indigenous education. The discussion will then venture into articulating education (formal and indigenous) in the (post) COVID-19 era. It will challenge scholars to think through the profound tasks in fostering the place of indigenous knowledge in (post) COVID-19. In establishing a way forward, the chapter proposes the embracement by educators of disruptive pedagogies. Lastly, the chapter will deliberately discuss the survival of indigenous knowledge post pandemic.

Key words: *COVID-19, formal and indigenous education, theorizing indigenous knowledge post COVID-19.*

Abbreviations

GHRP:	Global Humanitarian Response Plan
HEI:	Higher Education Institutions
IK:	Indigenous Knowledge
LDU:	Local Defense Unit
MOH:	Ministry of Health
UNICEF:	United Nations Children’s Fund
WHO:	World Health Organization

1. Entrance into the conversation

In scripting this piece of work, I supplicate in advance to be exempted from following the orthodoxly ‘acceptable’ format of presenting ideas in scholarly forums. Such structured formats as providing introduction, literature reviews, theoretical frameworks, methodology (of a study), discussion, drawing new conclusion among others is the very approach that I have often contested in my scholarly works over time as a deliberate effort to arrive at what I construe as freedom from imposed neocolonial arrangement. This chapter will instead take a non-conventional approach that is anchored on what many indigenous/indigenous-oriented scholars would call a conversational approach (cf. Kovach, 2010; Stronach and Adair, 2014; Goulding and McGarty, 2016; Dawson, Toombs and Mushquash, 2017). A conversational approach supports the project of breaking free from institutionalized and domineering/colonizing practices through recovery and restoration of subjugated identities, practices/methodologies of knowledge production and transmission. Therefore, the conversational approach used in the production of this piece recognizes the challenging history of research practices and research dissemination with, for, and on Indigenous and formerly colonized peoples in diverse academic disciplines (Quayle and Sonn, 2019). This approach is crucial for healing from imposed/internalized oppressions and paying tribute to generational traditions.

My discussion in this piece is therefore, a thoughtful challenge for audiences to critically reflect through the profound tasks that scholars (specifically indigenous/indigenous-oriented) have in fostering the place of indigenous knowledge in education (post) COVID-19. Further, the conversation presents strategies for decolonizing mainstream education through the production of new knowledge and acknowledging power relations to cultivate the ethos of harmonious coexistence (including co-existence with non-human nature in our worlds). Therefore, the conversational process is significant for sanctioning cultural malleability through contextually relevant approaches that recognize and promote indigenous education (cf. Dei, 2008; Adyanga, 2012; Dedgeon, 2015; Adyanga and Romm, 2016).

The uniqueness of the conversational approach, which is understood as mutual to indigenous scholars and community, is embedded in its ontological, epistemological, and axiological relationality (cf. Chilisa, 2012): “A common thread that cuts across the beliefs of the colonized *Other* is that people are spiritual beings with multiple relationships that should be nurtured throughout the research” (Chilisa 2012: 20) using a conversational process. Therefore, a well-natured conversational approach which also is an indigenous research method is accordingly informed by relational ontologies, relational epistemologies, and relational axiology (cf. Chilisa, 2012; Romm, 2015).

2. Returning to the subject of this conversation, one may ask: Why (post) COVID-19?

Comparable to the adverse and unfortunate experiences and impacts of colonial rule that the formerly colonized societies have had to put up with, the bearings of COVID-19 pandemic on formal and indigenous education will likely pervade for decades among indigenous communities. Plausibly, it will contribute to drawbacks that will rip through the indigenous education, cultures, spirituality, identity etc. of indigenous people who are often the most minoritized. With the above, the response to the inquest “why (post) COVID-19?” is simply an invitation to study the statistics of COVID-19 infections, deaths, relegation of the world economies, and closure of education institutions globally since early 2020 when the virus was declared a pandemic by the World Health Organization (WHO).

2.1 COVID-19 in Uganda and the closure of educational institutions

The coronavirus infection (COVID-19¹⁹), previously known as the “2019 novel coronavirus” was declared a pandemic by the WHO on March 11, 2020 after reported cases of over 118,000 COVID-19 illnesses in over 110 countries and territories globally. The declaration by the WHO followed the fear of sustained risk of further global spread. Following the declaration, many countries around the world entered a lockdown state, closing their borders to passenger means of transportations and, in some countries, curfews (restrictions) were imposed to contain movement of citizens within certain hours.

Uganda’s first case of the novel coronavirus infection (COVID-19) was confirmed on March 21, 2020. The patient was a 36-year-old Uganda male who arrived from Dubai aboard Ethiopian Airlines. With this development and earlier cautionary measures, which were being planned before the first case of COVID-19 was detected, Uganda swiftly responded to the pandemic by following the framework of the global humanitarian response plan (GHRP), which focused on containing the spread of COVID-19 and decreasing massive sickness and mortality. Following the GHRP framework, the Uganda Intersectoral COVID-19 Response Plan 2020 was established to, among others, raise financial resources with a target of over \$ 200 m USD to aid the fight against the pandemic. By the end of 2020, a total sum of \$ 32.6 m USD was funded through this plan alone (UNOCHA, 2020).

Further, the government closed all education institutions (kindergartens to university) on March 22nd, sending home over 15 million students. A week later, the whole country was placed on total lockdown. The implication is that public transits and private passengers’ vehicles were suspended; most social services were closed with only essential services such as health sector,

¹⁹ WHO announced “COVID-19” as the name of this new disease on 11 February 2020, following guidelines previously developed with the World Organization for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO)

food markets, security, water, cargo transportation, electricity departments and a few others left running. To manage the lockdown, the government imposed a state of emergency (curfew) running from 7:00pm to 6:30am. The national army, police and paramilitary group called Local Defense Units (LDUs) ruthlessly enforced the lockdown and the curfew in a bid to contain the spread of the virus. By June 2020, COVID-19 positivity rates had increased after partial easing of the lockdown measures. Community infections gained traction across the country with the central region taking a lion share. The increase in community transmission inexorably strained the capacity of the already stretched health care sector.

Concerned by heightened community transmission by late June 2021, the United Nations Children's Fund (UNICEF) raised alarms for increased donor support to help Uganda in its frantic fight against the pandemic. Although the call by UNICEF for increased donor support to Uganda could have been made in good faith, one wonders if reliance on donor support or foreign aid is the right investment that a society needs to build an inclusive and self-sustaining economy. Certainly, this has been a subject of contestation for many scholars (Wood, 1986; Andrews, 2009).

2.2 Pandemic response versus education provision

With Uganda overstretched by the fight against the virus, diminutive emphasis has been placed on formal education of learners. Government critics argued that the protracted school closure is directly responsible for the high rate of teenage pregnancies during the lockdown. For instance, the UNICEF (2021) reported that 25% percent of Ugandan teenage girls became pregnant by the age of 19 and close to half were married before the age of 18 during the pandemic period. Schools that have traditionally been safe spaces for the girls are on lockdown, hence exposing them to the predators and sex offenders in their communities. Retorting to the mounting pressure from the citizens and international community for urgent reopening of schools, Uganda's president remained adamant. He admitted that it is true the girls are getting pregnant but, at least, getting pregnant is better than dying from Covid-19. The President implied that reopening schools before massive vaccination of teachers and students would put the learners at the risks of contracting and possibly dying of COVID-19.

Disruption of service delivery in education and other aspects of health sector: Because of the immense concentrations of resources in fighting the pandemic, planning/budgeting for education was put in the backseat (schools have been closed for nearly two years). Additionally, the majority of Ugandan population living in abject poverty in rural areas often relying on free health care provided by the government have experienced significantly reduced access to such services. There have been reports of increased mortality rate from avoidable diseases such as malaria (Bukuluki *et al.*, 2020; Development Initiative, 2020). It also compromised access to family planning and other healthcare programs hence leaving millions of Ugandans in a state of vulnerability. For instance, Apondi *et al.*, (2021) reported a 17% increase in teen pregnancy during the pandemic period in Uganda. They also argued that 50% of women and girls sought

the post-rape care past the recommended 72 hours. The delayed reporting for post-rape care services at health care centers was directly attributed to the pandemic lockdown measures such as ban on movements and public/private means of transportation. The injunctions on public and private means of transportation resulted in movement limitations of people with pre-existing health conditions mainly from rural areas hence leading to increased risk of death from preventable diseases. In its policy brief to Uganda's Parliament in March 2021, the Westminster Foundations for Democracy concisely lamented the dilemma for women and girls, thus:

“This is especially critical for women and other vulnerable people who need essential and urgent healthcare. Women and girls, for example, need access to sexual and reproductive health services, which include maternal health care, access to menstrual hygiene products, access to contraceptives, and facilities that promote safe sex life, and emergency healthcare when they suffer gender-based violence. Failure to access timely transport services for medical care for women and other vulnerable groups has resulted in preventable deaths (Wamajji, p. 6)”.

Further, cases of rape and sexual assault against women and girls are reported to have increased by 24% (Apondi *et al.*, 2021) during the pandemic period. Undeniably, the high rate of teenage pregnancy is a direct result of prolonged school closure that exposed the school girls to sex predators, increased poverty, and violence against women and girls – all exacerbated by the COVID-19 lockdown measures.

Responding to the COVID-19 pandemic, the Government of Uganda in June 2020 directed that all universities transition to e-learning to ensure continuity of education. However, due to limited ICT facilities, weak infrastructural capacity, and scarce resources to affect that transition, little progress was made by both public and private universities. For the few universities that attempted such a transition, the transition to online learning reduced students' enrollment significantly. Additionally, academic staff could not easily adapt to eLearning as many were used to the traditional face-face pedagogy. In brief, government directives issued haphazardly resulted into many students particularly those especially from rural areas dropping out of university education. This exacerbates the imminent gender disparity gaps in Uganda's education. Specifically, the transition to online education modules coupled with what can be considered irrational bans on public and private means of transportation closed the doors to learning for many students, mostly women and girls from rural areas without electricity and internet connectivity. Further, the fact that students have to travel on foot for long distances to access internet facilities for online education also increased the risk of sexual assault and harassment of women and girls. Therefore, addressing gender inequality in Uganda's education is an immediate concern that will require a great deal of sensitivity and community-led interventions to create meaningful change in post pandemic era.

Historically, experience from the colonized society has demonstrated that formal education which mainly leads to the production of dominant western knowledge (Nakata, 1997; Le Grange, 2007; Adyanga, 2012; Akena, 2014) has continually been prioritized. Because of privileging domineering western knowledge over the others, the formal education system has been prioritized in Uganda since its inception in 1886 by the Christian Missionaries. However, with the onslaught of COVID-19, priority in service delivery shifted to fight the pandemic, leaving formal education institution gates locked (as hitherto mentioned). The shifting of priority from formal education should ignite in us (educators) the concern over the predicament of indigenous education with already a history of deliberate marginalization (Shizha, 2006; Dumbrill and Green, 2008; Akena, 2012). The adverse bearings of the pandemic response on indigenous education (within the schooling system) will likely worsen with the spike in infection and community transmission of the Delta variant in Africa.

Noticeably, the pandemic has demonstrated that developing societies cannot rely on developed western societies or donor support to get a breakthrough. Manifestly, the conduct of developed western societies led to heighten vaccines inequality during the peak of the pandemic. Consequently, when the developed societies started easing lockdown measures in mid-2021 due to increased vaccine intakes, developing societies were struggling to acquire the vaccines and continued registering a spike in new cases of COVID-19. This only echoes the urgency for Africa to look inward for locally relevant GHRP required to jumpstart its economy post COVID-19. In his address at the WHO Health Summit Regional Meeting held in Kampala in June, 2021, the WHO Director-General re-echoed these sentiments when he asserted

“As you know, high-income countries have been able to vaccinate large portions of their populations and started to ease public health and social measures. Meanwhile, most low-income countries still do not have enough vaccines to cover their most vulnerable and at-risk populations, let alone the rest of their populations. We are facing, as a result, a two-track pandemic, fueled by inequity..”.

Lamenting that Africa must not be left behind in vaccine distribution, the WHO Director decried the increasing gaps between the haves and the have nots, which is contributing to an extremely worrying rise in COVID-19 cases across the continent.

3. Painting a picture of COVID-19 infection in Africa

Globally, the overall number of coronavirus cases has surpassed the 172.9 million mark, while the deaths have increased to over 3.71 million, (Johns Hopkins University, 2021) by July 2021. In Africa, Uganda, Zambia, and Namibia have emerged as countries with the highest rising infections from the new COVID-19 variant code-named Delta variant. Tunisia, the Democratic Republic of Congo as well as Rwanda are also among the worst affected countries as of July

2021 (WHO). The WHO further reported that the number of cases and deaths in Africa had increased by almost 40% and in some countries, the number of deaths had tripled or quadrupled.

For Uganda, the increase in COVID-19 new cases can be attributed to the laxity and partial easing of lockdown measures following strict enforcement in 2020 and throughout the national election period. Shortly after conducting the presidential and parliamentary election in February 2021, Uganda partly relaxed several COVID-19 restrictions. As a result, there was an upsurge in socializing and social mobility, hence leading to increased number of contacts among the citizens. These factors were intensified by the scarce vaccine distributions and vaccine hesitancy in the country. The spike in cases undoubtedly sent Uganda on a second lockdown in early June with government initially declaring 42-day travel restrictions – this was later extended. Such measures meant that education institutions that provided safe havens for students, especially women and girls remained closed. Although the measures kept learners in their natural settings where they are fully exposed to indigenous education, it remains to be seen how the reopening of educational institutions anticipated for January 2022 will accommodate the indigenous education in schools. As educators, we have challenging tasks to engage and empower communities to continuously adhere to the pandemic containment measures. Among others, these measures include avoiding crowds, regular hand washing/sanitizing, wearing face masks, keeping physical distance, good diets.

Further, educators have a responsibility to sensitize the community to maximize the lockdown periods for the inculcating indigenous education and knowledge system to learners. The future of our society rests in the evocation of the good practices from the so called “tradition” to interlace with the so called “modern” in search for local solutions to address diverse challenges in society. This is a decolonizing perspective that seeks to revive best practices from the past. A decolonizing perspective is significant for interrogating and disrupting the prevailing social relations that maligns indigenous peoples (Nicoll, 2004; Kovach, 2010).

4. Education transformation post-pandemic

With the digitization of formal education as a strategy for learning continuation during the pandemic, policy makers need to consider the following major thematic areas in education planning, implementation, and management post pandemic:

- **Digitization of education** (blended method of teaching and learning). There is no doubt that conduct of formal education will greatly change. COVID-19 has pushed African countries to venture into digital education. Though eLearning is turning out to be the new normal with a potential to be integrated with the traditional method, African education systems will encounter greater inequalities due to digital disparities between rural and urban areas, the haves and have nots. Consequently, and in the long run, most learners especially from rural areas will be excluded from the privileges that accrue from education due to inability to afford digital education. Some scholars and education

policy makers view the pandemic as having ushered an opportunity for creatively to enroll blended method of education delivery. Although reasonable, such an approach does not only fail to recognize and appreciate the differences between the “haves and have nots”, but also assumes an oversimplification that all learners will benefit from education digitization. Unless identified and addressed at the initial stage, the digital divide risks widening the growth of the underclass, hence exacerbating the rise in acts of criminality among young people excluded from benefits that accrues from formal education. Also, we must be careful of reinforcing only Western styled learning – and make efforts to Indigenize the curriculum.

- **Increased inequality in access to education.** Majority of learners from rural areas will be excluded from the privileges that accrue from education due to inability to afford digital education, hence increasing the digital divide between rural and urban areas. For instance, by locking out over 15 million learners from schooling for nearly two years in Uganda, COVID-19 pandemic has intensified inequality to education access. This state of affairs has exacerbated the digital divide between rural and urban areas hence making home-learning ineffective for many learners, leading to high school dropouts especially for women and girls. Additionally, the need to travel long desolate distances for internet access has increased the susceptibility of women and girls to violence. Uganda is one of the African countries with the largest gender gap in internet penetration. Post pandemic planning needs to consider this important aspect in education, parity, equity, access and retention for society to holistically resurface.
- **Heightened emphasis on medical research.** Specially, research into traditional medicine is so critical for Africa to cater for growing health needs of the young population. African scientists and scholars need to purposely venture into tapping the natural resources that the continent is endowed with to innovate diverse medicinal components that addresses the challenges posed by several diseases. This is so central in address Africa’s health needs with the fastest growing population of young people. Statistically, about 60% of Africa’s population is under the age of 25, making Africa the world’s youngest continent (Cities Alliance, 2020). Maintaining this growth, attributed to high fertility coupled with declining child mortality rate requires internal effort that prioritizes traditional medicinal research which kept the continent at lower risk of diseases. This is a struggle to improve on the continent’s medicinal/vaccine discoveries efforts, usages and preservation.
- **University programs restructuring.** Certain university programs such as the study of indigenous people and indigenous knowledge may be discontinued by some Higher Education Institutions (HEIs) for their supposed emphasis in ‘outdated traditionalism’ and ‘supposedly not a wise expenditure of the scarce financial resources’. Without a shadow of a doubt, there is a profound danger in this which, of course, is a possibility. The significance of IK cannot be over reiterated. This generational knowledge is largely considered by indigenous scholars as offering a comprehension of interactive nuances of homegrown paradigms that are compatible with indigenous people’s ways of seeing/ living in the world and embracing decolonizing perspectives (Wane, 2006; Kovach, 2010; Adyanga, 2012). Therefore, all curriculum planners should give significant and

- equal weighing to both formal and indigenous education/knowledge system in designing instructive priorities post pandemic.
- **Decrease in the number of private schools.** Increase in number of private education institutions running out of operation due to breakdown in revenue flows from students' fees. COVID-19 has demonstrated its effects beyond the health care sector in diverse ways. For Uganda specifically, private schools that often rely on revenue flows from students have suffered immensely. This is due to close to two years closure of schools which strangles their sole source of revenue: fees collection from students. The escalating youth population, the majority of whom end up in private schools due to few government schools in the continent, will present a huge challenge if not addressed. While the continent's natural resources are vital for post pandemic recovery, the huge number of uneducated and unemployed youth will be a source of insecurity in the continent. The above, coupled with the likely decline in number of university enrolled students, and decline in the number of students successfully completing studies will prospectively intensify large-scale social unrests. This will frustrate the continent's post pandemic recovery effort. Education policy planners and implementors need to be ahead of the game to curb the looming crises in the sector.
 - **Civilization.** As we often read in historical texts, civilization began in Africa many years ago along the Nile Valley (Mokhtar, Mokhtar, and Mukhtār, 1981; Trigger, 1993). However, the failure by Africans to institutionalize and document the ancient civilization is costing the continent immensely. Scholars of today have a responsibility to avoid repeating the mistakes of the past. However, we must watch out for the danger of the dislocated appropriation of IK in the process of documentation. African Canadian Scholar, Dei (2008), cautions against haphazard documentation; he states: "*It is also important to understand what happens when Indigenous Knowledge is documented in ways that disembodies it from the people who are its agents, when the knowers of that knowledge are separated out from what comes to be known, in ways that dislocates it from its locale, and separates it from the social institutions that uphold and reinforce its efficacy...* (p. 08)". I am not trying to advocate that the failure to document and/or place intellectual property rights on ancient civilization in Africa is the sole factor for the diverse misfortunes in society. Rather, I am advocating that the future of our society rests in the evocation of the good practices from tradition and its interweaving with modern innovations in search for solutions to address diverse challenges being faced in the present times. With this, I recognize the diversity of internal and external paradoxes accounting for upheavals in the content. But again, the paltry development our society has registered demonstrates just one valued index and that it is constantly evolving. The infusion of diverse cultures, language, belief system, and identity we take for granted has overtime been forged into a complex process of societal evolution. This process is a critical requirement in comprehending the interaction between and among different forces which determine how power operates in the changing society.

5. Theorizing indigenous knowledge post pandemic

In terms of the way forward for IK in post COVID-19 era, I present my ideas with the embodiment of key principles of generating pragmatic axiological process for IK survival. These axiological processes present a departure from the conventional and hegemonic mode of knowledge production monopolizing most ivory towers in Africa. Theorization of post COVID-19 education must be expanded to involve power relation and system of domination within educational spaces. This calls for the embracement of subversive pedagogies (Cohen, 1988; Bezucha, 2013; Dexter, 2015) delivered by voices that challenge the gate keepers of education policy planners to deliberately include indigenous education in budgeting and resource allocation. I construe subversive pedagogy as an effort by scholars/activists to shake the foundations of the establishment by undertaking innovative *albeit* non-confrontational teachings/instructions/research as a strategy for addressing daunting educational issues. In taking such pedagogies, I outline as a starting point four key approaches for disrupting the establishment that perpetuate the subjugation of non-dominant knowledge systems, as follows:

- ✓ Wittingly integrate relevant elements of indigenous knowledge and indigenous research methodology during in-class or online instructions, students' supervision, and the infusion of conversational approach to provoke debates among students on critical educational issues.
- ✓ Promote the teachers' sharing of their experiences cultivated from natural surrounding within educational spaces. This will provide the teachers with chances to collaborate in the construction of safe spaces that support their capacity building and pedagogical growth (cf. Gutierrez, 2016).
- ✓ Continually reevaluate the progress of inclusive education implementation in post COVID-19 era and address emerging issues of inequity such as the repudiation of IK from the educational programs.
- ✓ Intensify the involvement of elders in education planning post the pandemic. Among indigenous communities, embodied/personified ways of knowing which reiterate the connection between the physical and spiritual world are nurtured and sustained by elders, the custodian of IK (cf. Adyanga and Romm, 2016). Henceforth, theorization of IK in post the pandemic calls for the profound integration of elders' perspectives.

In adopting the key approaches outlined above, my gaze is grounded on what African American scholar Molefi (2017) refers to as Afrocentricity. Further, working with African indigenous concepts and Afrocentricity as a philosophy, therefore, I embrace the value of collective accountability and reciprocal relationality that deviates from universal imposition common with western mode of knowing. In articulating Afrocentricity to ground the challenges faced by African society, Molefi notes:

“Afrocentricity refers to the intellectual work of a group of African philosophers, historians, and sociologists during the late twentieth century with varying degrees of attachment to the central idea that the key crisis in the African world is the profoundly disturbing decentering of African people from a subject position within their own narrative (p. 231)”.

Connecting Molefi’s innovative ideas with the seminal work of Dei (2008), monopolizing western mode of knowledge production by formal educational institutions in Africa is squarely responsible for the “glaring disparities and inequities, structured along lines of ethnicity, culture, religion, gender, and class” (Dei, 2008, p.11). Unless disrupted through adoption of an expansive definition and approach to education, the disparities will pervade. For IK, Goduka (2012) argues that much as western-oriented ways of knowing are disposed to undervalue collective modes of thinking and knowing, indigenous ways of knowing are purposefully designed to embody the communal mode of knowledge creation and co-creation. Further, she acknowledged the collection and storage of knowledge in indigenous communities is often for the collective benefits. Specifically, she reasoned *“communal knowledge ensures that knowledge is not collected and stored for personal power and ownership by individual specialists, but is rather developed, retained, and shared within indigenous groups”* (p. 5). This consciousness is a challenge for critical scholars to rupture the binarism rampant in ways that multiplicity of knowledge is constructed, validated, disseminated, and sustained.

Therefore, indigenous scholars and allies have to resist the binary view of ‘tradition’ versus ‘modernity’ (cf. Bendix, 1967; Adyanga, 2012; Vukovich, 2013) and draw counter narratives that embrace, celebrate, and promote an array of knowing. In a fairly recent piece of work, certain scholars referred to this approach as epistemological pluralism (Miller *et al.*, 2008; Andreotti, Ahenakew and Cooper, 2011; Romm, 2017). These scholars view epistemological pluralism from indigenous people’s philosophical and ontological lens in which different ways of understanding the universe complement each other and no single way of knowing is superior over others.

6. A Petition to “walk the talk”

Indubitably, it is hypocritical for scholars to promote IK while at the same time replicating (without question) established structures and interactional patterns that disparage the knowledge. Therefore, the questions that should intrigue our mind in post-pandemic education reconfiguration are:

- a) Why has the study of indigenous knowledge not properly taken roots in our ivory towers in Africa?
- b) Why do we have many indigenous/indigenous-oriented scholars concentrating their works (and mostly theoretical) in the ivory towers?

Although these are not new questions, scholars have not taken them seriously or critically reflected on them with a grain of action. Scholars and researchers have a relational accountability to indigenous people to self-reflect and establish how they are implicated. Unfortunately, we (scholars) have continued to execute our work from a “paradigm of scarcity” (Dei, 2012) in a relentless search for tenured position in the university through the production of multiple publications that have no real “social transformative agenda” (Romm, 2017). This pleads for a consideration of the next question:

- a) Have indigenous/indigenous-oriented scholars made efforts to break loose from the structured conventional and institutionalized patterns of working from 9 am – 5: 00 pm? This question calls for honest critical reflections and internal rejoinder.

If we are to contest and resist the annexation and negation of IK (Dei, 2102) in post pandemic era, then there is need for challenging *the powers that be*. Challenging such powers calls for proper comprehension of key features/manifestations of such power. It is those features that must be problematized and not taken for granted because they promote unhealthy competition and individualism. Such features include but are not limited to:

- ✓ Publish or perish: this is a common saying used in HEIs to refer to insurmountable pressure exerted on academic staff to publish their research findings or innovative ideas in order to not only remain relevant, but also gain vertical mobility. This practice is unfortunately promoting the culture of unhealthy competition, individualism, and academic staff stress level. Many who cannot cope simply end up being outwitted from the system.
- ✓ Making annual paper presentations at local and international conferences: many academic and research institutions now require academic staff to make a certain number of paper presentations at local and international conferences. Though a good strategy to expand staff social and networking relationships and institutional marketing, this culture promotes unhealthy competition and knowledge monopolization. The researchers are forced to claim copyright and ownerships over produced knowledge with often total negation of study participants who are equally co-knowledge producers.
- ✓ Coercive participation in academic and community engagement activities with dictated agenda (usually disguised as research agenda), and
- ✓ Completion of annual performance appraisals for promotion and salary increments, among others.

We often embroil ourselves in such institutionalized features without considering how they promote hegemonic discourses and individualistic tendencies which are antithesis to indigenous worldviews of communalism. Such individualized systems with roots in colonization are deeply engrained in our society and silently sowing the seeds of dissonance, competition, frauds, and conflicts. Resisting such institutional systems can be costly to scholars. The costs can be physical, financial, emotional and also psychological. Therefore, scholars with a societal

transformative agenda have a responsibility to think and act strategically, which then invites the next question as the conversation progresses:

- b) What approach is required of scholars to methodically innovate analytical systems for realizing new and inclusive education in post COVID-19 era?

The above question takes me retrospectively to the issue of documentation. Anchoring my gaze on tradition, I appreciate the challenges associated with documenting IK and related practices and hence the hesitation by many IK scholars. However, as previously discussed, failure to document innovative ideas exposes such novelty to arrogation, displacement from the source without credits, and misappropriation. We live in a volatile world in which dishonesty, deceitful people, and fraudsters masquerade freely in search of easy targets. Without proper documentation, novel ideas are prone to end-up in the hands of fraudsters who have no consideration for the collective benefits. Dei (2008) extends the discourse in favor of documentation when he asserts “sometimes the spoken word cannot survive the passage of time and must be textualized. Yet we must uphold the power of orality as an elegant and purposeful form of knowledge-making” (p.7). Expanding this view, documentation allows for embracing what Midgley (1996) calls methodological pluralism — using a variety of research methods in a theoretically coherent manner, becoming aware of their strengths and weaknesses, to address equivalent variety of issues in society. With documentation, we become aware of the danger of selfish binarism of ‘tradition versus modernity’ in knowledge production and instead advocate for epistemological pluralism (Healy, 2003; Miller *et al.*, 2008; Romm, 2017).

7. Highlights from the conversation

COVID-19 pandemic has presented us with unique challenges as well as opportunity. In terms of opportunity, the closure of schools and sending home of learners has allowed for more time with the parents, guardians, and the community. This process has to a large extent, exposed learners to non-dominant knowledges, teaching methodologies, and acquisition of life skills that are often excluded from dominant curricula. Though not intended, school closure has presented the long-awaited challenge to the dominant western way of knowing that views other knowledges as “inherently un-scientific” and, subsequently, non-intellectual (Watson-Verran, and Turnbull, 1995; Hoppers, 2005; Adyanga, 2012). Certainly, the worthiness of the so called ‘scientific’ is lost if science excludes other ways of understanding, seeing, interpreting, and living in the world around them – or what is often called people’s lived experiences. The common adage in Africa that *it takes a village to raise a child* implies that every adult member of a particular community is an instructor and/or guardian. These instructors play the collective role of imparting into every child from that community diverse knowledge, values, mutually acceptable belief systems, ethos, and life skills required to be responsible citizens.

Finally, the preceding discourse emphasized the deliberate effort to articulate an all-encompassing education planning for societal growth post pandemic through the promotion of epistemological

pluralism and documentation of IK. This process requires concerted involvement of elders who are the custodians of IK to dialogue with formal education policy planners in post pandemic era for harnessing the synergies between dominant and indigenous knowledge. A huge body of literature (Dei, 2000; Semali and Kincheloe, 2002; Wilson, 2004; Wane, 2006; Dei, 2008; Adyanga, 2012; Adyanga, 2014; Dedgeon, 2015; Adyanga and Romm, 2016) suggests that the call for elders' involvement in knowledge integration in formal education institutions has previously been sounded with high intensity. However, implementation has either been politicized or botched. In planning education reemergence post pandemic lockdown in Africa, the need to reinvigorate the profound contribution of elders is critical. Elders' participation strengthens the preferment of orality, a fundamental process for cultural and IK survival. Orality as a method of knowledge generation, validation, transmission, and archival is significant for disrupting systemic power relations that have permeated the supremacy of western mode of knowledge production in the education institutions (Dei, 2008; Adyanga, 2012). Finally, the preceding conversation has also demonstrated the urgent need to provide for gender-responsive economic and social planning that put social service deliveries at the heart of the post pandemic recovery. It is important for all economic recovery measures (immediate and long-term) to incorporate inclusive education undercurrents and a gender sensitive lens designed to accommodate historically marginalized knowledge systems and their production mode.

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References

- Adyanga FA and Romm NRA (2016). "Researching indigenous science knowledge integration in formal education: interpreting some perspectives from the field" *International Journal of Educational Development*, **3**(1), 1-14.
- Adyanga FA (2014). "African indigenous science in higher education in Uganda" (Doctoral dissertation, University of Toronto (Canada).
- Akena FA (2012). "Critical analysis of the production of western knowledge and its implications for indigenous knowledge and decolonization" *Journal of Black Studies* **43**(6):599-619.
- Andreotti V, Ahenakew C, and Cooper G (2011). "Epistemological pluralism: Ethical and pedagogical challenges in higher education" *AlterNative: An International Journal of Indigenous Peoples* **7**(1):40-50.

- Andrews N (2009). "Foreign aid and development in Africa: What the literature says and what the reality is" *Journal of African Studies and Development* 1(1):8.
- Apondi R, Awor AC, Nelson LJ, Cheptoris J, Ngabirano F, Egbulem C D, and Hegle J (2021). "Gender-based violence shadows COVID-19: Increased sexual violence, HIV exposure and teen pregnancy among girls and women in Uganda" *Journal of the International AIDS Society* 24(S4):53-5.
- Asante MK (2017). "The Philosophy of Afrocentricity. In The Palgrave Handbook of African Philosophy" (pp. 231-44). Palgrave Macmillan, New York.
- Baricaua GS (2016). "Building a classroom-based professional learning community through lesson study: Insights from elementary school science teachers" *Professional Development in Education* 42(5):801-17.
- Bendix R (1967). "Tradition and modernity reconsidered" *Comparative studies in society and history* 9(3):292-346.
- Bezucha RJ (2013). "Feminist pedagogy as a subversive activity. In Gendered Subjects" (pp. 81-95). Routledge.
- Bukuluki P, Mwenyango H, Katongole SP, Sidhva D, and Palattiyil G (2020). "The socio-economic and psychosocial impact of COVID-19 pandemic on urban refugees in Uganda" *Social Sciences & Humanities Open* 2(1), 100045.
- Chilisa B (2012). "Indigenous Research Methodologies". London: Sage.
- Cities Alliance (2020). "The Burgeoning Africa Youth Population: Potential or Challenge?" Accessed from <https://www.citiesalliance.org/newsroom/news/cities-alliance-news/%C2%A0burgeoning-africa-youth-population-potential-or-challenge%C2%A0>
- Cohen MA (1988). "Subversive pedagogies: Schoenberg's "Theory of Harmony" and Pound's": A few don'ts by an imagiste". Mosaic" *A Journal for the Interdisciplinary Study of Literature* 21(1):49-65.
- Dei GJS (2000). "Rethinking the role of indigenous knowledges in the academy" *International Journal of Inclusive Education* 4(2):111-32.
- Dei GJS (2008). "Indigenous knowledge studies and the next generation: Pedagogical possibilities for anti-colonial education" *The Australian Journal of Indigenous Education* 37(S1):5-13.
- Development Initiative Report (2020). "Socioeconomic impact of COVID-19 in Uganda. How has the government allocated public expenditure for FY2020/21?" Accessed from https://reliefweb.int/sites/reliefweb.int/files/resources/Socioeconomic_impact_of_Covid-19_in_Uganda.pdf
- Drawson AS, Toombs E, and Mushquash C J (2017). "Indigenous research methods: A systematic review" *International Indigenous Policy Journal* 8(2).
- Dudgeon P and Walker R (2015). "Decolonizing Australian psychology: Discourses, strategies, and practice" *Journal of Social and Political Psychology* 3(1):276-97.
- Dumbrill GC and Green J (2008). "Indigenous knowledge in the social work academy" *Social Work Education* 27(5):489-503.
- Goduka N (2012). "Re-discovering indigenous knowledge-ulwazi lwemveli for strengthening sustainable livelihood opportunities within rural contexts in the eastern cape province" *Indilinga African Journal of Indigenous Knowledge Systems* 11(1):1-19.

- Goulding D, Steels B, and McGarty C (2016). “A cross-cultural research experience: Developing an appropriate methodology that respectfully incorporates both Indigenous and non-Indigenous knowledge systems” *Ethnic and Racial Studies* **39**(5):783-801.
- Healy S. (2003). Epistemological pluralism and the ‘politics of choice’. *Futures* **35**(7):689-701.
- Hoppers CAO (Ed.). (2002). “Indigenous Knowledge and the Integration of Knowledge Systems: Towards a philosophy of articulation” New Africa Books.
- Kovach M (2010). “Conversation method in indigenous research. First peoples child & family review” *An interdisciplinary journal honoring the voices, perspectives, and knowledges of first peoples through research, critical analyses, stories, standpoints and media reviews* **5**(1):40-8.
- Le Grange L (2007). “Integrating western and indigenous knowledge systems: The basis for effective science education in South Africa” *International Review of Education* **53**(5):577-91.
- Miller TR, Baird TD, Littlefield CM, Kofinas G, Chapin III FS, and Redman CL (2008). “Epistemological pluralism: Reorganizing interdisciplinary research”, *Ecology and Society* **13**(2).
- Mokhtar MGED, Mokhtar G, and Mukhtār MJAD (Eds.) (1981). “Ancient Civilizations of Africa” (Vol. 2). University of California Press.
- Nakata M (1997). “The cultural interface: An exploration of the intersection of Western knowledge systems and Torres Strait Islanders positions and experiences” (Doctoral dissertation, James Cook University).
- Nicoll F (2004). “Are you calling me a racist?": Teaching critical whiteness theory in Indigenous sovereignty” *Borderlands ejournal* **3**(2).
- Quayle AF and Sonn CC (2019). “Amplifying the voices of indigenous elders through community arts and narrative inquiry: Stories of oppression, psychosocial suffering, and survival”, *American Journal of Community Psychology* **64**(1-2):46-58.
- Romm NRA (2015). “Reviewing the transformative paradigm: A critical systemic and relational (Indigenous) lens”, *Systemic Practice and Action Research* **28**(5):411-27
- Romm NRA (2017). “Researching indigenous ways of knowing-and-being: Revitalizing relational quality of living. In *Handbook of research on theoretical perspectives on Indigenous knowledge systems in developing countries* (pp. 22-49). IGI Global.
- Semali LM and Kincheloe JL (2002). “What is indigenous knowledge?: Voices from the academy” Routledge.
- Shizha E (2006). “Legitimizing indigenous knowledge in Zimbabwe: A theoretical analysis of postcolonial school knowledge and its colonial legacy” *Youth and Children’s Studies*. 2.
- Stronach M and Adair D (2014). “Dadirri’: Reflections on a research methodology used to build trust between a non-indigenous researcher and indigenous participants. *Cosmopolitan Civil Societies*” *An Interdisciplinary Journal* **6**(2):117-34.
- The Observer (2021). “Uganda won’t need any more COVID-19 vaccine donations – Museveni” Accessed from <https://observer.ug/news/headlines/70337-uganda-won-t-need-any-more-covid-19-vaccine-donations-museveni>

- Trigger BG (1993). “Early civilizations: Ancient Egypt in context” American Univ in Cairo Press.
- UNICEF (2021). “Adolescent development. Improving access to information, life skills and essential services to reduce their vulnerability” Accessed from <https://www.unicef.org/uganda/what-we-do/adolescent-development>
- UNOCHA (2020). “Uganda Intersectoral COVID-19 Response Plan 2020” <https://fts.unocha.org/appeals/1004/summary>
- Vukovich D (2013). “China and Orientalism: Western Knowledge Production and the PRC” Routledge.
- Wamajji R (2021). “The Impact of COVID-19 on Women and Girls”. Policy brief presented to the Parliament of Uganda” West Minster Foundations for Democracy. Accessed from <https://www.wfd.org/wp-content/uploads/2021/07/Impact-of-COVID-19-on-women-and-girls..pdf>
- Wane NN (2006). “Is decolonization possible?” In *Anti-colonialism and education* (pp. 87-106). Brill Sense.
- Watson-Verran H and Turnbull D (1995). “Science and other Indigenous Knowledge Systems”, *Handbook of science and technology studies*” 115-39.
- WHO (2021). “WHO Director-General’s speech at the World Health Summit Regional Meeting, Africa 2021” Accessed from <https://www.who.int/director-general/speeches/detail/who-director-general-s-speech-at-the-world-health-summit-regional-meeting-africa-2021>
- Wilson WA (2004). “Introduction: Indigenous knowledge recovery is indigenous empowerment”. *American Indian Quarterly* 359-72.
- Wood RE (1986). “From Marshall Plan to Debt Crisis: Foreign Aid and Development Choices in the World Economy” (Vol. 355). University of California Press.

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Chapter Sixteen

Economic development for holistic wellbeing in the (post) COVID-19 Era

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Abstract - The 7th Annual International Conference of the Society for the Advancement of Science in Africa (SASA) was held virtually due to COVID-19 prohibiting travel. The conference focus was on research (including community-based) as it relates to issues such as healthcare, education, and economic development in Africa. This chapter hones in on the issue of how, (post) COVID-19 (or in the light of COVID-19), we can consider the reframing of economic development so that the intention is not to “return to normal” (defined as what seemed to be “normal” before COVID-19 struck the globe). Based largely on community-based research undertaken in December 2020-January 2021 in Nwoya district, Uganda, we propose some recommendations for not returning to what is considered “normal” in the dominant narrative permeating the globe. As many authors have pointed out (including those committed to decolonization), a global economic system geared to increased wealth accumulation concentrated in the hands of the very few, the continued plundering by “developed” nations of the resources of those named “developing”, the attendant ecological damages caused in the wake of so-called “development”, and the public health crises linked to pollution of the land and waters of vulnerable communities in the global South, have become cast as a “normal” state of affairs in conventional parlance. This chapter joins the choir of resistance voices which question this

conventionality and offers a vision of new possibilities based on Ubuntu-type principles of relationality, as expressed *inter alia* by the Ugandan participants.

Key words: *Holistic wellbeing; indigenous understandings of relationality; reviving relationality in the current era; community agency in the face of injustice; potential role of foreign enterprises; neighborliness.*

Abbreviations

DISO:	District Internal Security Officer
FG:	Focus group
LCV:	Local Council Five
MP:	Member of Parliament
NEMA:	(Uganda) National Environmental Management Authority (NEMA)
RA:	Research Assistant
RDC:	Resident District Commissioner
SDG:	(U.N.) Sustainable Development Goals

1. Introduction

Our deliberations on economic development for holistic wellbeing (post) COVID-19 are based in part on research undertaken (2020-2021) in three villages in Nwoya district, Northern Uganda. The study involved conducting four focus group (FG) sessions with 40 participants (with ten in each one, composed of more or less numbers of men and women). The participants were from three villages who were negatively affected by the unregulated operation of, in particular, a foreign-owned agro-processing company that had entered the community in 2016 and started operations. One of the authors (FAA) was aware of protest initiatives that had been activated by the community, through his informal conversations with some of the villagers early in 2020. It turned out from the FG sessions that we organized later in the year (2020) that despite the seemingly good intention (as advertised on the factory website) to provide work to local villagers and to engage local farmers in farming of cassava that would be bought for a fair price and would in turn be processed by the factory for biofuel, the entry of the factory into the community created much disappointment and distress. The study participants relayed accounts of unjust work practices such as low pay and delayed payment, lack of interest in training local workers to participate in more skilled jobs, incidents of sexual exploitation of the women who got work in the factory and, very disturbingly, against the poor waste management practices of the factory, which resulted in the rivers and land becoming severely polluted. Furthermore, instead of empowering the local farmers to grow the needed cassava for processing, the factory (in arrangement with some local leader) bought up a lot of the land to organize their own farming. The way in which the land issue was handled was therefore also regarded by the community participants as a betrayal. The facilitation of the FG discussions enabled the participants to

reflect together on the purpose of their protest initiatives, how they had developed a community-based movement, and what lessons they felt that others (in Uganda as elsewhere) could learn from their ways of handling their protest against experienced social and environmental injustice. (For many detailed quotations of the trajectory of their conversations, please see Adyanga and Romm, 2021, forthcoming.)

During a dissemination of results workshop (2021), where we also invited further discussion, the participants “checked” our synthesis of the main results from the various FG discussions, and also raised additional points for attention, including additional recommendations for running business that may be in accordance with genuine development. (33 participants from the study community attended the workshop, which was held at the home of a village chief. In addition, some other members of the community also joined the discussion.) In this chapter we concentrate on their key suggested recommendations and we align these with wider literature which advocates not returning to the seemingly “normal” operation of a purely pecuniary approach to economics (or what has been termed “business as usual”). The critique of the “business as usual” model has been undertaken by a myriad of authors from across the globe, such as: Mattick (2011); McIntyre-Mills (2014, 2020); Mies and Shiva (2014); Arko-Achemfour and Dzansi (2015); Weir (2015); Magdoff and Williams (2017); Escobar (2018); Khotari *et al.*, (2018); Bassey (2019); Spash (2020); Gram-Hanssen, Schafenacker, and Bentz (2021). These scholars see the implementation of “business as usual” as an adverse quest and instead propose new and responsible ways of doing business. We indicate how the Ugandan participants’ visions that inspired their protest movement contribute to the plea not to return to “normal” – or to presage a “new normal” which fails to unhinge global inequalities and injustices (Fernando 2020; Stevano *et al.*, 2021) – and to instead search for radical alternatives (post) COVID-19.

In brief, the participants expressed that many of the injustices currently pervading this (and other) societies, are taken as “normal” and, hence, not resisted on a collective level, even by those bearing the brunt of them. However, they suggested that people facing the injustices should “come together” and protest – because some success can arise out of this. In the case of the factory that had operated exploitatively in the community, after strategizing about how to proceed, the participants eventually approached the local radio station, who publicized the environmental disasters; and this led to the local district leaders contacting the national environmental protection agency, National Environmental Management Authority (NEMA). Thereafter the factory became closed, pending the introduction of a non-pollutive waste disposal system. To date, the factory is still closed. The participants welcomed this outcome as they recognized that, in the words of one participant (resonating with the sentiments of the group), the factory owners were “up to no good” in their community. On the whole, the participants strongly expressed disappointment that their (and their government’s) generosity in allowing the factory into the community had been hijacked and abused. They indicated on what basis they may be able to work in mutual collaboration with foreign-owned enterprises, in terms of a neighborly relationship.

In structuring the chapter, we firstly spell out our paradigmatic approach and commitment to a decolonizing agenda that guided the study (Section 2). We indicate how we invoked what certain Indigenous authors (that is, authors hailing from areas which have been subjected to Western colonization) call an Indigenous research paradigm (cf. Mkabela 2005, Kovach 2009, Chilisa 2012, 2020, Rix *et al.*, 2019). Invoking an indigenous paradigm implies, as Mkabela (2005: 180) notes, that the research “takes on a normative and cultural dimension as the researcher cannot be reduced to merely the collection and (re)production of [purported to be] value-free scientific knowledge” (Akena, 2012). In that endeavor, we (critical Indigenous scholars) seek to pioneer new analytical systems for comprehending our communities and problematizing some of the normalized oppressions and/or injustices. Mkabela notes that the concept of Indigenous research in Africa “becomes a way of linking the purpose of the research to the very discourse that emerges and is legitimized from within the African framework” (2005: 180). We explain in Section 2 how we activated this paradigmatic approach when conducting the FG sessions. In Section 3, we hone in on some of the statements as expressed by participants during the FG discussions. We concentrate in particular on statements that have to do with their vision (implicitly and explicitly expressed) of why they considered the factory was “up to no good” and what it would mean to “do good” (in Arko-Achemfuor and Dzansi’s terms, 2015, where doing business is associated with doing good). We indicate how the participants’ expressions reveal what “good” living would amount to in terms of what they consider to be (relational) common sense, where relationships between humans and the more-than-human world need to be cherished. We then move on in Section 4 where we point to certain key recommendations as a route to not neglecting either social or environmental justice in the rush to so-called return to “normal” existence (post) COVID-19. Section 5 turns to a discussion of contrasting views of “human nature”: we indicate why a view of human beings as existing in relation is more likely to offer a way forward for the United Nations Sustainable Development Agenda – SDG (2015), where the focus has to be “on the social and environmental consequences of economic actions” (Sachs, 2015, as cited in Halvorsen 2019: 159). We indicate how this agenda resonates with the study participants’ expressions of a holistic understanding of an inclusive wellbeing (including people and the planet). Section 6 concludes our chapter.

2. Our paradigmatic approach

The underpinning of our study in terms of our ontology, epistemology, and axiology was an Indigenous paradigm. Chilisa, in her book entitled “Indigenous Research Methodologies” (2012, with a 2nd edition in 2020), points to the features of an Indigenous paradigm in general (of which an Indigenous paradigm applied to the African context is an example). Briefly put, Chilisa, Major, and Khudu-Peterson (2017) explain that what is distinct about an Indigenous research paradigm is that it embraces “ontological, epistemological, and axiological assumptions emanating from the cultures, histories, philosophies and lived experiences of those [often] marginalized by Euro-Western paradigms” (2017: 2). They feel that the so-called “big four” paradigms normally considered to be the “major” ones in academic literature (namely, positivist, constructivist,

transformative, and pragmatic ones) do not do sufficient justice to Indigenous worldviews, ways of knowing, and understanding of ethical principles during the research process. They, thus – along with other Indigenous authors from other parts of the globe – consider it important to pose the Indigenous paradigm as a distinct option. As Chilisa and Mertens (2021) point out: “The argument is that Indigenous paradigms need their own space (Chilisa, 2020; Held, 2019; Kovach, 2009; Romm, 2018; Wilson, 2008) so that their intersection with Western approaches can be critically examined. Chilisa (2012, 2020), Held (2019), and Romm (2018) have started to include it as a fifth paradigm in the typology of paradigms” (Chilisa and Mertens 2021: 6).

What is regarded as distinct about the Indigenous paradigm (and what is commonly understood as common to all Indigenous thinking by different Indigenous cultural heritages) is its grounding in an ontology, epistemology, and axiology of relationality (as noted by Chilisa 2012: 20): “A common thread that cuts across the beliefs of the colonized Other is that people are spiritual beings with multiple relationships that should be nurtured throughout the research process”. A postcolonial Indigenous research paradigm is thus informed by *relational ontologies*, *relational epistemologies*, and *relational axiology* (2012: 20, our emphasis).

Within the context of colonized society, the fifth paradigm is being championed by critical Indigenous scholars with the realization that the dominant philosophies and epistemological discourses rooted in colonial history have failed to successfully pervade the social, political, and economic realities of the colonized.

Chilisa explains that a relational ontology as applied in research practice means that “the social reality that is investigated can be understood in relation to the connections that human beings have with the living and the nonliving” (p. 20). In the Ugandan context, we were cognizant of, and reminded during the research process, how the participants themselves understood and expressed this ontology as part of their cultural heritage. For instance, one participant expressed that: “You see everything you find in our society living or nonliving depends on each other to be able to regenerate”. This aptly expresses Chilisa’s argument that researchers need to be (culturally) sensitive that this relationship of interdependence is what is being investigated when looking at “reality”.

Chilisa goes on to explain that as far as a relational epistemology is concerned, it is understood that “all the systems of knowledge are built on relationships”. That is, it is only via our relationships (as knowers relate to one another and discuss views together) that “knowing” occurs (p. 21). We were very cognizant of this in our setting up of the research as a process of FG discussion (among, respectively, the four different groups) so that people could together discuss their views, rather than considering that “individual” views as proffered in the course of the discussion were their “final” statements. In Adyanga and Romm (2021), we provide detailed quotations on how the course of the discussion proceeded, as participants added to, modified, agreed with, or questioned each other statements, towards a build-up of collective insights. We also show that we, as professional researchers, were not passive onlookers and that our way of

posing questions and probing participants (or rather, the authors' FAA and NRAR ways, as the sessions were held in the local language) also helped to stimulate the discussion. In this way, we brainstormed and problematized collectively with FG participants some of the deep seated and presumably 'untouchable' issues of injustices in society that were previously considered by the study community as "unstoppable".

As regards a relational axiology, Chilisa notes that this implies "relational accountability" in the research process, that is, as researchers she urges us to recognize that "all parts of the research process are related and that the researcher is accountable to all relations" (2021: 22). She also specifies that an Indigenous approach means that we are specifically attuned to the concerns of those most marginalized in the social and ecological fabric of life. Hence it is important to include "the voices of those disadvantaged on the basis of gender, race, ethnicity, ableness, health, socioeconomic status, sexual orientation, age, and so on [including the voice of mother nature who all-too-often marginalized in our discourses]" (2012: 25). She adds that "Ubuntu [in the African context] offers guidance concerning how the research should be geared to "promote community, belongingness, togetherness, and well-being" (p.22) in terms of its desired social impact (cf, Akena, 2020). Again, during the conduct of the FG sessions, the Ugandan participants will have been aware (through the way we set the questions) that we felt part of the "community", in some solidarity with their struggle, and were concerned, as they were, with issues of social and ecological justice. (Please see Appendix A for our guiding questions that directed the discussions.)

The actual facilitation of the sessions was done by one of the authors (FAA) and two research assistants (RAs) respectively (with FAA facilitating two of the sessions and the RAs each facilitating one). The facilitation was guided by an interview guide constructed by all the authors along with a training manual for the RAs, which FAA went through with them face-to-face. In this article we do not concentrate on the details of the sessions, as this is recorded in Adyanga and Romm (2021, forthcoming). We focus more on the participants' views of what "good business" may amount to and on their recommendations for pursuing such business on the part of foreign-owned enterprises (and on the part of governments allowing them to operate in the country). The major discussions are anchored on key recommendations proffered by FG participants on how to improve relations between the foreign-owned enterprises and the host community for mutual collaboration and benefits.

3. Some ideas on the input of foreign investors in the community: Lost opportunities for mutuality

As indicated in the Introduction, space limitations mean that we can refer to only parts of the extracts of FG participants' expressions. We are therefore focusing on what we took to be the participants' sense of opportunities for mutuality that were lost and indeed abused. Our first four questions (see Appendix A) were meant to elicit discussion around how the study participants

viewed the foreign investors and also to consider how the company in question acquired the land on which to operate.

In answer to these questions, the tenor of the FG discussions was that insofar as “these people are from an area which has a better financial stability they [can] come to improve our lives or make our lives better”, they can be welcomed; but that (as another participant expressed in the same FG discussion) “we welcome these visitors with open hands as long as they can cooperate with us. What we hate is suppressing our youth and polluting the River” (The reference of these two (male) speakers to suppressing the youth was a reference to the ill-pay of the workers who were mainly youth and to the fact that they were not trained to do more skilled work as had originally been suggested by the factory. The reference to the pollution of the river was a reference to the poor waste disposal system used by the agro-processing factory.)

In another FG session, one of the participants again expressed that if the factory did “good”, then, this would be acceptable. One of the men commented “If good relationship was there, you see the person you started a connection with is good for the development to be better”. He continued to state that “if the government can allow them, it should bring some training opportunities to help them gain the knowledge so that the youth can gain skills because education for some of the youths got spoilt” [meaning they did not have the opportunity to get educated]. The implication here is that training should have been one of the provisos that the government sets for the foreign companies to start operating.

In regard to the buying of land, it was explained by one of the men that the agro-processing company got land when they came from around River Ayago (i.e., the investors first bought land near River Ayago) and they met up with one mzee [elderly man] from the other side of the river. The mzee sold them a small piece of land and later connected with a person whose land is connected to the one of mzee. They [the factory owners] bought the land later. So they have since that time been expanding by buying other people’s land. Others are being threatened to sell off their land. So now we all fear that we may lose our land to [the company]. If we knew this was their intention, we would not have welcomed them here”.

The quotation above is one example of how participants expressed a sense of betrayal while also expressing concern regarding the non-transparency of the process of buying land. In all the FG discussions the issue of the buying up of land of the farmers was vehemently raised. This makes sense given the cultural basis of the traditional land tenure system (cf. Adyanga 2017, Arko-Achemfuor, 2019), where use of land is supposed to be consensually defined through community-based decisions. This is why Bassey (2019) also suggests that “we [in Africa] would do well to recapture the [spirit of] Ubuntu – that made the collective the basis of communal organizing” (2019: 5). The FG participants therefore voiced collective resistance and resilience of the locals in the face of exploitative economic enterprise.

The spirit of Ubuntu, *albeit* difficult to define, refers to the notion that, as Chilisa summarizes (and translates into English): “I am because we are”. That is, we owe our very “being” to our relationships with others and indeed to “all of creation” (Chilisa 2020: 24). Dissatisfaction with the poor/abusive relationship established with the community was expressed succinctly by a (female) participant as follows: (Lady speaking): “Poor disposal of the factory waste, the issue of getting work for the children in our homes, their late payment, their return late from work from 8 am to 9 pm. The time keeps changing as when the boss decides and the payment if you start work from 8 am to 5:30 pm you are paid 7,000. From 5:30 onwards is paid as overtime paid 750 shillings per one hour worked. They said over time would be paid after every two weeks but later it turned into two months of which you are paid one month like that so that you don’t leave the work and for us the farmers, we were deceived to plant cassava. There were no markets, others were sending their cassava on credit and no payment has so far been made”. This participant stated the farmers had been promised that the factory would offer a market for the cassava that they planted specifically in order to serve the factory, but that this did not transpire as arranged – there had thus been a deception rather than the development of a reciprocal relationship. (The factory in the main decided to buy up additional land to rather plant cassava themselves, thus riding roughshod over previous oral understandings with the community.)

Another female likewise expressed her disdain for the principle of relationality and fair play in dealings with people (and the land) that was unabashedly disregarded by the factory owners, a principle that she regarded as “common sense”. (Lady speaking): “It should be common sense that you can’t go and start mistreating people on their land. We didn’t go to them but they are the ones who came here and now want to destroy our lives, animals, and the surrounding rivers and the fish that live in it. This is not right. Supposing someone from Uganda goes and does the same thing in their country, how would they feel?”

Yet, another female speaker in the same FG discussion followed up by pointing to implications for investors and investment. (Lady speaking): “*Let other people be careful next time they want to receive investors from outside our country. Now, I know that if care is not excised and investors are allowed in the community without proper laws guiding them, they end up abusing the community’s generosity. They should be accountable to the people and their waters, trees, land, soil, religion, and culture but should not behave like [this] factory that has no regards for all this*”.

Although none of the participants as cited above referred explicitly to Ubuntu, we can see that the Ubuntu value of strengthening rather than destroying human-to-human and human-to-other-living relationships, (including the waters, trees, land, soil, religion, and culture as part of the community) is being invoked.

Naturally, we concur with Maris, that in appealing to the value of Ubuntu (even implicitly by these participants), this does not imply that they sought “*a full return to pre-colonial traditions*” (2020: 321). As Maris points out, no-one [writing or speaking about Ubuntu and its relevance] is

“advocating a narrative of complete return” as this would imply over-romanticization of distant past history. What is hoped for, as also expressed by these participants, is a return to some of the ideals incorporated in the philosophy of relationality as a way forward for a more sane (healthy on all levels) existence. Again, citing Bassey, what is being proposed is “recapturing the interconnectivity of our humanity [including our relations with Mother Earth] towards an overall experience of wellbeing (2019: 5). (Bassey is the director of the ecological think tank called “Health of Mother Earth Foundation” based in Nigeria.) In the context of Africa, Bassey suggests that “political leaders are yet to dissect the fact that the industrialized world got to where it is now through unsustainable exploitation of nature and unjust exploitation of territories and people” (2019: 4).

What we wish to underscore from our brief account of some participants’ expressions is that the way in which the land issue and other forms of disempowerment were experienced was not considered as “normal” practice (in the sense of fair practice). In expressing the lack of normality/fairness, the participants referred to a system of land distribution not based on commodification of the land, but based on a more communal understanding of the land as a communal asset also to be protected rather than denatured. Considering the issue of foreign owners’ exploitation of people and of the land now being seen as “normal” in many quarters of the globe (including by certain leaders in the Ugandan context), one participant in one of the FG sessions stated (when we asked the question as to what others may learn from their protest movement). (Lady speaking): *“They can learn that injustice exists in all society and that is becoming normal since there are people who normalize the injustices. [However], no challenge is greater than the power of the oppressed poor who have come together”*.

In relation to possibilities for foreign-owned companies to contribute to the community, certain options were expressed, for example:

(Man speaking): *“What we want, our problem is they add for us a bright group who can bring for us development if there is a new factory to offer job opportunities”*.

(Lady speaking): *“I want if this group can be removed and a new factory be brought to replace the current one”*.

(Man speaking): *“If a new company is coming, they should work with those who are in that area before they can start looking for others, if there is no knowledge, training should be provided so that they can gain knowledge to pay their children in the future. I also ask of such big factories who find a good neighbor to at least pick some of the children for sponsorship so that the children can later work in the factory”*.

Regarding the current tension and ill-feeling, another (male) speaker offered the suggestion that:

(Man speaking): *“I think something that brings people together in a reconciliatory method would help to ease tension. For now, I am thinking of a game like football. You see sport has a great power of uniting rival parties and we can do it if someone can fund it. Maybe even the factory can do that and other social responsibilities like building a school and a hospital ... or they can take some of our young people for skill training so that they can compete for better position in the factory”.*

These were the kinds of possibilities for acting as “good neighbors” and “doing good” that were referred to as options for mutual collaboration (if not with this factory then with other potentially more “neighborly” ones). In the workshop, certain recommendations for what the government could do firstly to try to hold this factory to account and secondly to tighten their practices for allowing factories into the country, were expressed. In Section 4, we provide a summary of the recommendations arising from the FG and workshop discussions. Then in Section 5, in order to give substance to the “viability” of the recommendations, we offer some deliberations in relation to the understanding of “human nature” underlying the Ubuntu view of humans as owing their “being” to their relationality. This serves to offer a counterpoint to those who argue that the recommendations and options for “good living” as implied by the Ugandan participants, are not viable due to the essential self-interested nature of “human beings”.

4. Recommendations arising from the focus group sessions and workshop

While foreign-owned investments are argued by mainstream economists to bolster economic growth and, in this way, contribute to the countries in which they operate (cf. Durham 2004, Li and Liu 2005), the experience of the agro-processors in Nwoya district, Koch Goma Subcounty has proved otherwise. The factory indeed, as expressed by the study participants, turned out to be a source of socioeconomic anguish to the locals. The unregulated operation of the foreign-owned “investment” became a major source of poverty, economic disempowerment (as farming land was bought up and hence their livelihoods became threatened), distress (as participants felt exploited and betrayed), and ill-health (from the pollutive effects on their water and land, as well as from the anxiety). As redress measures, study participants came up with the following recommendations:

1. The factory should be investigated and brought to face justice for all the injustices they have meted against the villagers. For instance, a male participant stated: *“I feel very sad sitting here talking about the exploitative “cobras” in that factory who used my daughter under the pretext of giving her a job and left her with sexually transmitted disease – the job they later offered her paid so little”.*
2. Participants recommended that the factory operation license be suspended until they put in place a proper waste disposal mechanism. The enforcement of such a waste disposal mechanism should be monitored by incorruptible district leadership and selected

- members of the local community – *“because we are the ones who suffer the most in the event of poor waste disposal”* – asserted a female participant.
3. Government should come up with a minimum wage bill below which a company cannot pay any of its employee. This will protect the locals from exploitations. Also, working hours needs to be reduced: *“how can a normal human being work from 8am – midnight, this is torture meant to break the person physically and emotionally”*.
 4. In consultations with the farmers, the government should come up with price stabilization for agricultural products so that the local farmers are not exploited by big companies such as X [the factory].
 5. The local and national leaders should create sensitization awareness meetings with the local communities so that we are kept informed of the nature of foreign companies like X, the nature of their work, their aims and possible benefits to the community. *“For example, X came to our community under the guise of setting up a sugar factory but now they have deviated to producing alcohol from Cassava”* – stated a male participant”.
 6. Participants suggested that the government should *“only allow foreign-owned companies with good international reputation”*. They questioned the record of this factory and asked the government to do a retrospective background check to understand them better, and in the future also to do background checks before allowing foreign companies into the country.
 7. People in leadership positions like the Chairperson Local Council Five (LCV), the Resident District Commissioner (RDC), the District Internal Security Officer (DISO), and area Member of Parliament should regularly come down and interact with them so as to understand issues affecting them. They stated that such responsibility should not be left to University researchers alone. *“we elected some of them into office and why aren’t they coming to talk to us like you people from the University have done – what are they fearing? Why did they seek our votes if they are not willing to be our voices?”*
 8. The foreign-owned factory should foster a good relationship with the community by supporting social services provisions such as renovating hospitals, schools, roads, offering scholarships, and giving good salaries to their children, buying the villagers’ cassava at good prices, and giving skills’ training to their young people so that they get the chance to be promoted to supervisory positions in the factory.
 9. Finally, participants recommended that the local leaders who received bribes from the factory owners to ignore the sufferings of their people should be given a stern warning. *“They should be reminded that we [the villagers] are the ones who employed them and*

not the factory, we voted for them to be in leadership. Therefore, they must exercise their responsibility to us and not to the factory bosses” – stated a female participant.

During the workshop, participants expressed hope that their voices will be heard by those in leadership position to influence policy change that leads to better living conditions for them and other surrounding communities, while respecting the ecological web of life. They reiterated that they could embrace foreign-owned investments/businesses coming into their community. However, such investments/ businesses should respect their environmental and human rights principles so that both the company and the community could benefit from mutual collaboration. In responses to their appeals made to FAA during the FG sessions and again in the workshop that district and national leadership should be alerted to their concerns, FAA held meetings with the RDC and a candidate parliamentarian prior to the workshop, and after the workshop he spoke again to this Member of Parliament (MP)-elect (who was from a neighboring constituency and a diplomat now turned Member of Parliament-elect) and to the area MP-elect from the study constituency, hoping in this way that the participants’ concerns and recommendations could be made more public in local and national circles. The two legislators promised to follow up the complaints of the study participants once they are sworn into offices (swearing in of new MPs is scheduled for May 2021).

The recommendations cited above for nurturing a “good relationship” between the foreign-owned companies and the community (including its natural environment) may seem unrealistic if we are working with a view of human beings as essentially self-interested and an attendant view of business “investment” as a way for people to pursue their self-interest (rather than pursuing good relations with people and the planet). But this is precisely what is in question when we challenge mainstream economics. It is to this controversy that we now turn.

5. A discussion on “human nature”

As noted above, ecological economists, along with ecofeminists, socially-oriented authors, and a host of Indigenous traditions and practices as expressed in oral and written history, call on us to challenge the taken-for-granted mainstream economics assumption of human motivation as linked solely to “individual preferences”. In this regard, ecological economist Spash suggests that ecological economists concur with the socialist critique of “free market systems”, which are buttressed by “educat[ing] individuals to act as selfish hedonists, thereby creating power structures which reinforce inequality” (2009, p. 77). This point is also expressed by Murove (2005) when he points out that the notion that the economy runs on self-interested motivation was historically invented at a certain stage in history – namely, to support industrialization/ colonization, including the treatment of nature as a “resource” to be exploited for human self-interest. Murove argues that it is regrettable that certain “early modern economists attempted to divest economics from morality” and in this process the “idea of sympathy as social logic” was “hardened into a theory of self-interest” (Murove 2005: 154). In the same vein, Gintis questions the notion of “*homo economicus*”. *Homo economicus*, he notes, as postulated in conventional

economic theory, implies that people are treated as “car[ing] about social interactions only insofar as they [their interactions] affect their final consumption [of goods] and wealth” (2009, p. 151). Magdoff and Williams argue that while in the current era indeed many people become socialized into believing that fulfillment is a consequence of pursuing a self-interest, this is not a historical constant. They argue that to reach a socially just and ecologically healthy world, humans need to be socialized in terms of a recognition of our connectedness with others, so as “to enable prosocial behavior patterns to become dominant, and antisocial behavior, so prized and rewarded in capitalist societies, to fade into the background” (2017: 195).

All of these authors criticize the understanding of people as essentially “self-interested” by exploring how people can (and have in different historical periods and different geographical regions) been more oriented to practicing their relations with others in terms of a notion of reciprocity. Gergen (2009) makes a similar point when he refers to our capacities for “relational being” (he cites the Ubuntu notion of caring and compassion in this regard: 2009: 388). Likewise, McIntyre-Mills (2014: 71), citing De Waal (2009) notes that the “competitive logic that plays out between human beings in competition for jobs and resources is unsustainable. We can evolve through cooperation”. She argues that this is all the more crucial in reconsidering how we can shift current globalization trends (post) COVID (or in the COVID-19 era) so that we do not fall back into “business as usual” (2020: 827). She suggests that Stiglitz, Sen, and Fitoussi’s (2010) notion of “wellbeing stocks” is helpful for those wishing to understand (and practice) new potential paths for development as linked to wellbeing. As she puts it:

“This requires reframing not only economics but our relationships”. COVID-19 provides a once-in-a-lifetime opportunity to rethink our place in the web of life by extending and applying Stiglitz *et al.*’s (2010, p. 15) multidimensional measure of wellbeing (McIntyre-Mills 2020: 830).

In short, drawing on the work of authors from various fields in the social sciences, including transdisciplinary research, we can question a restricted (and Western individualist) view of “human nature”, which currently buttresses the model of mainstream economics and provides support for “business as usual”.

6. Conclusion

In this chapter we drew wisdom from the Indigenous participants’ views of what can be called more “just” ways of organizing business such that it is good business (as also storied by, for example, Arko-Achemfuor and Dzansi, 2015, and Korten, 2015). We explored a storyline (based on participants’ understandings) where doing good business entails not causing social and ecological damage in its midst. We indicated that in certain literature produced in “the West”, despite the still prevalence of mainstream economics, there are critical voices that have been raised against the dominant economic model by, for example, ecological economists (cf. Martinez-Alier 2009, Spash 2020), ecofeminists (cf. Plumwood 2002, Stephens 2015), and socialist-oriented authors (cf. Harvey 2006, Magdoff and Williams 2017). Notably, within this

critical oeuvre, many authors of “non-Indigenous” origin point to the richness of Indigenous traditions (e.g., Gergen 2009, Korten 2015, McIntyre-Mills 2017, Magdoff and Williams 2017, Escobar, 2018) insofar as these traditions encompass a philosophy of relationality, and caring/compassion as a normative framework. We have indicated in this chapter how the Indigenous expressions and reflections as proffered by the Ugandan study participants highlight the quest not to return to “normal”, but indeed to generate a radical transformation of the (current) “normal”. Or as McIntyre-Mills (2020: 835) critically puts it: “*Passion for ‘business as usual’ and our lack of compassion [in this case the lack of compassion of the factory owners] has brought into being the present [global] order*”.

Finally, we have demonstrated that the evocation of Ubuntu philosophy and practice was premised on circumventing the paradoxical tensions nurtured by the factory’s failure to honor erstwhile oral contract (to buy cassava at fair prices) with the villagers. This evocation was a search for home-grown solutions to exploitative, oppressive, and imposing/colonizing greed of the foreign-owned enterprise. By evoking the philosophy of Ubuntu mirrored in generational epistemology and memory, the locals conceptualized power to freedom as vested in communal relationship which must be tapped and utilized. As Foucault (in Patton and Morris, 1989) reminds us, “*power is born out of plurality of relationships which are grafted onto something else, born from something else, and permit the development of something else*” (p.187). Acquiring power by the oppressed villagers who initially perceived themselves as incapable of taking action, was operationalized by embracing the principle of collective wellbeing, relationality and accountability. As such the acquired power, which we call collective consciousness, was used by the villagers to interrogate and subvert (cf. Delpit, 1988) the exploitative and avaricious foreign-owned factory’s *modus operandi*. This led to brainstorming during the different FG sessions of key recommendations for the collective wellbeing. Therefore, the Ubuntu ethos as used by FG participants (though without mentioning it) critiqued and challenged the neutrality of normative oppressions. By imbuing the ethos into praxis, the oppressed community disrupted and shifted the boundary of socio-economic/environmental injustices from politics (because oppressions are often politicized) to collective activism that piloted the birth of holistic wellbeing reiterated in their recommendations.

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Appendix A: Interview guide questions posed to participants in the focus group sessions

1. There are many foreign investors in the country these days. What is your impression of foreign investors?

2. Do you know of any facility set up by foreign investors in your community?
3. If yes, how did the investor/s acquire land on which they set up the facility/factory?
4. What is the relationship between your community and the facility?
5. What are the common socio-economic and ecological injustices (related to environmental damage) prevalent in your community?
6. Who are the perpetrators of these social and environmental issues?
7. How do the local community organically organize to resist social and social-economic-ecological issues described above?
8. Please consider in particular how you think the community created spaces for discussing the experienced injustices and to consider together ways of getting them attended to by the multinational corporations?
9. How did the community continue to think of ways forward when initial raising of the issues were not addressed?
10. How did the community members share ideas together and develop a way forward?
11. What challenges would you say the community faced in resisting issues of injustices in your community?
12. How effective is the community organizing to challenge social injustices and what are some of the reasons that you think the movement for justice becomes (more or less) effective – Please share with us some examples from experience in your village? For example, how was the local government brought- in in this case and what role do you think did they play?
13. What lessons can be learnt from such organic social movement organizing?
14. Do you think this experience from your community is transferable to other contexts in Uganda and even in other countries?
15. What recommendations (if any) would you give to address the social and environmental issues identified above?
16. What do you suggest we should emphasize in our write-up in various articles etc. for wider audiences inside and outside Uganda and in our recommendations to the Ugandan government? Please mention as many ideas as come to mind!
17. Any other thoughts or comments?

References

- Akena FA (2020). “The “Miss Curvy Uganda” pageant: Representation, commodification and exploitation of women’s bodies”, *Social Semiotics* 1-16.
- Akena FA (2012). “Critical analysis of the production of western knowledge and its implications for indigenous knowledge and decolonization”, *Journal of Black Studies* 43(6):599-619.
- Adyanga FA (2017). “Customary Land Tenure and Ecological Sustainability in Acholiland, Northern Uganda”. In JJ McIntyre-Mills and NRA Romm (Eds.), *Balancing Individualism and Collectivism* (pp. 221 –37). New York: Springer.

- Adyanga FA and Romm NRA (2021). "Collective Action for Regeneration of the Web of Life in the Face of Disruptive Injustice". In JJ McIntyre-Mills and Y Corcoran-Nantes (Eds.), *Education for Regenerative Transformation* (Chapter 5). Cheltenham: Edward Elgar (forthcoming).
- Arko-Achemfuor A (2019). "Putting Communal Land into Productive Use Through Collaborations, Networking and Partnerships in rural South Africa". In JJ McIntyre-Mills & NRA Romm (Eds.), *Mixed Methods and Cross Disciplinary Research Towards Cultivating Eco-Systemic Living*, pp. 251-66). Cham, Switzerland: Springer
- Arko-Achemfuor A and Dzansi DY (2015). "Business doing well by doing good in the community". *The Journal of Commerce* 7(2):53-68.
- Bassey N (2019). "Breaking the Chain of Development". In A Khotari, A Salleh, A Escobar, F Demaria, and A Acosta (Eds.), *Pluriverse: A Post-Development Dictionary* (pp. 3-6). Chennai: Tulika books.
- Chilisa B (2012). "Indigenous Research Methodologies". London: Sage.
- Chilisa B (2020). "Indigenous Research Methodologies" (2nd edition). London: Sage.
- Chilisa B, Major TE and Khudu-Petersen K (2017). "Community engagement with a postcolonial, African-aased relational paradigm", *Qualitative Research* 17(3):326-39.
- Chilisa B and Mertens DM (2021). "Indigenous made in Africa evaluation frameworks: Addressing epistemic violence and contributing to Social Transformation". *American Journal of Evaluation* 1098214020948601.
- De Waal F (2009). *The Age of Empathy: Nature's Lessons for a Kinder Society*. Portland: Broadway Books.
- Delpit L (1988). "The silenced dialogue: Power and pedagogy in educating other people's children". *Harvard Educational Review* 58(3):280-99.
- Durham JB (2004). "Absorptive capacity and the effects of foreign direct investment and equity foreign portfolio investment on economic growth", *European Economic Review* 48(2):285-306.
- Escobar A (2018). "Farewell to Development". Interview by Allen White, *Great Transition Initiative* (February 2018). <https://greattransition.org/publication/farewell-to-development>.
- Fernando JL (2020). "The Virocene Epoch: The vulnerability nexus of viruses, capitalism and racism", *Journal of Political Ecology* 27(1):635-84.
- Gergen KJ (2009). "Relational Being: Beyond Self and Community". New York: Oxford University Press.
- Gintis H (2009). "Beyond Homo Economicus." In CL Splash (Ed.), *Ecological Economics* (pp. 150- 166). London: Routledge.
- Gram-Hanssen I, Schafenacker N, and Bentz J (2021). "Decolonizing transformations through "Right Relations". *Sustainability Science*, 1-13. <https://doi.org/10.1007/s11625-021-00960-9>.
- Harvey D (2006). "Neo-liberalism as creative destruction". *Geografiska Annaler: Series B, Human Geography* 88(2):145-58.

- Held MBE (2019). “Decolonizing research paradigms in the context of settler colonialism: An unsettling, mutual, and collaborative effort”. *International Journal of Qualitative Methods* **18**, 1-16.
- Khotari A, Salleh A, Escobar A, Demaria F, and Acosta A (2018). “Introduction: Finding Pluriverse Paths”. In A Khotari, A Salleh, A Escobar, F Demaria, and A Acosta (Eds.), *Pluriverse: A Post- Development Dictionary* (pp. xxi-xlii). Chennai: Tulika books.
- Korten DC (2015). “Change the Story, Change the Future: A Living Economy for a Living Earth”. Berrett-Koehler Publishers.
- Kovach M (2009). “Indigenous Methodologies: Characteristics, Conversations, and Contexts”. Toronto: University of Toronto Press.
- Li X and Liu X (2005). “Foreign direct investment and economic growth: An increasingly endogenous relationship”, *World Development* **33**(3):393-407.
- Magdoff F and Williams C (2017). “Creating an Ecological Society”. New York: *Monthly Review Press*.
- Maris CW (2020). “Philosophical Racism and Ubuntu”. In *Dialogue with Mogobe Ramose. South African Journal of Philosophy* **39**(3):308-26.
- Mattick P (2011). “Business as Usual: The Economic Crisis and the Failure of Capitalism”. London: Reaktion Books.
- Mies M and Shiva V (2014). “Ecofeminism”. London: Zed Books
- Mkabela Q (2005). “Using the Afrocentric method in researching indigenous African culture”. *The Qualitative Report* **10**(1):178-89.
- Murove MF (2005). “The Theory of Self-interest in Modern Economic Discourse”: Doctoral thesis, University of South Africa, Pretoria.
- Martinez-Alier J (2009). “Ecological Economics: Taking Nature into Account”. In CL Spash (Ed.), *Ecological Economics* (pp. 39-61). New York: Routledge.
- McIntyre-Mills JJ (2014). “Transformation from Wall Street to Wellbeing”. New York: Springer.
- McIntyre-Mills JJ (2017). “Planetary Passport: Representation, Accountability and Re-generation”. New York: Springer.
- McIntyre-Mills JJ (2020). “The COVID-19 era: No longer business as usual”. *Systems Research and Behavioral Science* **37**(5):827-38.
- Patton P and Morris M (Eds.) (1979). “Michel Foucault: Power, Truth, Strategy”. Sydney: Feral Publications.
- Plumwood V (1993). “Feminism and the Mastery of Nature”. London: Routledge.
- Rix EF, Wilson S, Sheehan N, and Tujague (2019). “Indigenist and Decolonizing Research Methodology”. In P Liamputtong (Ed.), *Handbook of Research Methods in Health Social Sciences* (pp. 253–67). New York: Springer.
- Romm NRA (2018). “Responsible Research Practice: Revisiting Transformative Paradigm in Social Research”. New York: Springer.
- Sachs J (2015). “The Age of Sustainable Development”. New York: Columbia University Press.
- Spash CL (2009). “The Development of Environmental Thinking in Economics”. In CL Spash (Ed.), *Ecological Economics* (pp. 62-83). London: Routledge.

- Spash CL (2020). “‘The Economy’ as if People Mattered: Revisiting Critiques of Economic Growth in a Time of Crisis”. *Globalizations* 1–18. <https://doi.org/10.1080/14747731.2020.1761612>.
- Stephens A (2013). “Ecofeminism and Systems Thinking”. New York: Routledge.
- Stevano S, Franz T, Dafermos Y, and Waeyenberge EV (2021). “COVID-19 and crises of capitalism: Intensifying inequalities and global responses”, *Canadian Journal of Development Studies / Revue canadienne d'études du développement* 42:1-2, 1-17, doi: 10.1080/02255189.2021.1892606.
- Stiglitz J, Sen A, and Fitoussi JP (2010). “Mis-measuring Our Lives: Why the GDP Doesn’t Add Up”. New York: The New Press.
- Weir JK (2015). “Lives in Connection”. In K Gibson, DB Rose, and R Fincher (Eds.), *Manifesto for Living in the Anthropocene* (pp. 17-22). New York: Punctum books.
- Wilson S (2008). “Research is Ceremony: Indigenous Research Methods”. Halifax: Fernwood.

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Chapter Seventeen

Assessing COVID-19 impacts on Africa

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Abstract – This is a compilation of a socioeconomic survey of experiences from 24 countries in various African regions, specifically on trade and tourism. On that basis, an economic and social recovery program is proposed and outlined.

1. Introduction and sample size

This presentation is a compilation of a socioeconomic survey of experiences from Eastern, Southern, Central, Western, and Northern Africa from among the greens, the business community, and the general population who contributed their views basing on their respective country experiences. In particular, the respondents came from the following countries: Algeria, Tunisia, Morocco, Egypt, Northern Sudan, Ethiopia, Nigeria, Burkina Faso, Niger, Mali, Cameroon, Togo, Chad, Central African Republic, Democratic Republic of Congo, Uganda, Kenya, Rwanda, Burundi, Mozambique, Mauritius, Zambia, Zimbabwe, and Madagascar.

2. Points of discussion

The negative impacts of the severe acute respiratory syndrome-corona virus disease-19 (COVID-19) have been based mainly on trade and tourism.

2.1 Trade

Both local and international trade are both greatly affected.

Africa is an import-based continent. Closing down borders means closing down on the economy and livelihoods. The population has no access to supplies, to business, and to income, which has escalated already the sky-rocketing unemployment and poverty levels in Africa. A clear example is the total collapse of the informal sector dominated by women that depends on day-to-day sales from imported goods, especially from China and other Asian and Middle Eastern countries.

Furthermore, Africa greatly benefits from international remittances. The financial flows and remittances of Africans living in the diaspora, as well as financial support from partners of the African continent, have drastically reduced.

Loss of trade has created a collapse in the African economies, rendering the population even more prone to the COVID-19 pandemic.

2.2 Tourism

This was the first sector to be affected by the lockdowns of the COVID-19 pandemic, and it is the most hit sector as closing down borders curtails any movements on which tourism depends. Taking a simple example of the 10 most visited countries in Africa in 2019, including Uganda, South Africa, Egypt, Morocco, Tanzania, Mauritius, Kenya, Ethiopia, Tunisia, and Zimbabwe, one finds that tourism is the leading earner of foreign currency for these most visited countries. So, travel restrictions, and closing down airports and borders means closing down on this important resource. In addition, millions of people that are employed in the tourism sectors such as airlines, hotels, tour companies and so on have been greatly affected.

Having spoken about tourism and trade, we cannot forget about the enormous social problems as a result of the COVID-19 pandemic. There are also a number of reported social problems experienced mostly by women and girls. Confinement has put families together, but it has also isolated some families, and therefore escalated problems like domestic violence, mental health, stress, and suicide, which mostly overwhelm women as they are essentially the ones on the frontline of many societal problems.

The abrupt close down of schools has facilitated school drops. Many young girls have been reported pregnant and, therefore, not likely to go back to school when schools resume. The boys have also been reported to be engaged in gambling and gaming in nearby community facilities, exposing them to possibilities of addiction and crime.

3. Conclusions and recommendations

Based on the points of discussion, I would like to conclude and propose the following recovery program:

The collapse in the African economies will no doubt increase their debt burdens. So any economic recovery program should have that in mind.

African countries must review the economic model from import-based to export-based or self-sustenance. Local industries must be empowered and consumption of local products should be promoted by the respective governments and other stakeholders.

Africa must invest, adopt, and enhance e-governance since this has provided a platform to transact business during the COVID-19 era.

Partners and friends of the African continent, should revive their international collaborations by initiating and supporting collaborative projects to support the economic recovery and social rehabilitation.

Projects targeting women empowerment and leadership should be encouraged. Despite the roles played by women in the fight against the COVID-19 pandemic by taking lead at the frontline of these problems, women still struggle to be considered equal especially economically.

Leadership is the way to show gender equality. Senior positions should be accorded to women because of the enormous roles they play in society.

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Chapter Eighteen

COVID-19 pandemic predicts gloom for Africa

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Abstract - The African continent is historically known for its socio-economic challenges, disproportionate burden of infectious diseases, and relatively poor or ill-equipped health systems. With the rapidly increasing numbers of infections and deaths from the COVID-19 pandemic across the world, it has been predicted that the African continent will expect to suffer unprecedented devastation compared to the rest of the world. This presentation explores the predicted gloom for Africa resulting from the COVID-19 pandemic in relation to its impact on HIV infection - a disease that has disproportionately burdened the continent.

Key words: *Africa, COVID-19 pandemic, HIV burden, health services devastation.*

List of abbreviations

AIDS:	Acquired Immunodeficiency Syndrome
ART:	Antiretroviral Therapy
COVID-19:	Coronavirus Disease - 2019
HIV:	Human Immunodeficiency Virus
PLHIV:	People Living with HIV
PPE:	Personal Protective Equipment
SOPs:	Standard Operating Procedures
UNCST:	Uganda National Council for Science and Technology
WHO:	World Health Organization

1. COVID-19 Pandemic and Africa

Africa, especially sub-Saharan Africa is known to have the highest burden of most of the infectious diseases, understandably from the historical poor socio-economic challenges that contribute to weak health systems. The coming of COVID-19 was undoubtedly expected to have the heaviest toll in Africa, however, the response to the pandemic has not lived to the

billing by pundits. If the COVID-19 had such high infectious and mortality rates in the western world, then, the worst was predicted for Africa. Many questions were posed: Is Africa going to be able to withstand the expected onslaught? Will all resources be channeled to the COVID-19 containment at the expense of other activities such as HIV services and research? These and many more are questions that beg answers in order to understand the interaction between the COVID-19 pandemic and the HIV epidemic in the African context.

The novel coronavirus was first reported from Wuhan city in China in December 2019 and, within three months, it had spread across the world prompting the World Health Organization (WHO) to declare the disease a global pandemic on the 11th of March, 2020 [1]. The world's poorest continent, Africa, with the most vulnerable populations to infectious diseases, was predicted to be significantly affected by the ongoing COVID-19 outbreak [2]. By 2010, the global deaths from HIV/AIDS had increased to 1.5 million [3]. It was even proposed that the immune status that makes people with HIV (PLHIV) vulnerable to tuberculosis could also make them susceptible to coronavirus infection [4]. It was, thus, expected that there would be an unprecedented surge in COVID-19 infections in PLHIV, outstripping resources in Africa for HIV services due to the fact that Africa, which already has weak health systems, would be severely and adversely affected by the pandemic. The COVID-19 pandemic would inevitably lead to disruptions of provision of HIV services for people living with HIV and those at risk of acquiring HIV in sub-Saharan Africa. Mathematical models predicted the potential effects of such disruptions on HIV-related deaths and new infections in sub-Saharan Africa, projecting that a 6-month interruption of supply of antiretroviral therapy (ART) drugs across 50% of the population of PLHIV who are on treatment would be expected to lead to 1.63 times increase in HIV-related deaths over a 1-year period [5].

The reality of COVID-19 in Africa for now seems to show otherwise. All predictions of severe devastation of health services due to COVID-19 did not exactly come to pass at the levels that were expected. A systematic review found that controlled HIV infection does not appear to result in poorer COVID-19 outcomes among PLHIV [6]. Could there have been disruptions in HIV research as a result of COVID-19 pandemic? The answer to a large extent is, yes! However, Africa exhibited mixed approaches in their response to the COVID-19 pandemic. Most African countries openly declared its existential threat to health, while some other countries opted to downplay or plainly ignore it. As such, not much is known about the impact of the pandemic in the latter group of countries. The first case of COVID-19 in Africa was reported in Egypt on 14 February 2020. Since then, at least 52 countries in Africa have reported the infection, to which Dr Matshidiso Moeti, the WHO Regional Director for Africa remarked that for Africa "COVID-19 has the potential not only to cause thousands of deaths, but to also unleash economic and social devastation" [7].

2. COVID-19 situation update worldwide by 31 October 2020

The COVID-19 pandemic has been a threat to Africa due to several factors: relatively weak health infrastructure, low health workforce capacity, low capacity to make timely diagnosis, low or no capacity to develop and or acquire treatment needed, and fragile economies. The pattern of the disease on the African continent for the larger part of sub-Saharan Africa seems to defy the prediction that “poorer is equal to much affected” while “richer equals less affected”. What have been documented is that the Republic of South Africa, followed by Egypt, and Morocco (middle-income countries) have reported the highest infections and mortality rates from COVID-19 infections compared to some of the sub-Saharan countries with more limited resources [8,9].

3. Effects of COVID-19 control measures

Globally most countries’ response for containment and control was to: Minimize person-to-person contact by keeping physical distance between persons (‘social distancing’); directives for people to stay home hence the ‘lockdown’, as it became popularly known; people were asked to wear a face mask and/or face shield whenever in public; those working in health facilities handling cases of COVID-19 infection were mandated to wear full personal protective equipment (PPE) that included use of full body gowns, masks, face shields and gloves; and washing hands with soap and water and/or using alcohol-based hand sanitizer were some of the control measures put in place in many countries. Some of the African countries applied these control measures either fully or partially, while others added dusk-to-dawn curfew as a means to control night time activities such as in bars and night clubs.

These control measures were probably responsible for minimizing the level of COVID-19 infections and deaths. There were, however, some drawbacks to them in that they limited access to health facilities and care generally for patients including those for PLHIV, as HIV care requires regular appointments, initiation, and top-up or refills of medications.

By 31 October 2020, there were a total of 45,667,780 cases of COVID-19 reported around the world with total deaths standing at 1,189,499. The highest cases and deaths were reported in the Americas, followed by Asia, Europe, Africa, and Oceania as shown in Table 1. These numbers are expected to grow as more cases are reported.

Table 1: Global COVID-19 status by 31 Oct 2020

Continent	Reported Cases	Deaths
Africa	1,776,595	42,688
Asia	13,461,293	239,675
America	20,546,580	640,513

Europe	9,840,736	265,565
Oceania	41,880	1,051
Other	696	7

4. COVID-19 and HIV research in Africa

Eastern and Southern Africa are the hardest hit by HIV. The region is home to around 6.2% of the world's population but has 54% (20.6 million people) of the total number of people living with HIV in the world as reported in 2019 [10]. The interaction between COVID-19 and HIV involves adverse health and socioeconomic impacts arising from successive waves of high COVID-19 in the context of increased pre-existing vulnerabilities, fragile health systems, limited social protection, and high HIV prevalence [8]. As new outbreaks and successive waves of COVID-19 were predicted to occur, the magnitude and severity of the pandemic remained unpredictable. Globally, by 1 November 2020, approximately 46 million cumulative cases and 1.2 million deaths due to COVID-19 had been recorded compared with 38 million PLHIV and 1.7 million deaths from HIV. The projection was then that the COVID-19 pandemic response would divert resources from HIV as a result of the response measures to control and prevent the pandemic. In Africa this would be attributed to:

- a) Lockdowns and border closures imposed to contain COVID-19 from impacting both the production of medicines and their distribution, thus, potentially leading to increases in their cost and to supply issues.
- b) Weak economies would not sustain prolonged lockdowns without dire economic consequences.
- c) Poor healthcare systems cannot provide adequate treatment for all COVID-19 infected persons.
- d) High burden of co-infections may exacerbate COVID-19 infections and mortality.
- e) Limited capacity for testing and contact tracing precludes isolation of infection cases.

Recent modeling has estimated that a six-month complete disruption in HIV treatment could lead to between 471,000 – 673,000 additional deaths from AIDS-related illnesses [5]. In addition, if services to prevent mother-to-child transmission of HIV were similarly halted for six months, the estimated increase in new child HIV infections would be drastically heightened in some sub-Saharan African countries (e.g., 162% in Malawi, 139% in Uganda, 106% in Zimbabwe, and 83% in Mozambique).

HIV infection has not been established to be a risk factor for severe COVID-19, however, PLHIV can be infected with COVID-19 and the severity of illness depends on prevailing co-morbidities (high blood pressure, heart disease, lung disease, cancer, diabetes, or being of older

age) and social disparities, and not just HIV infection [11, 12]. It is, however, now known that PLHIV who are on effective antiretroviral treatment (ART) are not at greater risk of getting COVID-19 compared to the general population as the understanding of the risk of developing severe COVID-19 in people living with HIV continues to evolve. Current evidence suggests that HIV is less of a risk factor for severe COVID-19 than other health conditions. However, PLHIV not on treatment or not virally suppressed may be at a greater risk severity of infection with COVID-19. As for HIV being a risk for COVID-19 infection, it has been suggested that COVID-19 is currently leading to decreased access to HIV prevention services and HIV testing, and worsening HIV treatment access and virologic suppression, which could lead to worsening the HIV epidemic control [12].

Critical considerations need to be applied to investigate the effects of the COVID-19 pandemic on HIV research, including investigation of: how interruptions in HIV service delivery programs have been affected; how service delivery programs have responded to the COVID-19 pandemic; how HIV research can be conducted in the wake of the COVID-19 pandemic; and how data from the community can be collected in the middle of a pandemic/lockdown situation.

While research in HIV must be conducted during this pandemic, elaborate preparations for data collection will be required including but not limited to: a) Ethical clearance for data collection that meets the standard operating procedures (SOPs) for COVID-19 containment and prevention; b) adequate training of data collectors in the SOPs; c) complete protection of the data collectors as well as the study participants from infection with COVID-19; d) handling transport issues for study participants in the wake of the travel restrictions; e) treatment and care (ART refills) of the study participants; and f) most importantly, addressing issues of stigma related with COVID-19 infection. These are but some of the tasks that, if done, may guarantee continued services as well as provide measures to ensure that research in HIV and AIDS can be carried out during this era of the COVID-19 pandemic situation.

Research regulatory authorities may weigh-in to ensure that researchers maintain SOPs that will protect the study participants as well as the researchers from spreading or acquiring COVID-19 infection. In the case of Uganda, the Uganda National Council for Science and Technology (UNCST), the research regulatory authority, requires all researchers to submit Risk Management Plans to mitigate the control or prevention of COVID-19 which must be approved before they can be cleared to go in the field to collect data.

5. Conclusion

In conclusion, it can be said that the COVID-19 pandemic may not have devastated the health systems in Africa as was predicted, but the truth of the matter is that the control and containment measures to mitigate against the pandemic have impacted how services and research in HIV will be handled.

References

1. Time magazine (2020). “World Health Organization declares COVID-19 as a “Pandemic”.
2. Lone SA and Ahmad A (2020). “COVID-19 pandemic—an African perspective”, *Emerging Microbes & infections* **9**(1):1300-8.
3. Lozano R, Naghavi M, Foreman K, *et al.* (2012). “Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010”, *The Lancet* **380**(9859):2095-128.
4. Adepoju P (2020). “Tuberculosis and HIV responses threatened by COVID-19”. *The Lancet HIV* **7**(5): e319-e20.
5. Jewell BL, Mudimu E, Stover J, *et al.* (2020). “Potential effects of disruption to HIV programmes in sub-Saharan Africa caused by COVID-19: results from multiple mathematical models”, *The Lancet HIV* **7**(9):e629-e40.
6. Cooper T, Woodward B, Alom S, and Harky A (2020). “Coronavirus disease 2019 (COVID-19) outcomes in HIV/AIDS patients: a systematic review”, *HIV medicine* **21**(9): 567-77.
7. World Health Organization (2020). “COVID-19 cases top 10,000 in Africa”.
8. European Center for Disease Prevention and Control (2020). “Geographic Distribution COVID-19 Cases Worldwide”.
9. World Health Organization (2020). “COVID-19 status report, 31 October 2020”.
10. AVERT. HIV and AIDS in East and Southern Africa Regional overview, 2019.
11. Mirzaei H, McFarland W, Karamouzian M, and Sharifi H (2020). “COVID-19 among people living with HIV: A systematic review”, *AIDS and Behavior* 1-8.
12. Brown LB, Spinelli MA, and Gandhi M (2021). “The interplay between HIV and COVID-19: Summary of the data and responses to date”, *Current Opinion in HIV and AIDS* **16**(1): 63-73.

About the author

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Chapter Nineteen

Fighting the next pandemic: A phytochemical approach from African *flora* - An overview

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Abstract - Management of any pandemic requires a multidimensional approach with a hand from all players. At every break of a pandemic, there is always no immediate treatment and efforts are often devoted to social distancing, isolation/quarantine, diagnosis, and care with prospects to treat but with no clear medication. The approach has always been to permit the body to fight off the pandemic by boosting its immune system through selective diet and or food supplements as external immune boosters in addition to arresting symptoms. With the exception of COVID-19, the burden of HIV epidemic and seasonal flu pandemics, infectious disease outbreaks have mostly devastated developing societies. The use of herbal remedies to cure several kinds of human diseases has a long history in Africa. Various plant parts are used to prevent, dispel symptoms or regress deformities to normal. A portion of the pharmaceutical products currently being prescribed by physicians including opium, aspirin, digitalis, paclitaxel, docetaxel, vinblastine, vincristine, quinine, and artemisinin have a historic use as herbal remedies. African medicinal plants are rich in such natural bioactive metabolites with therapeutic values against several diseases including deadly fevers. The therapeutic properties of these metabolites are a factor of the type and amount of alkaloids, phenolics, flavonoids, quinones, saponins, and terpenes contained. Human ingestion of these bioactive trigger pharmacological effects like antiviral, anti-inflammatory, analgesic, antidiabetic, antimicrobial, anti-parasitic, and antioxidant effects, thereby arresting the causal or symptomatic effects manifested in the pandemics. Ethno-medical and phytochemical studies on the African medicinal plants have led to the isolation of promising antiviral, anti-inflammatory, anti-parasitic, analgesic, and antimicrobial metabolites. Our discussion in this chapter is premised on challenging Africans Scientists (ethnobotanists, phytochemists, microbiologists, and pharmacologists) to collaboratively intensify the search

for phytochemicals as drug leads and explore options for developing these leads into functional medicines for the various diseases/pandemics devastating the continent.

Key words: *Pandemic; herbal remedies, phytochemicals; drugs.*

Abbreviations

AIDS:	Acquired Immune Deficiency Syndrome
CDCL	(U.S.) Centers for Disease Control & Prevention
COV:	Coronavirus
COVID-19:	Coronavirus disease-2019
DALY:	Disability-Adjusted Life Years
HIV:	Human Immunodeficiency Virus
MERS:	Middle East Respiratory Syndrome
NCD:	Non-Communicable Diseases
nCOV:	novel Coronavirus
SARS:	Severe Acute Respiratory Syndrome

1. Introduction

Diseases from infections are a menace to human health taking a center cause of death, infirmity as well as messing up the social-economic wellbeing. Poor economies are hit most, given their vulnerable health care systems and human behavior. Poverty, traditions, and copied cultural practices contribute to the spread of these infections (Szymanski, Schnaar, and Aebi, 2017).

Viral and bacterial pathogens are the major contributors to the most devastating infections that cause new and strange diseases which can be hard to cure or whose treatment may take long to find. The list of such illnesses is becoming long every day to include cancer, HIV, and the deadly fevers of Ebola, influenza, Spanish flue (Lin, Hsu, and Lin 2014), MERS CoV, SARS CoV and SARS CoV-2 (Wang, Li, and Liu 2020) infections. Emergence of these infections has put into check the global health preparedness to contain their damage as is the case for the COVID-19 pandemic. Outbreaks of this kind are and will continue to be perilous to global health. They are not easy to vaccinate nor treat before understanding the nature, life cycle, and survival mechanism of the underlying pathogen. Despite the numerous interventions and clinical trials, there are no approved therapeutics for 2019 nCoV as of now (Lythgoe and Middleton, 2020) taking the trend of HIV. It is the first among the epidemics to bring both the world health and economy to their knees (Tu *et al.*, 2020). The three contagious coronaviruses in humans have their origin in Asia; the viral SARS CoV 2002-2003 Guangdong province, southern China, the microbial MERS CoV 2012, Saudi Arabia, and now the viral 2019 nCoV in Hubei province, Wuhan City, China (Chakraborty *et al.*, 2020). The latter has been the most lethal spreading to thirty-one provinces with over 2,000 victims and 10% mortality within the first month of the outbreak (Chakraborty *et al.*, 2020). Nothing detoured its gained momentum for intercontinental

spread and capacity to tear through the advanced health care systems of the super economies. Given the free population mix and explosion, growing interstate travels, trade, urbanisation, and armed conflicts (Huremović *et al.*, 2019), the emerging epidemics will continue to spread rapidly (Lin, Hsu, and Lin 2014). Africa seems to take a neutral role in the fight against infections, Could this be due to being unconscious of the challenges posed by these epidemics or lack of technical capacity and resources? Africa's burden of disease is high with communicable diseases at the center lead, yet, the threat from non-communicable diseases is real (Kuate and Efferth 2015). To Africa, every disease is almost an epidemic due to the high level of unconsciousness, unpreparedness, and limited capacity to prevent, contain or eliminate any of the diseases before escalation. We make a loud alarm to developed economies and do nothing ourselves to the numerous challenges in our house. Resource commitment to health care is held as a luxury in the opinion of African leaders. The African scientists, on the other hand, only take surveillance and prevalence studies of our problems, just to accumulate quantitative evidence and data for the developed countries to base on in working out a solution to an African problem. This scientific, unsigned allegiance cannot liberate Africa from the entanglement of disease and poverty. There seems to be a forgotten history or lost confidence in the African path to civilization, given the sound historical Egyptian civilization in terms of political organization, architecture, spiritualism, and health system. It is believed that tropical diseases mainly protozoa and helminth metazoans that hit African at the prime time of civilization impaired the continent's development (Spinage, 2012). Patterson argues that "*European penetration to the interior of Africa may have been aided by the inadvertent introduction of new diseases or the facilitation of the spread of indigenous ones*" (Patterson 1974).

Our main recommendation is that we need to act now using a multisector collaborative approach if we are to tamper the epidemic of non-communicable diseases (NCDs) in Africa (Justine *et al.*, 2018).

2. Infectious diseases in Africa

Infectious diseases are the second leading cause of death and of disability-adjusted life years (DALY) worldwide. Among the deadly infectious diseases, acute lower respiratory tract infections, HIV/AIDS, diarrheal diseases, tuberculosis, and malaria predominate (Fauci, 2001). The fears for deadly infectious diseases with a potential spread worldwide (as for nCoV-19) has increased. Yet, still, resurgence of enduring infectious diseases (like tuberculosis, AIDS) remains a threat amidst other diseases (Tognotti, 2013). The global burden of infectious diseases depends on established incidences and prevalence of known infections but also on the uneven flow of emerging (new like AIDS) and reemerging (old like influenza A, Ebola, malaria, yellow fever) infections (Fauci, 2001). Africa has suffered many different diseases in the past, but the ones of today seem strange and have caused more suffering. The environment, settlement, and food pattern having changed might have resulted into these diseases. Unfortunately, the disease management techniques did not change in an equal measure. Laino retorts that the new, emerging, and re-emerging old infectious disease outbreaks affect Africa most and it looks like

the continent is a breeder of emergent pathogens. Many of the more than 30 new infectious diseases since the mid-1970s, are said to have their origin in Africa (Laino, 2003).

Opportunistic infections can arise from the immune suppression by a disease, but also erratic outbreaks are more devastating in populations with no acquired or cross immunity that comes with repeated exposure to infections (Spinage, 2012). For example, the African children under five who survive the battle against *Plasmodium falciparum* parasites seemingly acquire an immunity for further attacks. This, however, is effective against only the same *P. falciparum* strain known to them since childhood. On re-infection only very mild symptoms will manifest as chills and/or slight fever with no clinical symptoms for malaria (Curtin, 1961). For yellow fever, the victim will either die in about 7 days or recover with a gained effective immunity against any further attack, which prevents the ex-victim from being a parasite host (Curtin, 1961).

Fauci (2001) reports that cholera, Lassa fever, Ebola hemorrhagic fever, Marburg, plague, human monkey pox, yellow fever, Hepatitis C, HIV, Rift valley fever, multidrug-resistant tuberculosis, and drug-resistant malaria either emerged or reemerged from Africa. Every emerging infection has the capacity to claim many lives. For example, 20 million people died worldwide from the influenza A epidemic in 1918, more than 30 million cumulated deaths due to AIDS (Fauci, 2001), and approximately 4 million deaths due to COVID-19 by May 2021 have occurred. However, reemerging infections can ambush and take more lives as was the case with influenza A that took 200,000 more lives in 1957 in the United States than the 500,000 lives lost in 1918 (Fauci, 2001). A scenario to be most feared is the periodically reemerging Ebola hemorrhagic fever in Africa, as evidenced by the 11,310 deaths reported in Guinea, Liberia, and Sierra Leone during the 2014-16 epidemic (CDC, 2020).

In this 21st century, emergence of resistant strains of pneumococci, enterococci, staphylococci, *P. falciparum*, and *Mycobacterium tuberculosis* has been reported, including viral resistance to antiretroviral drugs used in the management of HIV (Fauci, 2001) and cancer. The resistance is likely from human weakness of drug abuse, self-medication, incomplete dosage, and pathogenic mutation in addition to threats of genetically-modified resistant microbes for bioterrorism (Tognotti, 2013) in this century. This may require an advance stock of vaccines based on sequenced resistant genomes of microbes or computationally modeled.

The epidemics that have had geographically restricted spread like Ebola, cholera, multidrug resistant malaria, West Nile fever etc. cause medical curiosities and a burden to the societies affected, but are never regarded to be a global public health threat (Fauci, 2001). Such epidemics take long to attract global intervention and end up devastating economies, especially those of developing countries. This is a call to developing countries to step up their preparedness in terms of resources and technical staff to counteract the devastation before it occurs. We need “African solutions to African challenges by African scientists” was an overtone during the SASA 2021 international virtual Health Conference, Accra, Ghana.

Historically, quarantine has been used as a public health measure to contain the blowout of such communicable diseases. This strategy worked well against historical outbreaks like the Black Death (1347 and 1351), the 1347–1352 plague epidemic, cholera (1865–1866), the 1918 influenza pandemic, leprosy, the 2009 influenza A(H1N1) (Tognotti, 2013) and has been credited in the fight against the current health terror of COVID-19. Quarantine is a means of separating suspected animals, persons, and goods that may have been exposed to a contagious disease. This practice, though common with sick animals, is quite stigmatizing in humans and requires intense campaign not to be received with prejudice. This good strategy is liable to political abuse (especially in Africa). It also looks unethical, economically frustrating, and socially dehumanizing as people meet and treat each other with suspicion. It ushers in untimely redundancy and despair, occasioning criminality. A striking balance, therefore, between public health and persons wellbeing should always be spelt out on the inception of this commonly enforced strategy.

The emergence of 2019 nCoV (2019 novel coronavirus) has stressed the need for therapeutic alternatives to alleviate and stop this new epidemic (Martinez, 2020) as we prepare for the next pandemic. The success of any therapeutic intervention requires identification of the antiviral mechanisms of the agents, proposing likely points of interaction with the viral life cycle (either viral entry, replication, assembly, or release) together with an understanding of the virus–host-specific interactions (Martinez, 2020). As alternative means, herbal medicines and purified natural products having a functional resemblance to the molecules in our bodies, provide a rich resource for novel antiviral drugs or their leads. In this respect, several extracts and pure compounds have been screened against different viruses.

3. African herbal medicine in history

The generational use of herbal medicine globally is anchored in their efficacy (Tugume *et al.*, 2016) that governs their acceptability and application (Elujoba, Odeleye, and Ogunyemi 2005) as alternative health remedies. In Africa, mainly for the rural poor, herbal medicine is not their choice but what is available which works, looks safe, and is probably affordable (Elujoba, Odeleye, and Ogunyemi, 2005). It is striking to learn that even in America where the choice is modern medicine, over one third of the population uses herbs for health needs with an annual expenditure of more than 3 billion U.S. dollars (O'Hara *et al.*, 1998).

The survival and resistance of Africans to some infections interested European explorers to study the flora of the new places, their foods, and more so the plant medicines used. The use of medicinal plants in the management of disease has a long history. However, by then, water soluble extracts of leaves, stem bark, root bark or even whole plant (Oteng *et al.*, 2019) were being used as concoctions, decoctions, infusions, ointments, macerates, or their powder on tea or sauce (Elujoba, Odeleye, and Ogunyemi, 2005).

The advantage of this approach exploited the synergistic effect of the numerous metabolites in the plant to offer the health benefits (Mahomoodally, 2013). However, the proponents of modern medicine to-date refute the efficacy of natural remedies on the basis of lack of validity, despite the many ethno-medical evaluation reports being published. Yet still, many of the pharmaceuticals being dispensed today have a historic use as herbal remedies, including aspirin, quinine, opium, and digitalis. Modern medicine today emphasizes isolation of active compounds from their natural sources. It is reported that about 80% of the active ingredients in the modern drugs indicate a therapeutic value positively correlated to the traditional use of the natural herb (Oteng *et al.*, 2019).

History traces African healing formulation to about 3200 BC during the time of Menes, the first Pharaoh of Egypt. In his reign, Athothis, his son was recognized for his acquaintance of varied therapeutic preparations. However, in scientific perspective, the great Imhotep is honored as the first African physician during the time of Zosar pharaoh of the third dynasty, 2980 BC (Bates, 1994; Iwu, 2014). Imhotep is reported to have been a renown healer who, by 525 BC, had been idolized as the “god of medicine”. The other was Hesy-Re (2600 BC) who was the chief dentist and physician in the same dynasty (Bates, 1994; Iwu, 2014).

It is ironical for African medicinal plants to receive little recognition by the modern herbal or phytopharmaceutical producers, yet they consist of herbs and health foods with documented health benefits. In the modern pharmacopoeias, there are only a few of such potent herbs like *Physostigma venenosum* (calabar bean), *Strophanthus*, areca nuts, kino, *Salix*, kola, *Catharanthus roseus* (African periwinkle) and *Harpagophytum procumbens* (devil’s claw). It is irrefutable that there are African varieties in the many certified drugs (Iwu, 2014).

It is worth noting that, the African *Rauvolfia vomitoria*, is richer in reserpine (the antihypertensive alkaloid) and in ajmaline (the antiarrhythmic drug) than the other praised species of *Rauvolfia* from elsewhere. Also the willow plant, *Salix capensis*, has been used for ages in southeastern Africa as a painkiller and antipyretic; it contains esters of salicylic acid whose acetylated form is aspirin - the universal analgesic drug (Iwu, 2014).

Despite the research efforts on the chemical constituents and biological evaluation of African medicinal plants, development of these into therapeutic agents is little or has been neglected. Studies on African medicinal plants and their documentation has not been fully embraced as in other traditional societies like the Indian and Chinese. The knowledge on African medicinal plants is becoming limited, fragmented, and deliberately distorted by the superiority syndrome of western civilization (Iwu, 2014). Despite all of this, some attempts to document African herbal plants and their therapeutic values has been done as in Table 1.

Table 1- Ethnobotanical uses of representative plants from the African flora

Plant species (Common name)	Part used	Condition managed	Region	Reference(s)
<i>Acacia senegal</i> (L.) Willd. (Gum Arabic or gum acacia)	Various parts	Bleeding, bronchitis, diarrhea, gonorrhea, leprosy, typhoid fever, and upper respiratory tract infections.	Semi-desert and drier regions of sub-Saharan Africa	(Mahomoodally, 2013)
<i>Aloe ferox</i> Mill. <i>Xanthorrhoeaceae</i> (Bitter Aloe or Cape Aloe)	Leaves	Bitter tonic, antioxidant, anti-inflammatory, analgesic, antiseptic, germicidal, antiviral, antiparasitic, antimicrobial, antitumor, and anticancer	South Africa and Lesotho	(Mahomoodally, 2013)
<i>Artemisia herba-alba</i> Asso (Med)- <i>Asteraceae</i> - <i>Wormwood</i> . (wormwood or desert wormwood)	Roots and aerial parts	Arterial hypertension and diabetes, diabetes, bronchitis, diarrhea, hypertension, and neuralgias, analgesic, antibacterial, antispasmodic, and hemostatic agents	Northern Africa	(Mahomoodally, 2013)
<i>Aspalathus linearis</i> (Brum.f) R. <i>Dahlg. (Fabaceae)</i> <i>Rooibos</i>		Herbal tea. chronic restlessness, vomiting, and stomach cramps, bronchodilator, antispasmodic, and blood pressure lowering effects, antispasmodic, antimutagenic	South Africa and throughout Africa	(Mahomoodally, 2013)
<i>Centella asiatica</i> (L.) Urb. (<i>Apiaceae</i>)- <i>Centella</i> . <i>Centella asiatica</i>	Leaves	Wound healing, burns, ulcers, leprosy, tuberculosis, lupus, skin diseases, eye diseases, fever, inflammation, asthma, hypertension, rheumatism, syphilis, epilepsy, diarrhea, and mental illness	Madagascar and South Africa	(Mahomoodally, 2013)

Plant species (Common name)	Part used	Condition managed	Region	Reference(s)
<i>Catharanthus roseus</i> (L.) G. Don (<i>Apocynaceae</i>) (Madagascar periwinkle)	Leaves	Bitter tonic, galactagogue, and emetic. rheumatism, skin disorders, and venereal diseases, antimutagenic	Madagascar and other tropics	(Mahomoodally, 2013)
<i>Cyclopia genistoides</i> (L.) Vent. (<i>Fabaceae</i>) Honeybush	Leafy shoots and flowers, fruit pulp, seeds, leaves, and whole plant	Restorative, expectorant in chronic catarrh and pulmonary tuberculosis, increases appetite, aids digestion, alleviates heartburn and nausea	South Africa	(Mahomoodally, 2013)
<i>Momordica charantia</i> Linn. (<i>Cucurbitaceae</i>) (Bitter Melon)		Remedy for diabetes, hypoglycemic agent	Tropical Africa	(Mahomoodally, 2013)
<i>C. sanguinolenta</i> (Lindl.) Schlechter (‘Ghana quinine’)	Roots, stem and leaves	Malaria, upper respiratory and urinary tract infections, diarrhea, hypertension and as wound scarring	West Africa	(Oteng <i>et al.</i> , 2019)
<i>Terminalia ivorensis</i> A. Chev (‘black afara’ or ‘amire’)	Various parts	Malaria, yellow fever, pile, stomach ulcer, wounds and other infections	West Africa	(Oteng <i>et al.</i> , 2019)
<i>Elaeis guineensis</i> Jacq (oil palm)	Leaves and other parts	Gonorrhoea, rheumatism, headache, wounds and malaria	West Africa	(Oteng <i>et al.</i> , 2019)

Plant species (Common name)	Part used	Condition managed	Region	Reference(s)
<i>Phyllanthus emblica</i> L. (Indian gooseberry)	Various parts	Diarrhea, inflammation, diabetes, jaundice, cough, asthma, peptic ulcer, skin diseases, leprosy, intermittent fevers, headache, anemia, dizziness, snakebite and scorpion-sting	Tropics	(Oteng <i>et al.</i> , 2019)
<i>Syzygium aromaticum</i> L. (clove)	Various parts	Anthelmintic, anti-asthma and other allergic disorders, anti-inflammatory, antioxidant, antiviral, anti-parasitic properties and antimalarial skin diseases like eczema, psoriasis, and antiplasmodial		(Oteng <i>et al.</i> , 2019)
<i>Azadirachta indica</i> A. Juss (neem tree)	Different parts		Tropic and semitropical regions Sierra Leone, Cameroon, Sudan, Ethiopia, Uganda, Kenya, Angola, Zambia and Mozambique	(Oteng <i>et al.</i> , 2019)
<i>Harrisonia abyssinica</i> Oliv.	Stem bark	Antimalarial		
<i>Zanthoxylum zanthoxyloides</i>	Roots	Sickle cell anemia, tooth ache, and oral hygiene		(Elujoba, Odeleye, and Ogunyemi, 2005)

Plant species (Common name)	Part used	Condition managed	Region	Reference(s)
<i>Ancistrocladus abbreviatus</i>	Not specified	Anti-HIV	Ghana, Cameroon	(Elujoba, Odeleye, and Ogunyemi, 2005)
<i>Corynanthe pachycerus</i>	Not specified	Male stimulant	Ghana	(Elujoba, Odeleye, and Ogunyemi, 2005)
<i>Vernonia amygdalina</i>	Leaves, roots	Malaria, Convulsions, stomachache	Uganda	(Tugume <i>et al.</i> , 2016)
<i>Warbugia ugandensis</i>	Bark	Cough, flue	Uganda	(Tugume <i>et al.</i> , 2016)
<i>Prunus africana</i>	Leaves, bark	Leaves, Bark Fainting, prostate cancer	Uganda	(Tugume <i>et al.</i> , 2016)
<i>Piptadeniastrum africana</i>	Leaves, Bark	Cough	Uganda	(Tugume <i>et al.</i> , 2016)
<i>Erythrina abyssinica</i>	Bark	Yellow fever, convulsions, anaemia, infertility hiccup, stop vomiting	Uganda	(Tugume <i>et al.</i> , 2016)
<i>Albizia coriaria</i>	Bark	Cough, swollen rectum, skin rash	Uganda	(Tugume <i>et al.</i> , 2016)
<i>Spathodea campanulata</i>	Leaves, Bark, roots	Pregnancy care, infertility, skin infections, hernia	Uganda	(Tugume <i>et al.</i> , 2016)
<i>Mondia whitei</i>	Roots	Stimulate sexual potency, energy booster	Uganda	(Tugume <i>et al.</i> , 2016)

Plant species (Common name)	Part used	Condition managed	Region	Reference(s)
<i>Alstonia boonei</i>	Bark	Malaria	Uganda	(Tugume <i>et al.</i> , 2016)
<i>Capsicum frutescens</i> L.	Fruit, roots	Hernia, Pancreas, Prostate cancer, Erectile dysfunction	Uganda	(Tugume <i>et al.</i> , 2016)
<i>Flemingia grahamiana</i>	Roots	Diarrhea and dysentery	Zimbabwe and Malawi	(Jansen, 2005)
<i>Millettia dura</i> Dunn	Root, leaves, seed	Hernia, diarrheas, painful menstruation, vulnerably	Kenya, Tanzania, Congo/DRC	(Banzouzi <i>et al.</i> , 2008)
<i>Millettia eetveldeana</i> Hauman	Bark, root sap, leaves	Stiff neck, epilepsy, laxative, feverish aches, and general tiredness	Congo/DRC	(Banzouzi <i>et al.</i> , 2008)
<i>Millettia lasiantha</i> Dunn	Roots	Aphrodisiac	Kenya	(Banzouzi <i>et al.</i> , 2008)
<i>Millettia usaramensis</i> Taubert	Roots, root pulp	Fish poison, convulsion, aphrodisiac, snake bite	Kenya, Tanzania	(Banzouzi <i>et al.</i> , 2008)
<i>Abroma augusta</i> L.	Not stated	Cold, cough, diarrhea, fever, menstrual problems, neck pain	New Guinea, Uganda, DRC	(Motaleb, 2011)
<i>Asparagus racemosus</i> Wild		Constipation, jaundice, stomach pain, increase mother's milk	Africa	(Motaleb, 2011)

Plant species (Common name)	Part used	Condition managed	Region	Reference(s)
<i>Boerhavia diffusa</i> L.	Roots, leaves	Jaundice, anemia, ascites, ophthalmia, gonorrhoea, abdominal tumor, cancer, blood purifier, anti- inflammatory, epilepsy, dysentery	Sudan, S. Africa, Nigeria	(Motaleb, 2011)

Table 1 is just a snap shot of the many beneficial plants from the African flora. Many of these plants have metabolites of proven therapeutic values like *Physostigma venenosum* (calabar bean), *Strophanthus*, areca nuts, kino, *Salix*, kola, *Catharanthus roseus* (African periwinkle), *Harpagophytum procumbens* (devil's claw), *Rauvolfia vomitoria*, willow plant, and *Salix capensis* (Iwu 2014).

The emergence of 2019 nCoV (2019 novel coronavirus) has stressed the need for therapeutic alternatives to alleviate and stop this new pandemic (Martinez, 2020) as we prepare for the next pandemic. In this respect, several extracts and pure compounds have been screened against different viruses, as highlighted in the subsequent sections. The success of any therapeutic intervention requires identification of the antiviral mechanisms of the agents, proposing likely points of interaction with the viral life cycle (either viral entry, replication, assembly, or release) together with an understanding of the virus–host-specific interactions (Lin, Hsu, and Lin, 2014). As alternative means, herbal medicines and purified natural products having a functional resemblance to the molecules in our bodies, provide a rich resource for novel antiviral drugs or their leads. Several extracts and pure compounds have been screened against different viruses.

The protein purified from the ripe seeds of *Momordica charantia* contained effectively anti-HIV-1 activity in addition to effectively inhibiting H1N1 influenza virus. It actually possesses a broad antiviral activity against various types of viruses (Pongthanapisith *et al.*, 2013).

The known antimalarial herb, *Artemisia annua* shows potency against both SARS CoV and HIV-1, while *Artemisia afra* shows activity only against HIV-1, the aqueous and ethanolic extracts of *Ocimum basilicum* against Enterovirus 71, Curcumin against both Hepatitis B and C virus, while extracts of *Zanthoxylum chalybeum* and *Warburgia ugandensis* against Measles virus (Lin, Hsu, and Lin 2014). Aqueous extracts of lemon balm, peppermint, prunella, rosemary, sage, and thyme all showed strong antiviral activity *in vitro* against herpes simplex virus type 1 and 2 (HSV-1 and HSV-2) (Nolkemper *et al.*, 2006).

Bitter melon also has been documented with *in vitro* antiviral activity against numerous viruses including Epstein-Barr, herpes, and HIV viruses. In an *in vivo* study, a leaf extract demonstrated

the ability to increase resistance to viral infections as well as to provide an immunostimulant effect in humans and animals (Kumar and Bhowmik, 2010).

Methanol extracts of *Terminalia belerica* Roxb, *Swietenia mahagoni* L., *Woodfordia floribunda* Salisb. and *Garcinia mangostana* L. contain potential anti-HIV-1 protease inhibitors with IC50 values of 50, 40, 40, 50 µg/mL, respectively (Nugraha and Keller, 2011). Beside these, stem and leaf of bitter melon is used in cancer treatment, in vital infections (HIV, herpes, Epstein Barr, hepatitis, influenza, and measles) (Prarthna, Supe, and Roymon, 2014).

Apigenin against Coxsackievirus, Quercetin against Dengue virus (DENV-2), aqueous and ethanolic extracts of *Ocimum basilicum* gave linalool, apigenin, and ursolic acid, and gallic acid against Enterovirus 71, Amide alkaloid from *Piper longum* against Hepatitis B virus, Biflavonoids from *Rhus succedanea* and *Garcinia multiflora*, as well as their methyl ethers and acetates (Lin, Hsu, and Lin, 2014).

Species from the family *lamiaceae* reported to contain cinnamic acid derivatives like caffeic acid, chlorogenic acid, p-coumaric acid, ferulic acid, and rosmarinic acid showed strong antiviral activity *in vitro* against herpes simplex virus type 1 and 2 (HSV-1 and HSV-2) (Nolkemper *et al.*, 2006).

Gallic acid and quercetine show a strong antiviral activity. Mangiferin is an antioxidant at different levels of oxidation sequence (Scartezzini and Speroni, 2000).

Alpha and beta momarcharin are two proteins found in bitter melon, which are known to inhibit the AIDS virus (Prarthna, Supe, and Roymon, 2014).

4. Results from some phytochemical studies

Basing on ethnobotanical reports, we developed interest to search for lead molecules that can act as temperate in the development of drugs to fight infectious diseases in Africa. Using different chromatographic techniques, a number of plants have been studied obtaining phytochemicals with varied structures. The varied structural diversity gives hope for diverse pharmacological activities as discussed below.

4.1 *Millettia dura*

The phytochemical study on the flowers of *M. dura* gave nine metabolites consisting of one flavonol, one chalcone and seven prenylated isoflavones were isolated and characterized. These included calopogoniumisoflavone-A, jamaicin, durmillone, dullarone, kaempferol, 4,2-dihydroxy-4-methoxychalcone, ichthyone, formononetin and 6- methoxycalopogoniumisoflavone-A (Buyinza *et al.*, 2019).

Three rotenoids millettone, milletosin and tephrosin were isolated and characterized from the seed pod of *M. dura* in addition to four isoflavones of calopogoniumisoflavone A, jamaicin, durallone and 6-methoxycalopogonium isoflavone-A. Meanwhile, thirteen secondary metabolites were isolated and characterized from the stem bark. These included isoerythrin-A-4'-(3-methylbut-2-enyl) ether, maximaisoflavone J, ferrugone, barbigerone, maximaisoflavone D, maximaisoflavone G and (\pm) deguelin in addition to the already isolated calopogoniumisoflavone A, jamaicine, durmillone, durallone, 6-methoxycalopogoniumisoflavone A, and tephrosin (Buyinza *et al.*, 2020).

4.1.1 Toxicity Studies

Tephrosin and durmillone had a promising selective cytotoxicity against A549 adenocarcinomic human alveolar basal epithelial cancer cell line, with respective IC_{50} values of 3.1 ± 1.2 and $6.6 \pm 1.2 \mu M$. Jamaicin showed toxicity to the cancer cell lines A549 (IC_{50} $11.4 \pm 5.0 \mu M$) and HePG2 ($44.3 \pm 3.2 \mu M$) without significant toxicity against the normal cells BEAS-2B and CCD19Lu ($IC_{50} > 100 \mu M$) but was cytotoxic to LO2 (IC_{50} $68.7 \pm 10.6 \mu M$). Jamaicin showed modest activity for the cancerous cells DLD-1WT ($IC_{50} = 20.9 \pm 0.9 \mu M$), while isoamacin showed toxicity of $IC_{50} = 14.5 \pm 3.4 \mu M$ against DLD-1WT and $IC_{50} = 13.5 \pm 0.6 \mu M$ against DLD. Kaempferol, was cytotoxic to the normal cell line BEAS-2B having an IC_{50} value of $57.1 \pm 6.4 \mu M$ (Buyinza *et al.*, 2019).

4.2 *Millettia leucantha*

Four flavonoids were isolated and characterized from the leaves of *Millettia leucantha* that is; chrysin, apigenin, chrysin 7-O- β -D-glucoside and genkwanin. While six compounds were isolated from the roots including 6, 7, 4'-trimethoxyflavone, taxasin, 6, 7, 4'-trimethoxyisoflavone, parabens acid and maackiain.

4.3 *Millettia lasiantha*

Leaves, stem, and roots of *M. lasiantha* were studied. From the leaves, four compounds were isolated, which were chrysin, apigenin, chrysin-7-O- β -glucoside, and Luteolin. The stem bark gave four compounds comprising three known isoflavones formononetin, 6, 7, 4'-trimethoxyisoflavone, Genistein, and a chalcone, isoliquiritigenin. The four compounds formononetin, genistin, genistein-7-O-glucoside, and the isomeric lascoumestan lascoumaronochromone were isolated from the roots (Buyinza *et al.*, 2021).

4.4 *Millettia usaramensis*

From the root bark of *M. usaramensis* ssp. *Usaramensis*, seventeen compounds were isolated and characterized as; 4-O-geranylisoliquiritigenin, 12-dihydrousarotenoid B, 12-dihydrousarotenoid C, 4'-O-geranyl-7-hydroxyflavanone (4), and

4'- O-geranyl-7-hydroxydihydroflavanol, usararotenoid A, 12-dihydrousararotenoid A, millettosin, 12a-epimillettosin, usararotenoid C, jamaicin, 4'-O-geranylisoliquiritigenin, 7-O-geranyl-5-hydroxyflavanone, tephrosin, maximaisoflavone H, colenemol, and 7-hydroxy-8,3',4'-trimethoxyisoflavone.

Some of these compounds showed moderate to low cytotoxic activities of IC₅₀ 25.7–207.2 μM. While 4-O-geranylisoliquiritigenin exhibited respective antiplasmodial activity, IC₅₀ values of 3.7 and 5.3 μM against 3D7 and Dd2 *Plasmodium falciparum* strains and was also cytotoxic to the HEK293 cell line (Deyou *et al.*, 2015).

4.5 *Platyclaphium voe`nse*

From *Platyclaphium voe`nse* (stem bark), eleven compounds were isolated and characterized as platyisoflavanone A-D, sophoraisoflavanone A, glyasperin F, formononetin, kumatakenin, isokaempferide, triterpenes, betulin and β-amyrin. Platyisoflavanone A showed antibacterial activity against *Mycobacterium tuberculosis* with MIC = 23.7 mM, and also showed cytotoxicity (IC₅₀ = 21.1 mM) in the vero cell test (Gumula *et al.* 2012).

4.6 *Flemingia grahamiana*

Flemingins A–C, chalcones; flemingins G–O, deoxyhomoflemingin and emodin were isolated from extract of *Flemingia grahamiana* (leaves). The chalcones flemingins A, B, C, G, and H were active in the DPPH radical scavenging assay (ED₅₀ 4.4–8.9 μM), while flemingins A and C showed respective cytotoxicity against MCF-7 human breast cancer cells of IC₅₀ 8.9 and 7.6 μM (Gumula *et al.*, 2014).

5. Conclusions

From our studies, plants produce phytochemicals of different classes (alkaloids, amides, benzonoids, chalcones, coumarins, coumestans, flavones, flavanones, isoflavones, isoflavanones, lignans, quinones, rotanoids, and steroids) having diverse structures which give them numerous biological and pharmacological values. If these compounds are robustly tested against a wide range of microbes, a number of keys (drugs) can be found that can fit and open (bind) different padlocks (substrates/ enzymes). By so doing, cures and vaccines will be found for the current diseases including 2019 nCoV and, in a way, be better prepared for the coming pandemics. The documented evidences on the pharmacological value of the African plants should not be shelved but rather adopted as working papers for the development of alternative and or modern medicine.

It is also worth noting that many plants from the African flora are not phytochemically evaluated or documented and yet the flora is being depleted and ethnobotanical knowledge is erasing very fast. This is attributable to population explosion necessitating new settlements, westernisation, which undermines indigenous knowledge, cultures, and practices, limited resource commitment

by African governments towards phytochemical and pharmacological studies, uncoordinated search for medical solutions either due to wrong training or ideological disorientation, etc. As noted by the Ugandan President during his inaugural address for his 6th term, “*Ugandan/African scientist lack the self-confidence vital for scientific interventions*”.

These challenges require a multisectoral approach to research engaging different players like ethnobotanists, phytochemists, microbiologists, pharmacologists, etc. to urgently speedup ethnopharmacological documentation, intensifying phytochemical research, and widening biological screening. There is a need for a movement towards community sensitization, establishing herbal plant reserves, and encouraging commercial cultivation of herbal plants in addition to intensifying collaboration, grants application, and deliberate government interventions. It will be ideal for African governments to institutionalize the use of traditional medicine parallel to modern drugs, which are not only expensive but also uncommon to populations far from urban centers.

References

- Banzouzi JT, Prost A, Rajemiarimiraho M, and Ongoka P (2008). “Traditional uses of African *Millettia* species (Fabaceae).” *International Journal of Botany* **4**(4):406–20.
- Bates P (1994). “Science education and equity.” *Equity Coalition for Race, Gender, and National Origin* **3**(2):1–42.
- Buyinza D, Mutiso Chalo D, Derese S, Ndakala A, and Yenesew A (2020). “Flavonoids and isoflavonoids of *Millettia Dura* and *Millettia Ferruginea*: Phytochemical review and chemotaxonomic Values.” *Biochemical Systematics and Ecology* **104**:104053, **91**:1–6. <https://doi.org/10.1016/j.bse.2020.104053>.
- Buyinza D, Derese S, Ndakala A, Heydenreich M, Yenesew A, Koch A, and Oriko R (2021). “A Coumestan and a Coumaronochromone from *Millettia Lasiantha*.” *Biochemical Systematics and Ecology* **97** (August): 104277. <https://doi.org/10.1016/j.bse.2021.104277>.
- Buyinza D, Yang LJ, Derese S, Ndakala A, Coghi P, Heydenreich M, Kam Wai Wong V, Möller HM, and Yenesew A (2019). “Cytotoxicity of Isoflavones from *Millettia Dura*”. *Natural Product Research*, September 1–4. <https://doi.org/10.1080/14786419.2019.1660335>.
- Centers for Disease Control and Prevention (2020). “2014-2016 Ebola outbreak in West Africa | History | Ebola (Ebola Virus Disease) | CDC.” March 17, 2020. <https://www.cdc.gov/vhf/ebola/history/2014-2016-outbreak/index.html>.
- Chakrabarty C, Sharma AR, Sharma G, Bhattacharya M, and Lee SS (2020). “SARS CoV-2 causing pneumonia-associated respiratory disorder (COVID-19): Diagnostic and proposed therapeutic options.” *European Review for Medical and Pharmacological Sciences* **24**:4016–26.
- Curtin PD (1961). “‘The White Man’s grave’: Image and reality, 1780-1850.” *Journal of British Studies* **1**(1): 94–110. <https://doi.org/10.1086/385437>.

- Deyou T, Gumula I, Pang F, Gruhonjic A, Mumo M, Holleran J, Duffy S, *et al.*, (2015). “Rotenoids, flavonoids, and chalcones from the toot bark of *Millettia Usaramensis*”. *Journal of Natural Products* **78**(12):2932–9. <https://doi.org/10.1021/acs.jnatprod.5b00581>.
- Elujoba AA, Odeleye OM, and Ogunyemi CM (2005). “Traditional medicine development for medical and dental primary health care delivery system in Africa”, *African Journal of Traditional and Complementary Medicine* **2**(1): 46–61.
- Fauci AS (2001). “Infectious diseases: Considerations for the 21st Century.” *Clinical Infectious Diseases* **32**(5):675–85. <https://doi.org/10.1086/319235>.
- Gumula I, Alao JP, Ndiege IO, Sunnerhagen P, Yenesew A, and Erdélyi M (2014). “Flemingins G–O, cytotoxic, and antioxidant constituents of the leaves of *Flemingia Grahamiana*.” *Journal of Natural Products* **77**(9):2060–7. <https://doi.org/10.1021/np500418n>.
- Gumula I, Matthias H, Derese S, Ndiege IO, and Yenesew A (2012). “Four isoflavanones from the stem bark of *Platyclaphium Voënsense*.” *Phytochemistry Letters* **5**(1):150–4. <https://doi.org/10.1016/j.phytol.2011.11.012>.
- Huremović D, Saeed A, Christy D, Saira H, Sameer K, Levin J, Linder H, and St. Victor G (2019). *Psychiatry of Pandemics: A Mental Health Response to Infection Outbreak*. Switzerland: Springer.
- Iwu M (2014). *Handbook of African Medicinal Plants*. 0 ed. CRC Press. <https://doi.org/10.1201/b16292>.
- Davies JI, Macnab JA, Byass P, Norris AS, Moffat N, Atul S, Sobngwi E, and S Daar Abdallah (2018). “Developmental Origins of Health and Disease in Africa—Influencing Early Life”. Vol 6 March 2018. South Africa: Stellenbosch Institute for Advanced Study. www.thelancet.com/lancetgh.
- Kuete V and Efferth T (2015). “African flora has the potential to fight multidrug resistance of cancer.” *BioMed Research International* 2015: 1–24. <https://doi.org/10.1155/2015/914813>.
- Kumar KPS and Bhowmik D (2010). “Traditional medicinal uses and therapeutic effects of *Momordica Charantia Linn*”. *International Journal of Pharmaceutical Sciences Review and Research* **4**(3):23–8.
- Laino C (2003). “Africa, the infectious continent.” *MSNBC.com*, October 29, 2003.
- Lin LT, Hsu WC, and Lin CC (2014). “Antiviral natural products and herbal medicines.” *Journal of Traditional and Complementary Medicine* **4** (1): 24–35. <https://doi.org/10.4103/2225-4110.124335>.
- Lythgoe MP and Middleton P (2020). “Ongoing clinical trials for the management of the COVID-19 pandemic.” *Trends in Pharmacological Sciences* **41** (6): 363–82. <https://doi.org/10.1016/j.tips.2020.03.006>.
- Mahomoodally MF (2013). “Traditional medicines in Africa: An appraisal of ten potent African medicinal Pplants.” *Evidence-Based Complementary and Alternative Medicine* 2013 (December): e617459. <https://doi.org/10.1155/2013/617459>.
- Martinez MA (2020). “Clinical trials of repurposed antivirals for SARS-CoV-2.” *Antimicrobial Agents and Chemotherapy* **64**(): e01101-20, /aac/64/9/AAC.01101-20.atom. <https://doi.org/10.1128/AAC.01101-20>.

- Motaleb MA (2011). *Selected Medicinal Plants of Chittagongo Hill Tracts*. Dhaka, Bangladesh: International Union of Conservation of Nature.
- Nolkemper S, Reichling J, Stintzing F, Carle R, and Schnitzler P (2006). “Antiviral effect of aqueous extracts from species of the *Lamiaceae* Family against *Herpes Simplex* Virus Type 1 and Type 2 *in Vitro*.” *Planta Medica* **72**(15):1378–82. <https://doi.org/10.1055/s-2006-951719>.
- Nugraha AS and Keller PA (2011). “Revealing indigenous Indonesian traditional medicine: Anti-infective agents.” *Natural Product Communications* **6**(12):1934578X1100601. <https://doi.org/10.1177/1934578X1100601240>.
- O’Hara AM, Kiefer D, Farrrell K, and Kemper K (1998). “A review of 12 commonly used medicinal herbs.” *ARC FAM/MED* **7**: 523–37.
- Oteng MS, Asafo-Agyei T, Archer MA, Atta-Adjei P Jr., Boamah D, Kumadoh D, Appiah A, Ocloo A, Boakye YD, and Agyare C (2019). “Medicinal plants for treatment of prevalent Diseases.” In *Pharmacognosy - Medicinal Plants*, edited by Shagufta Perveen and Areej Al-Taweel. IntechOpen. <https://doi.org/10.5772/intechopen.82049>.
- Patterson KB (1974). “Disease and medicine in African history: A bibliographical essay.” *History in Africa* **1**:141–8. <https://doi.org/10.2307/3171766>.
- Pongthanapisith V, Ikuta K, Puthavathana P, and Leelamanit W (2013). “Antiviral protein of *Momordica Charantia* L. inhibits different subtypes of Influenza A.” *Evidence-Based Complementary and Alternative Medicine* **2013**:1–6. <https://doi.org/10.1155/2013/729081>.
- Prarthna D, Supe U, and Roymon MG (2014). “A Review on phytochemical analysis of.” *International Journal of Advances in Pharmacy, Biology, and Chemistry* **3**(1):214–20.
- Scartezzini P and Speroni E (2000). “Review on some plants of Indian traditional medicine with antioxidant activity.” *Journal of Ethnopharmacology* **71**(1–2):23–43. [https://doi.org/10.1016/S0378-8741\(00\)00213-0](https://doi.org/10.1016/S0378-8741(00)00213-0).
- Spinage CA (2012). “Epidemic disease in African history I: Micro and macro parasites, zoonoses: Introduction, viral and protozoal diseases.” In *African Ecology: Benchmarks and Historical Perspectives*, edited by Clive Alfred Spinage, 191–228. Springer Geography. Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-22872-8_25.
- Szymanski CM, Schnaar, RL and Aebi M (2017). “Chapter 42: *Bacterial and Viral Infections*.” *ColdSpring Harbor Laboratory Press*, 2015–7. <https://doi.org/10.1101/glycobiology.3e.042>.
- Tognotti E (2013). “Lessons from the history of quarantine, from plague to Influenza A.” *Emerging Infectious Diseases* **19**(2):254–9. <https://doi.org/10.3201/eid1902.120312>.
- Tu YF, Chien CS, Yarmishyn AA, Lin YY, Luo YH, Lin YT, Lai WY *et al.*, (2020). “A review of SARS-CoV-2 and the ongoing clinical trials.” *International Journal of Molecular Sciences* **21** (7):2657. <https://doi.org/10.3390/ijms21072657>.
- Tugume P, Kakudidi EK, Buyinza M, Namaalwa J, Kamatenesi M, Mucunguzi P, and Kalema J (2016). “Ethnobotanical survey of medicinal plant species used by communities around Mabira Central Forest Reserve, Uganda.” *Journal of Ethnobiology and Ethnomedicine* **12**(1):5. <https://doi.org/10.1186/s13002-015-0077-4>.

Wang D, Zigang L, and Liu Y (2020). “An overview of the safety, clinical application and antiviral research of the COVID-19 therapeutics.” *Journal of Infection and Public Health* **13**(10):1405–14. <https://doi.org/10.1016/j.jiph.2020.07.004>.

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Chapter Twenty

Genetics, epigenetics, and ecogenetics: Perspectives of COVID-19

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Abstract - The COVID-19 pandemic has engulfed all continents, all four corners of the Earth, and all populations globally. The rapid and enduring spread of SARS CoV-2, which has affected millions of people with COVID-19 worldwide, highlights the imperative for a comprehensive understanding of its origins, structure, and biological characteristics. Accumulating evidence has revealed an interplay of genetic, epigenetic, and environmental factors that influence host response. Because of the profound economic, social, and personal/individual deleterious impacts of the COVID-19 pandemic, it is of utmost importance to understand the origins, structure, genetics, epigenetics, and ecogenetics of SARS CoV-2. Knowledge of the genetics and genome of SARS CoV-2 is key in understanding viral replication, viral transmission, host infection, mutational adaptability, and evolution. It helps in developing molecular-based diagnostic tests, targeted therapies, and vaccines. Knowing host biological factors (including genetics and epigenetics), and environmental factors that influence transmission, infection, and severity of disease could help in instituting effective treatment strategies and public health preventative measures, including vaccine scheduling.

It is known that genetic factors can influence the severity of infectious diseases caused by various pathogens including viruses. It is now well established that clinical presentation of COVID-19 varies from patient to patient and in different age groups. Even population to population variation in susceptibility has been observed. These observations suggest involvement of genetic factors in the etiopathogenesis of COVID-19 disease. Identified risk factors for disease severity include older age, male sex, asthma, experiencing lifelong systemic adversity, pre-existing co-morbidities such as cardiovascular disease, diabetes, and obesity. Additionally, epigenetic alterations have been shown to play a critical role in the etiopathogenesis and complications of coronavirus disease. Epigenetics refers to the study of stably heritable phenotype resulting from DNA methylation, histone modification, and RNA methylation which ultimately results in changes in chromatin conformational and activation states without altering the DNA nucleotide

sequence or genetic code. During normal physiologic and metabolic processes, epigenetic changes play a major role in genome stabilization and maintenance of cellular homeostasis. However, the epigenetic machinery can be repurposed by infectious agents to mediate disease processes including coronavirus disease. It has been demonstrated that SARS CoV-2, like other coronaviruses, antagonizes the immune system by employing a series of deleterious epigenetic mechanisms that lead to varying degrees of disease severity. Tracking and understanding the epigenetic changes in COVID-19 pathophysiology could lead to valuable knowledge crucial for developing novel COVID-19 treatments. Many therapeutic strategies under study and development rely on understanding the role of epigenetics in the etiopathogenesis of COVID-19. Finally, for most diseases including infectious diseases, the risk of developing clinical diseases is attributable to both genetic and environmental factors. In the absence of COVID-19 policy containment measures, environmental exposures including climate, diet, occupation, travel, stress, behaviour, and air and water pollution, can play a significant role in COVID-19 incidence and prevalence. The “waves” of COVID-19 disease between December 2019 to December 2021 suggest that ultimately seasonal patterns of undulating incidence and prevalence rates of SARS COV-2 infection and COVID-19 will emerge. Comprehensive information on environmental exposures year-round could be crucial in epidemiological modelling for forecasting future outbreaks and containment planning.

Keywords: *Host genetics, epigenetics, ecogenetics; mutation; pandemic; viral genome; variants; genetic lineage; zoonotic transmission; spike (S) protein; wildtype; Mojian mine; Wuhan city.*

Abbreviations

ACE:	Angiotensin-Converting Enzyme
AHR:	Aryl Hydrocarbon Receptor
CCHCR:	Coiled-Coil alpha-Helical Rod protein
CD:	Cluster of Differentiation
CDC:	(U.S.) Centers for Disease Control & Prevention
COVID:	Coronavirus Disease
CT:	Complex Transactivator
DAMP:	Damage-Associated Molecular Pattern
DC-SIGN:	Dendritic Cell-Specific Intercellular adhesion molecule-3-Grabbing Non-integrin
DNA:	Deoxyribonucleic Acid
DNMT:	DNA Methyltransferase
DPP:	Dipeptidyl Peptidase
FOX:	Forkhead box
HAT:	Histone Acetyl Transferase
HLA:	Human Leukocyte Antigen
ICAM:	Intercellular Adhesion Molecule
ICTV:	International Committee on Taxonomy of Viruses
MERS:	Middle East Respiratory Syndrome

MU:	Mucin
ncRNA:	non-coding RNA
NTD:	N-Terminal Domain
OAS:	Oligoadenylate Synthetases
ORF:	Open Reading Frames
PMSIS:	Pediatric Multi-System Inflammatory Syndrome
RBD:	Receptor-Binding Domain
RBM:	Receptor Binding Motif
RNA:	Ribonucleic Acid
SARS:	Severe Acute Respiratory Syndrome
SARSr:	SARS-related
SIG:	(U.S.) SARS CoV-2 Interagency Group
SLC:	Solute Carrier Family
SMDT:	Sequential Multi-Drug Therapy
TAP:	Transporter Antigen Peptide
TET:	Ten Eleven Translocation
TLR:	Toll-Like Receptor
TYK:	Tyrosine kinase
VBM:	Variants Being Monitored
VOI:	Variants of Interest
VOC:	Variants of Concern
VOHC:	Variants of High Concern
WHO:	World Health Organization
WIV:	Wuhan Institute of Virology
XCI:	X-Chromosome Inactivation

1. Introduction

Disease processes (or etiopathogenesis) are known to be influenced by biological and environmental factors. Almost all disease processes are influenced by one's biological make-up including age, sex, weight, nutritional status, and genetics. In addition, environmental factors including temperature, humidity, altitude, relief, and even latitude also play a significant role (Sironi *et al.*, 2020; Ficetola *et al.*, 2020). At an individual level, the anatomical structures and physiological processes affected determine the clinical presentation of the illness.

Disease processes can be caused by various factors including changes or mutations in genes, adverse prenatal environments, infectious agents, hormonal dysregulation, circulatory decompensation, physical trauma, blood disorders, and allergic, immunologic, and rheumatologic factors. The coronavirus disease of 2019 or COVID-19 is caused by the severe acute respiratory syndrome coronavirus-2 (SARS CoV-2). (Zhou *et al.*, 2020, Zhu N. *et al.*, 2020, WHO.) This name was adopted by the International Committee on Taxonomy of Viruses (ICTV) on February 11, 2020 (CSG of ICTV 2020). SARS CoV-2 is the seventh coronavirus known to infect humans

and the third coronavirus to cause severe disease and a pandemic in the twenty-first century (Atlante *et al.*, 2020). It is noteworthy that humans have had to contend with a coronavirus pandemic every decade since the dawn of the twenty-first century (CSG of ICTV 2020). Other viruses that have caused severe disease pandemics include severe acute respiratory syndrome coronavirus (SARS CoV) in the 2000s, and middle eastern respiratory syndrome corona virus (MERS CoV) in the 2010s. Four other corona viruses (HKU1, NL63, OC43 and 229E) caused mild disease (Corman *et al.*, 2018; Wang *et al.*, 2020). Wuhan city, China was the epicenter in December 2019, of the COVID-19 pandemic outbreak caused by the highly contagious coronavirus, SARS CoV-2, which is responsible for 251,352,340 cases and 5,072,046 deaths worldwide as of November 10, 2021 (Johns Hopkins Coronavirus Resource Center).

The COVID-19 pandemic has engulfed all continents, all four corners of the world, rich and poor countries, all socioeconomic classes, all races, all ethnic groups, all age groups, the powerful and the less powerful, rulers and the ruled. SARS CoV-2 practices extreme forms of equal opportunity, affirmative action, equality, inclusion, diversity of infection, and freedom to infect. It does not require a passport, visa, or air ticket to cross borders. COVID-19 perfectly demonstrates the multifactorial facets of disease etiopathogenesis. While SARS COV-2 has proven to be a resourceful equal opportunity agent, its virulence is often facilitated by certain biological, social, and environmental factors, ranging from genetic to ambient temperature. Its resourcefulness is demonstrated by its ever agile and constant vigilance in its mutational adaptability (Sironi *et al.*, 2020; Martinez, 2018; Ficetola and Rubolini, 2021). This poses challenges for controlling the pandemic it has wrought. Vaccines and pharmaceuticals designed to combat the pandemic could potentially be, and often are, rendered inefficacious due to rapid mutational changes of the core virulence factors of the virus.

The rapid spread of SARS CoV-2 and the millions of people affected with COVID-19 worldwide highlights the imperative for a comprehensive understanding of its structure and biological function. Accumulating evidence has revealed an interplay of genetic, epigenetic, and environmental factors that influence host response (Kgatle *et al.*, 2021). Because of the profound economic, social, and personal/individual deleterious impacts of the COVID-19 pandemic, it is of utmost importance to understand the origins, structure, genetics, epigenetics, and ecogenetics of SARS CoV-2. Knowledge of the genetics and genome of SARS CoV-2 is key in understanding viral replication, viral transmission, host infection, mutational adaptability, and evolution (Sironi *et al.*, 2020). It helps in developing molecular-based diagnostic tests, targeted therapies, and development of vaccines (Ovysyannikova *et al.*, 2020, Rahimi *et al.*, 2020). Knowing host biological factors (including genetics and epigenetics), and environmental factors that influence transmission, infection, and severity of disease could help in instituting effective treatment strategies and public health preventative measures including vaccine scheduling (Yildirin *et al.*, 2021).

2. Origins of SARS CoV-2

The persistently recurring global pandemic waves of SARS CoV-2 infection and COVID-19 disease poses serious threats to all aspects of human well-being (Shereenn *et al.*, 2020). Since the outbreak of the pandemic in Wuhan city, Hubei province in China in December 2019, a tremendous effort has been mounted to identify the intermediate host between SARS CoV-2 and SARS CoV-2-like coronaviruses in bat and possibly pangolin reservoirs (Latham and Wilson 2021; Banoun 2021, Sallard *et al.*, 2020). There is a 96% similarity between the bat coronavirus RaTG13 and SARS CoV-2, and both are closely related to the pangolin coronavirus, Pangolin-CoV, which is 91.02% and 90.55% identical to SARS CoV-2 and bat coronavirus, RaTG13, respectively, at the whole genome level (T. Zhang *et al.*, 2020). Further, SARS CoV-2 and RaTG13 represent some 40 - 50 years of divergence since the last shared bat progenitor coronavirus ancestor (Figure 1). Identifying the intermediate host of SARS CoV-2 could lead to elucidation of phylogeny and phylogeography, and to understanding the initial zoonotic process that led to virus spill-over to humans (Figure 1). Two arguments have been spiritedly advanced to explain the spill-over to humans of the bat progenitor of SARS CoV-2.

Figure 1 – Cumulative genetic divergence between SARS CoV-2 and RATG13

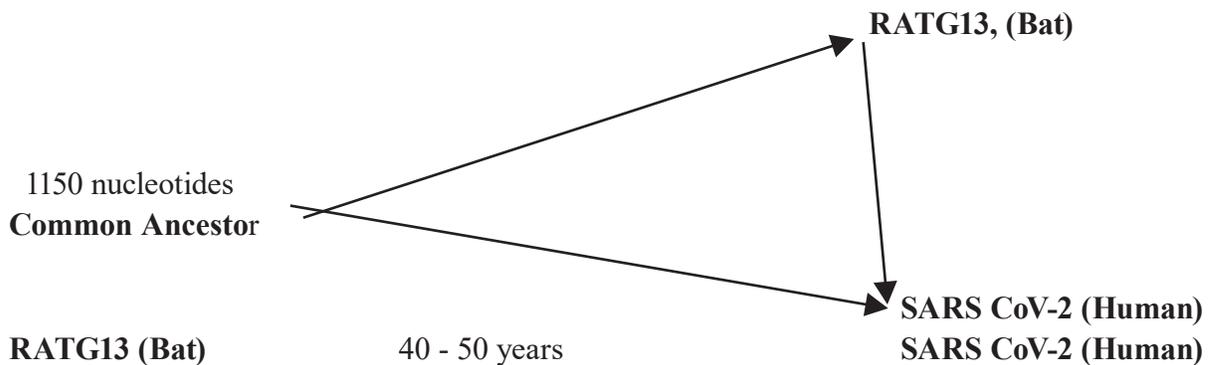


Figure 1 is a phylogenetic analysis of SARS-COV-2 and related coronaviruses (Serbecoviruses) circulating in horseshoe bats (*Rhinolophus*) across Asia shows that horseshoe bats are the likely SARS COV-2 progenitor reservoir species. Bat coronavirus RaTG13 is the closest Serbecoviruses related to SARS COV-2, and is estimated to have shared a common ancestor 40 years ago, a time span that represents a genetic gap of 1150 nucleotides between RaTG13 and SARS COV-2 (Lytras *et al* 2021. SARS CoV2 and RATG13 represent some 40 - 50 years of divergence since the last shared bat progenitor coronavirus ancestor. The cumulative genetic divergence gap between SARS CoV-2 and RATG13 is 1150 nucleotides.

The two hypotheses are fairly simple (contrast Figures 1 and 2).

One remises that SARS CoV-2 spilled over to humans through a natural zoonotic process in Wuhan, Hubei province (Latham and Wilson, 2021; Zhou and Shi, 2021; Wacharapluesadee *et al.*, 2021). This zoonotic process is hypothesized to involve as yet unidentified intermediate viruses between SARS CoV-2 and related bat coronaviruses, which collectively form the SARS-related coronavirus (SARSr-CoV) species (Benvenuto *et al.*, 2020; Lytras *et al.*, 2020; Li W *et al.*; Anderson *et al.*, 2020). The intermediate viruses are hypothesized to have been transmitted to humans through multiple wet market farmed or captured live animals including civets, cats, foxes, minks, and racoon dogs (Lytras *et al.*, 2020; Oppiessnig and Huang, 2020). This is believed to be so because at the beginning of the pandemic in December of 2019, the first detected cases of SARS CoV-2 were associated with Wuhan's wet markets (Lytras *et al.*, 2020; Xiao *et al.*, 20210). This lends credence to multiple spillover events in November and December of 2019 (WHO, 2020). Despite the spiritedness of the arguments in this hypothesis, the intermediate progenitor virus and the intermediate animal source of the spillover have as yet not been identified (Figure 2a).

The other hypothesis is the so called “lab origin” or Mojiang Miners Passaging argument, which places the geographic spill over ground zero at Mojiang mine in Yunnan province (Latham and Wilson, 2021; Sallard *et al.*, 2020) (Figure 2b). This hypothesis is based mostly on phylogeographic mapping and phylogenetic analysis of the genomes of SARSr-CoV. It argues for a direct bat to human *Sarbecovirus* transmission either by natural infection, or by an accidental laboratory escape, or by deliberate laboratory bioweapon research project-procured process (Latham and Wilson, 2021; Bloom *et al.*, 2021; Piplani *et al.*, 2021; Van Dorp *et al.*, 2020; Zhan *et al.*, 2020). The argument relies on an analysis of coronavirus genomes from Asia and narrowing down the geographic source of the bat progenitor of SARS CoV-2, and ultimately locating precisely where a bat progenitor virus left its bat reservoir host to ultimately become SAR CoV-2, hence triggering the chain of events that unleashed the COVID-19 pandemic (Lee *et al.*, 2020; Lytras *et al.*, 2020).

Figure 2 – Origins of SARS CoV-2

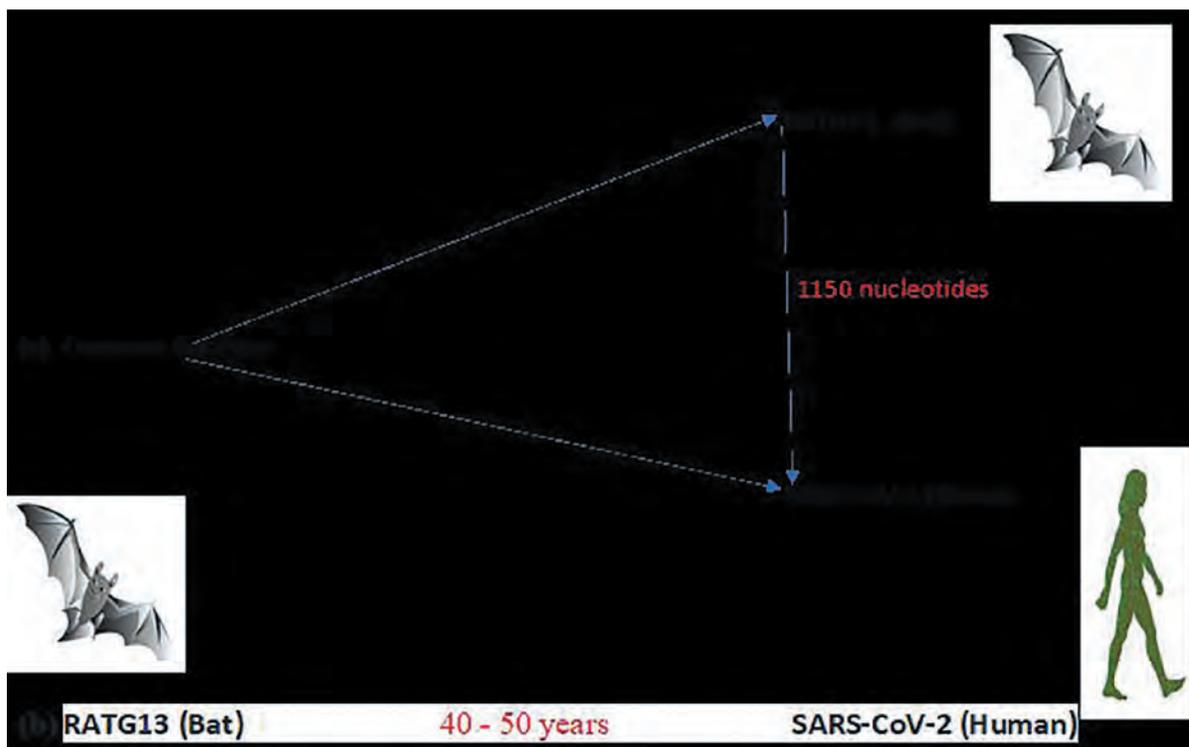


Figure 2a illustrates the natural “zoonotic spill-over” theory assumes a proximal source in farmed or smuggled or wild animals. This basis of this premise is that the first detected SARS-COV-2 human infections in December 2019 were associated with Wuhan wet markets lending credence to multiple animal-market-associated spillover events in November and December of 2019 (Lytras *et al.*, 2021).

Figure 2a - Natural zoonotic process hypothesis with Wuhan as epicenter

	Wuhan City wet market	
RATG13 (Bat)	Intermediate host	SARS
CoV-2 (Human)	? Pangolin-CoV, ?minks, cats, ferrets, rhesus macaques, ?Hamster, racoon dogs	
	Intermediate animal host so far not identified.	

This could have happened in three possible ways: the first possibility is that SARS CoV-2 could have resulted from infection of a researcher during a sample collection trip to the Mojiang mine; the researcher could have infected others with SARS CoV-2 after returning to Wuhan. The second possibility is that RaTG13, the bat coronavirus most closely related to SARS CoV-2, was obtained from the Mojiang mine and enhanced or altered for some vaccine- or

technology-related research purpose (Latham and Wilson, 2021). This genetically-engineered virus then escaped and spread world wide (Kaina 2020; Segreto and Deigin, 2021; Sirotkin and Sirotkin, 2020; DRASTIC, 2021). The third (and purportedly more plausible) possibility is the so called “Mojiang Miners Passage theory”. In April 2012, there was an apparent coronavirus outbreak at the Mojiang mine afflicting six miners and killing three of them (Rahalkar and Bahulikar, 2020). The miners became sick with COVID-19 – like respiratory symptoms while shovelling bat guano at the Mojiang mine. It is postulated that a progenitor bat SARSr-CoV that infected the miners evolved and transformed inside their bodies to become human adapted and virulent SARS CoV-2. Medical samples were taken from the miners and these samples were sent to the Wuhan Institute of Virology where the transformed virus escaped during laboratory experiments. This latter is the most favoured of the “lab origin” possibilities (Figure 2b).

Figure 2b - “Lab origin” hypothesis postulates the Mojiang mine in south-central Yunnan province as epicenter

Mojiang mine, south-central Yunnan province

RATG13 (Bat)	No intermediate host	SARS-CoV-2 (Human)
		Direct leap into humans (case of six miners)

Figure 2b illustrates the direct leap into humans (“lab origin” theory). Based on coronavirus genomes sequenced from samples across Asia, the geographical location of the direct bat progenitor of SARS COV-2 has been phylogeographically mapped to the south-central part of the Chinese province of Yunnan in a place called the Mojiang mine. This, was a site of an apparent coronavirus outbreak in 2012, affecting six guano shoveling miners, killing three; thus implicating the likelihood of direct infection by a bat virus or mixture of viruses that recombined into one. The bat virus(es) that infected the miners evolved inside their bodies to become human adapted (Latham and Wilson, 2021).

Natural zoonotic process hypothesis with Wuhan as epicenter argues for a horseshoe bat-to-intermediate host-to-human sarbecovirus spill-over event. The first detected SARS CoV-2 cases were associated with Wuhan wet markets; this is (purportedly) consistent with multiple animal-market associated spillover events. Disruption of meat trade and shortage of pork products at that time is postulated to facilitate wildlife-human contact as food consumers and producers resorted to alternate wildlife meat sources (Lytras *et al.*, 2020; Xiao *et al.*, 2021).

The “lab origin” hypothesis postulates that the Mojiang mine in south-central Yunnan province, is the site of the initiating zoonotic spillover where a SARS CoV-2 progenitor ancestor exited its horseshoe bat (Rhinolophid) reservoir (Kaina, 2020; Segreto and Deigin, 2021; Sirotkin and Sirotkin, 2020; DRASTIC, 2021). This hypothesis uses the phylogeography of SARS-like coronaviruses to forcefully advance supporting arguments. The phylogenetic analysis establishes that genetic relatedness among SARS CoV-2 lineage of coronaviruses in their bat

reservoirs is strongly correlated with sampling location (Latham and Wilson 2021). The analysis demonstrated that 99% of the genome of SARS CoV-2 is present in the combined genomes of RmYN02, RpYN06PrC31, and RaTG13. All are between 79% to 96.1% genomically similar to SARS CoV-2. This makes SARS CoV-2 a recombinant whose genome is, effectively, a synthesis of each of these different bat viruses as supported by the case of six miners who developed COVID-19-like symptoms (Latham and Wilson, 2021). The hypothesis proposes that a RaTG13-like coronavirus (or a mixture of viruses that later recombined into one from the mine) infected the miners (Rahakar and Bahulikar, 2020, Latham and Wilson, 2021).

Bat viruses that infected miners evolved (through a passage-like process) inside their bodies to become human-adapted. Samples from the miners were taken to the Wuhan Institute of Virology (WIV) where the virus infected humans after escaping during a research manipulation.

3. Structure of SARS CoV-2

Knowledge of the genetics and genome of SARS CoV-2 is key in understanding viral replication, viral transmission, host infection, mutation, evolution, molecular-based diagnosis, targeted therapies, and vaccine development. The novel human coronavirus (SARS CoV-2) belongs to the SARS-related coronavirus (SARSr-CoV) species, of the *Sarbecovirus* subgenus of the *Betacoronavirus* genus (Atlante *et al.*, 2020; Casanova, 2020; Li *et al.*, 2005; Sironi *et al.*, 2020; Rahimi *et al.*, 2020, Hu *et al.*, 2020). This family comprises an enveloped, non-segmental, positive-sense single-stranded RNA virus genome (Figure 3).

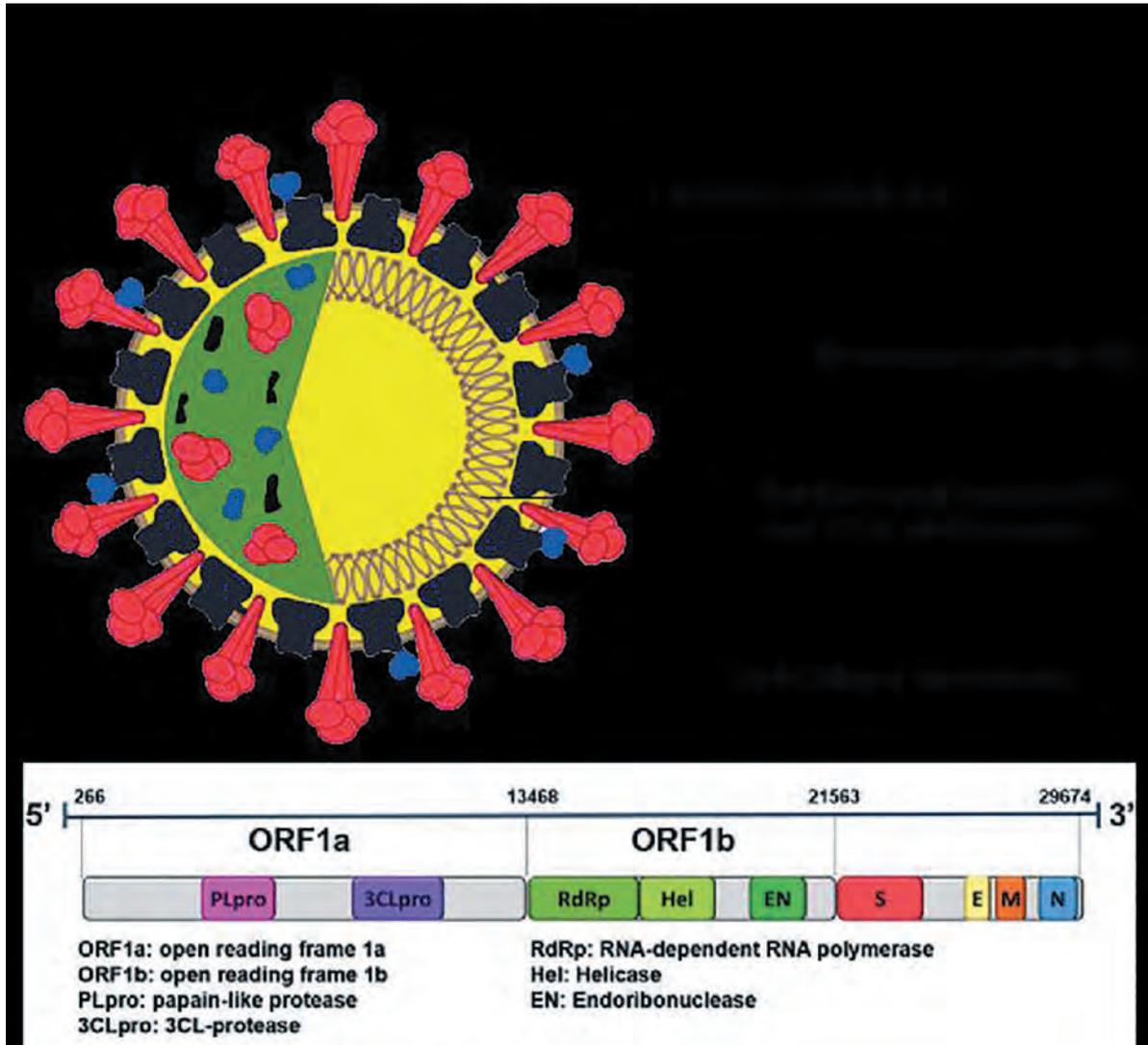
Figure 3 – Basic structure of SARS CoV-2

Figure 3 shows that, like other coronaviruses, SARS COV-2 is a large, enveloped, non-segmented, and positive-stranded RNA virus. The single-stranded viral genomic sequences are diverse in different variants, ranging from 29.8 kb to 29.9 kb. Its basic structure contains spike-like projections of a glycoproteins on the surface, which appears like a crown under the electron microscope; hence, is referred to as coronavirus. The genome organization includes sequences that encode structural and non-structural proteins. The structural proteins (sp) are located at the 3' terminus of the viral genome. The sp are implicated in host infection, membrane fusion, viral assembly, morphogenesis and release of virions; and includes the spike protein (S), envelope protein (E), the membrane protein (M) and the nucleocapsid protein. The non-structural proteins are located at the 5' end of the genome and includes two open reading frames (ORF), ORF1a and ORF1ab (Cosar *et al.*, 2021; Mittal *et al.*, 2020; Rahimi *et al.*, 2020; Atlante *et al.*, 2020; Shereen *et al.*, 2020; Lu *et al.*, 2020).

The basic structure of the SARS COV-2 consists of a viral genome, a lipid bilayer membrane, several non-structural proteins, and four structural proteins including the spike (S), envelope (E), membrane (M), and nucleocapsid (N) protein (Mittal et al 2020, Shereen et al., 2020, Atlante *et al.*, 2020; Naqvi *et al.*, 2020; Wang MY *al.*, 2020; Hu *et al.*, 2021). The viral genome is 29 kb (29,674 base) nucleotide base pair single-stranded RNA viral genome that encodes two open reading frames (ORF 1a and 1b), and the four structural proteins mentioned above, viz. spike glycoprotein, envelope, membrane, and nucleocapsid proteins (Mittal *et al.*, 2020; Rahimi, 2020; Zhang, 2020; Sironi, 2020). The spike glycoprotein (S) is critical in the pathogenesis of COVID-19 as the virus relies on it for host cell surface receptor binding and entry (Atlante et al., 2020, Walls et al., 2020). It is a trimeric protein formed by two subunits, S1 and S2. The S1 subunit contains an N-terminal domain connected by a linker of variable length to the receptor-binding domain (RBD). As in other coronaviruses, the S2 domain participates in membrane fusion (Shereen *et al.*, 2020; Duquerroy *et al.*, 2005). Unlike its close coronaviruses, the SARS COV-2 spike protein possess the unique molecular feature of a furin cleavage site insertion at the S1-S2 junction (Walls *et al.*, 2020; Zhang *et al.*, 2020). This putative furin recognition sequence motif at the S1-S2 cleavage site is a target for cell proteases during infection. Because of its crucial role in mediating infection of receptor-expressing host cells, the S-glycoprotein could be a critical target for antiretroviral neutralizing antibodies (Zhang *et al.*, 2020; McCulough *et al.*, 2020) (Table 1).

The other structural proteins play different functions in SARS CoV-2 viral biology: the nucleocapsid protein (N), the most abundant protein in SARS CoV-2, is a highly immunogenic phosphoprotein that it is critical in viral genome replication. The N-protein is often used as a marker in diagnostic assays (Zhang, 2020), It is also useful in developing SARS CoV-2 antigen and serological detection tests. The envelope E-protein is involved in viral assembly, and assembly of virus particles is the role of the membrane protein. The ORF8 region is believed to be involved in immune evasion (Cosar, 2021)

All viruses have the capacity to evolve or alter their genomic make-up over time. Molecular changes or mutations in the viral genome occur when the virus replicates or makes copies of itself.(Mittal *et al.*, 2020; Sironi *et al.*, 2020). The new virions are referred to as variants of the original virus (WHO, 2020). Mutations and likelihood of new variants increases when a virus circulates widely in a population. Most mutations and viral variants are harmless and have no or little impact on the virus' ability to cause disease. However, sometimes, mutations occur in a critical part of the viral genome that confer new properties such as increased transmission rates and/or ability to cause more severe, critical, and/or fatal disease (WHO 2020). Mutations could also facilitate adaptation of a virus for zoonotic transmission or sustained human-to-human transmissibility and virulence (Sironi *et al.*, 2020; Latham and Wilson, 2021). (See section 2 above on the origin of SARS CoV-2.)

Table 1 – Variants of concern documented globally

WHO Label	Pango Lineage	Earliest documented samples	Transmissibility	Immune Evasiveness	Vaccine Effectiveness
Alpha	B.1.1.7	United Kingdom (2020/09)	+++	--	√
Beta	B.1.351	South Africa (2020/10)	+	++++	√
Gamma	P.1	Brazil (2021/01)	++	++	√
Delta	B.1.617.2	India (2021/04)	++++	++	√
Lambda	C.37	Peru (08/2020)	++++	++	√
Delta plus	AY.4.2	UK (2021/07)	+++	++	√

Multiple genetic lineages of SARS CoV-2 have been emerging and circulating around the world since the beginning of the COVID-19 pandemic (WHO, 2021; CDC 2021). A lineage is a genetically closely related group of virus variants derived from a common ancestor. A variant has one or more mutations that differentiate it from other variants of the SARS CoV-2 viruses. Multiple variants of SARS CoV-2 have been documented globally throughout the pandemic (Table 1). There are currently tens of thousands of mutations in different segments of the SARS CoV-2 genome. For example, there are currently around 4,000 mutations in the S-protein gene, which facilitates viral entry into the cells (Cozar *et al.*, 2021). A number of SARS CoV-2 variants have emerged worldwide since the COVID-19 outbreak. The fastest-spreading variants were first detected in the U.K., South Africa, and Brazil (Table 1) and are referred by the WHO as variants of concern (VOC).

Multiple variants of the original (wild-type or novel coronavirus strain) of SARS COV-2 have now been identified and are circulating worldwide. The latest VOC include the highly mutated B.1.1.529 variant also known as Omicron, first identified in South Africa in November of 2021, and the variant AY.4.2, also known as “Delta Plus”, first identified in the United Kingdom in July of 2021. Both are highly transmissible and are currently the major VOC and most detrimental to global public health systems. Of all the variants, Omicron has caused the most pandemonium in the response of national governments since the advent of the COVID-19 pandemic. Scientists around the globe are racing to characterize the highly mutated Omicron variant as it was initially predicted to be highly transmissible and pathogenic (WHO 2021 November).

4. Variants of concern

Almost all so-called variants of concern (VOC) (WHO, 2020) are characterized by mutations in the S-protein gene (Cosar *et al.*, 2021). The common VOCs include:

B.1.1.7, 20I/501Y.V1, VOC202012/01. The B.1.1.7 variant was first detected in U.K. samples and began to spread rapidly. After a short time, it was seen in other countries across Europe,

Asia, and particularly India where it has caused an unprecedented public health devastation. The reason for the rapid spread is due to the N501Y mutation increasing the receptor binding affinity (Volz *et al.*, 2021). Furthermore, the B.1.1.7 variant appears to have a 30 % higher mortality rate along with other variants of SARS CoV-2 (Iacobucci *et al.*, 2021; Cosar *et al.*, 2021).

B.1.351, 20C/501Y.V2. The B.1.351 variant originated in South Africa. B.1.351 contains 9 Spike protein mutations in addition to mutations in the N-terminal domain (NTD) and in the receptor binding domain (RBD), and one mutation near the furin cleavage site (Wang *et al.* 2020) These new mutations are notable for a potential for immune escape, and thus impairment of the efficacy of current monoclonal antibody therapies or vaccines (Cosar *et al.*, 2021, McCallum *et al.*, 2021. This is mainly because many of the mutations reside in the antigenic supersite in NTD16,17 or in the ACE2-binding site (also known as the receptor binding motif (RBM) which is a major target of potent virus-neutralizing antibodies (McCallum *et al.*, 2021)

P.1. This variant was first detected in Brazil. It is a descendant of B.1.1.28.; it was identified in 42% of the positive individuals (Toovey *et al.*, 2021). It is notable for concerns about increased infection risk when co-mutations exist (Maggi *et al.*, 2021). However, effect on transmissibility and/or virulence, and potential for immune evasion, is unknown when no co-mutations are present (Maggi *et al.*, 2021, Trovey *et al.*, 2021).

P.2. This variant was identified in the U.S. in November 2020. It was noted to spread rapidly. Its neutralization has been observed to be reduced in patients harbouring this mutation (Garcia-Beltrum *et al.*, 2021).

B.1.617. This variant is characterized by a double mutation that was first detected in India in October 2020 (Moelling *et al.*, 2021). It has been detected in eight countries. While the effect of the individual mutations is well known, the combined effect of these mutations is unknown (Yadav *et al.*, 2021)

Lambda (C.37). This variant, was first identified in Peru in August 2020 and by the WHO in June 2021 (Wink *et al.*, 2021; WHO, 2021). Later, it was detected in 26 countries, especially in America, Europe, and Oceania (Saha *et al.*, 2020). It is spread rapidly and shows increased infectivity and immune evasion from antibodies (WHO, 2021; Wink *et al.*, 2021; Avecedo *et al.*, 2021).

P.3. The P.3 variant has been detected in South Africa, Brazil, and the U.K. It has also been reported recently in the Philippines (Gupta, 2021). It is associated with ACE2 receptor affinity and neutralizing antibodies (Andrew *et al.*, 2021).

B.1.1.298. First detected in a mink farm in Denmark in June 2020 (Zhang, 2021), it is similar to the B.1.1.7 mutation. It has been reported to be an escape mutation that causes a 4-fold increase in

ACE2 affinity (Bayari-Olmos *et al.*, 2021). It is also reported to have a high mutation potential. However it has been observed to infect fewer people compared to other variants.

4.1 Classification by the Interagency Group

The U.S. government SARS CoV-2 Interagency Group (SIG) classifies variants using a different classification scheme from that used by the WHO. The SIG variant classification relies on levels of variant circulation in the U.S. population. Its scheme defines four classes of SARS CoV-2 variants: Only the Delta (B.1.617.2 and AY lineages) is classified by SIG as a Variant of Concern (VOC). Other SIG classes are:

Variants Being Monitored (VBM): They include Alpha (B.1.1.7 and Q lineages, Beta (B.1.351 and descendent lineages), Gamma (P.1 and descendent lineages), Epsilon (B.1.427 and B.1.429), Eta (B.1.525), Iota (B.1.526), Kappa (B.1.617.1), 1.617.3, Mu (B.1.621, B.1.621.1), and Zeta (P.2);

Variants of Interest (VOI): There are none or they have been reclassified.

Variants of High Consequence (VOHC): To date, no variants of high consequence have been identified in the United States.

Since the SARS CoV-2 virus first emerged, a wide variety of drug compounds affecting the binding sites of the virus have been studied. Drug trials and vaccine studies are continuing (McCullough, 2021). However, considering the frequency of mutation of the SARS CoV-2 virus in all drug and vaccine studies, it is necessary to try multiple therapeutic combinations in different mutation types and to compare such studies, preventing possible pathways before the virus mutates (COSAR, 2021). The lack of effective therapeutic and preventive strategies against human coronaviruses necessitates drug and treatment research. It has previously been shown that designing a broad-spectrum inhibitor in a conservative target is a viable method for developing anti-coronavirus therapeutics given the high rates of mutation and recombination observed in viral replication (COSAR, 2021; McCullough 2021). (Table 2.)

Characterization of the genetic variants of SARS CoV-2 is crucial for tracking and evaluating its spread across countries and impact on the effectiveness of vaccines (Table 1) that currently have been approved for global SARS CoV-2 vaccination programs. Table 1 shows the variants of SARS CoV-2 by country, date of identification, and the changes and effects on the virus. The genomic variability of SARS CoV-2 samples scattered around the world may be under geographically specific etiological influences (see section 7 below on the ecogenetics of SARS CoV-2). Continuous monitoring of mutations will also be crucial in tracking the movement of the virus between individuals and across geographic areas (WHO, 2020; CDC 2020) (Table 1).

Table 2 - Agents having shown promise in sequential multidrug therapy (SMDT)

Agents	Sequential multidrug therapy
Nutraceuticals	Zinc sulfate, Vitamin D, Vitamin C, Quercetin
Anti-infectives	Azithromycin, Hydroxychloroquine, Remdesivir, Doxycycline, Ivermectin, Favipiravir
Antibiotics/ Antiviral antibodies	Azithromycin, Doxycycline Bamlanivimab, Casirivimab, Imdevimab, Remdesivir
Immunomodulators/ Corticosteroids/ Antiinflammatory	Budesonide, Dexamethasone, Colchicine, Prednisolone, Interferons
Antiplatelet agents/ Anticoagulants	Aspirin, Heparin, Apixaban, Rivaroxaban, Edoxaban, Dabigatran
Oxygen	

The COVID-19 vaccines that have been approved (Table 3) have proven to be effective in pandemic control and in ameliorating the severity of COVID-19 illness and mortality (WHO 2021, CDC, 2021). Although each vaccine is unique, all of them offer strong protection against severe disease.

The vaccines have also been demonstrated to provide protection against new virus variants. This protective broad spectrum effect on variants is due to the vaccines ability to elicit a broad immune response involving a range of antibodies and cells. Evidently, changes or mutations in SARS CoV-2 should not make vaccines completely ineffective (WHO, 2021; CDC, 2021). In the event that any of these vaccines prove to be less effective against one or more variants, it will be possible to change the composition of the vaccines to protect against these variants (WHO, 2021).

Table 3 – Vaccine platforms and corresponding doses

Vaccine	Doses	Platform
BioNtech-Pfizer	2	mRNA technology
Moderna	2	mRNA technology
AstraZeneca	2	Adenovirus vector/DNA
Johnson and Johnson	2	Adenovirus vector/DNA
Sputnik V	2	Adenovirus vector/DNA

5. Host genetics and COVID-19 pathogenesis

Knowledge of genetic variation and susceptibility at both individual and population level helps in understanding disease transmission, pathogenesis and immune response, assessing prognosis, identifying individuals at high risk of infection, disease severity, and death. It also helps individual and/or population-targeted drug design (precision medicine), in vaccine development, and in developing other preventative strategies (Rahimi *et al.*, 2020; Sironi *et al.*, 2020; Naqvi *et al.*, 2020; Velavan *et al.*, 2021; Seyed-Alinaghi *et al.*, 2021).

Since the onset of the COVID-19 pandemic, clinicians especially emergency room, intensive care, and general inpatient care physicians have become aware of the variability of the severity of symptoms in patients infected with SARS CoV-2 (Zhou *et al.*, 2020; Zhu *et al.*, 2020; WHO, 2020; Verdoni *et al.*, 2020). The most common symptoms include cough, fever, sore throat, nasal stuffiness, nausea, general body aches, fatigue, headache, loss of taste, loss of smell, anorexia, and breathing difficulties. Clinical features in hospitalized patients include cough, dyspnea, chest heaviness, chest pain, desaturation, thrombocytopenia, and thrombosis. Overall global case fatality rate ranges between 1 – 10% (Velavan *et al.*, 2021; McCullough, 2020). Symptoms in children are different from adults; not all children infected with SARS CoV-2 test positive, but almost all have antibodies to the virus. The unique COVID-19 symptom spectrum seen in children has been designated as the “Pediatric Multi-System Inflammatory Syndrome (PMSIS)” (Radia *et al.*, 2021, Chiotos *et al.*, 2020; WHO, 2020; Kaushik *et al.*, 2020). Symptoms are similar to toxic shock syndrome and Kawasaki’s disease. PMSIS is characterized by severe abdominal pain and vomiting, involvement of at least two affected organs (including the heart, kidneys, lungs, skin, and nervous system), and 60% suffer from heart complications.

It has long been known that genetic factors can influence the severity of infectious diseases caused by various infectious agents including viruses, bacteria, fungi, and parasites (Casanova and Abe, 2018). It is now well established that clinical presentation of COVID-19 varies from patient to patient and in different age groups. Even population to population variation in susceptibility to SARS CoV-2 infection and COVID-19 symptom severity have also been observed (Verdoni *et al.*, 2020; Velavan *et al.*, 2021; Seyed-Alinagh *et al.*, 2021). These observations suggest involvement of genetic factors in the pathogenesis and pathophysiology of COVID-19 disease. Identified risk factors for disease severity include older age, male sex, asthma, experiencing lifelong systemic racism, pre-existing co-morbidities such as cardiovascular disease, diabetes, and obesity. In addition, there are certain biological markers and variants. Ethnicity has also been identified as a potential factor associated with COVID-19 susceptibility and severity. There is now growing evidence of a genetic and molecular basis of susceptibility to infection as well as to the possibility of contracting a more severe form of COVID-19 disease (Seyed-Alinaghi, 2021; Velavan, 2021). Genomic and candidate gene association studies have increasingly demonstrated individual genetic predisposition to COVID-19. In a large international study, human genome parts associated with greater risk of severe COVID-19 were identified. Studies have identified

association of COVID-19 susceptibility and several common and rare variants in genes related to inflammation and/or immune responses.

It has been established that an excess number of men suffer from severe COVID-19 than women, blood type A is associated with a higher risk of infection with SARS CoV-2, and blood type O offers some protection. Angiotensin-converting enzyme 2 (ACE2) receptor gene expression has been strongly associated with the susceptibility, severity, and clinical outcomes of COVID-19 (de Buyzere *et al.*, 2020; Mao *et al.*, 2020, Varga *et al.*, 2020). SARS COV-2 is a high affinity ligand of ACE2. ACE2 receptors are multi-centric and highly expressed in the lungs, heart, vessels, gut, and kidneys. SARS COV-2 enters into the cell by binding of the viral spike (S) protein to the ACE2 receptor. ACE2 influences post-infection processes including inflammatory and immune responses (Banoun 2021; Guan *et al.*, 2020; Hadjadj *et al.*, 2020; Gomez *et al.*, 2020).

Human leukocyte antigens (HLAs) genes have also been demonstrated to influence COVID-19 disease severity. Expression of different variants has been associated with varying disease severity. HLA-G rs9380142, HLA-C*14:02, HLA-B*51:01 and HLA-A*11:01 have been associated with critical illness (Pairo-Castineira *et al.*, 2021). Previous studies showed that HLA-B*46:01 variant carriers have higher susceptibility to SARS CoV-2 infection, but recently no such association was observed. HLA-B*15:03 variant may provide some protection (Thompson *et al.*, 2020, Wang *et al.*, 2020). HLA genes typing may predict disease severity and hence appropriate intervention. Other host genetic factors associated with increased susceptibility to COVID-19 disease have been identified in genome wide association studies (Thirumalaisamy *et al.*, 2021, Seyed-Alinagh *et al.*, 2021). Some are very promising candidates for predicting increased susceptibility to infection with SARS CoV-2, risk for hospitalization, and developing severe or critical COVID-19 illness. Candidate genes identified are implicated in various pathophysiologic processes including cellular viral entry, immunity, inflammatory response, enhanced coagulation, and viral clearance. Different types of genetic factors including receptor genes, transcription factors, cytokine genes, expressed in various organ systems and tissues including lung tissue, gastrointestinal track, heart, vessels, kidneys, brain, testes, have been implicated in COVID-19 etiopathogenesis (Dai *et al.*, 2021; Casanova *et al.*, 2020; Velavan *et al.*, 2021; Ovsyannikova *et al.*, 2020; Huang *et al.*, 2020). The effects of the implicated gene variants have been demonstrated to be small but an additive combination of genetic variants creates a larger risk (Velavan *et al.*, 2021, Casanova *et al.*, 2020, Rahimi *et al.*, 2020).

The effects of the implicated gene variants have been demonstrated to be small but an additive combination of genetic variants creates a larger risk.

5.1 Host genetic risk factors associated with COVID-19 clinical spectrum

Many genes identified to be risk factors for COVID-19 are involved in various pathophysiologic processes, including viral entry into cells, immunity, and inflammatory processes (Table 4).

Table 4 - Host genetic risk factors associated with COVID-19 clinical spectrum

Gene/Locus	Associated with
<i>ABO</i> , blood group A	Respiratory failure
<i>ABO</i> , blood group A	Increased COVID-19 positivity, increased risk of hospitalization
<i>ABO</i> , blood type O	protective effect
<i>ABO</i> blood locus	Increased infection susceptibility
<i>ABO</i> blood locus	Increased risk of hospitalization
Angiotensin-converting enzyme-2 (<i>ACE2</i>)	Increased infection susceptibility
Cluster of Differentiation (<i>CD209</i>) or Dendritic Cell-Specific Intercellular adhesion molecule-3-Grabbing Non-integrin(<i>DC-SIGN</i>)	Risk for severity
Coiled-coil alpha-helical rod protein 1 (<i>CCHCR1</i>)	Risk for critical illness
Dipeptidyl peptidase 9 (<i>DPP9</i>)	Risk for severity
Forkhead box P4 (<i>FOXP4</i>)	Risk for hospitalization
Human leucocyte antigen (<i>HLA-DPBI</i>)	Risk for infection susceptibility
Human leucocyte antigen (<i>HLA-G</i>)	Risk for critical illness
Interferon-alpha and- Beta receptor subunit 2 (<i>IFNAR2</i>)	Risk for severity/critical illness
Intercellular adhesion molecule 5(<i>ICAMS5</i>)/Tyrosine kinase 2 (<i>TYK2</i>)	Risk critical illness
Mucin 5B (<i>MUC5B</i>)	Risk for severity
Oligoadenylate synthetases 1,2,3 (<i>OASI, 2, 3</i>)	Risk for critical illness/severity
3p21.31 Solute Carrier Family 6 Member 20 (<i>SLC6A20</i>)	Risk for respiratory failure, critical illness, severity, hospitalization severe illness
Toll-like receptor 7 (<i>TLR7</i>)	illness, severity, hospitalization severe illness

6. Epigenetics in coronavirus infection and COVID-19 pathogenesis

Epigenetics is the study of how environment and behavior can cause changes that affect the way genes work (Berger *et al.*, 2009; CDC, 2020; Passarge, 2018; Tzika *et al.*, 2018). Cellular epigenetic response can be triggered by various environmental and lifestyle factors including infectious agents, diet, stress, pollutants, chemicals and radiation. Epigenetics literally means “above” or “on top of genetics” or “in addition to changes in genetic sequence.” It refers to external modifications to DNA function resulting in regulation of gene expression or turning genes “on” or “off” without altering DNA structure or causing gene mutations (Tolleffsbol, 2011, 2012; Tzika *et al.*, 2018). Epigenetic changes can be cumulative, stable or reversible but do not change the genetic blueprint represented by DNA sequences. However, epigenesis can change how cells read a DNA sequence. Cumulative and stable epigenetic changes and the involved traits or phenotypes are heritable (Roseboom, 2019; Berger *et al.*, 2009). Phenotype changes are due to certain specific processes that arise independent of changes in genes (specific DNA sequences). Epigenetic mechanisms and alteration of gene function occur in the nucleus of a cell because of certain exposures to various environmental factors including infections, chemicals, medications, diet, exercise, behavioral and emotional factors (Passarge, 2018; Tolleffsbol, 2011, 2012; CDC, 2020). These factors trigger certain specific mechanisms or epigenetic marks inside the cell nucleus (Moura *et al.*, 2021, Kgatle *et al.*, 2021, Saksena *et al.*, 2021, Jaesnisch and Bird 2003).

The known mechanisms include:

- a) **DNA methylation:** which refers to the epigenetic process by which methyl groups are added to the C-5 position of the cytosine ring of DNA-by-DNA methyltransferases (DNMTs).
- b) **Histone modification:** by either methylation, acetylation or phosphorylation.
- c) **RNA methylation:** non-coding ribonucleic acid (ncRNA).

Figure 4 – Epigenetics in coronavirus infection

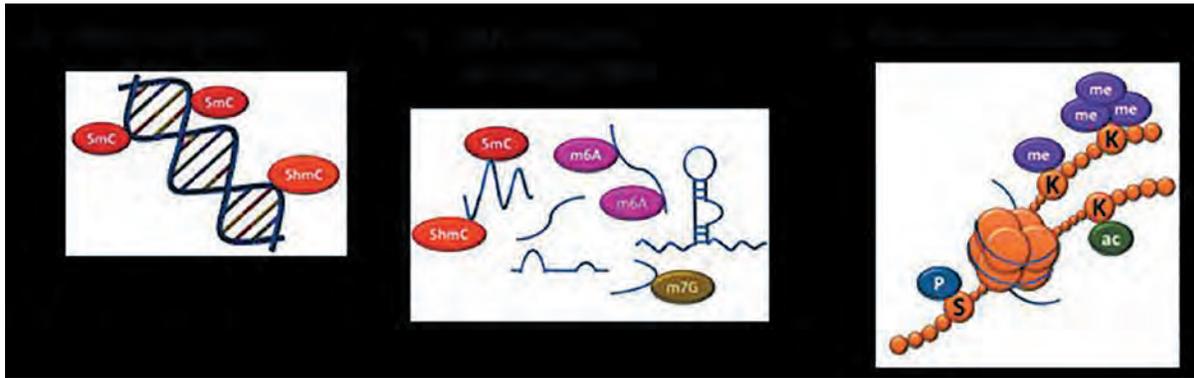


Figure 4 illustrates the epigenetic mechanisms: DNA methylation (A), RNA methylation/acetylation and non-coding modification (B) and histone modification/chromatin remodeling (C). These mechanisms are implicated in transcriptional regulation by activating or suppressing gene promoters or transposable elements in normal biologic processes such as aging, genomic imprinting and X-chromosome inactivation. Alteration of normal epigenetic mechanism to advantage SARS-COV-2 has been implicated in the etiopathogenesis of COVID-19.

These mechanisms work together to regulate gene expression, thus modulating metabolic processes in tissues. These epigenetic mechanisms acting in concert lead to chromatin remodeling and conformation, allowing chromatin access to proteins that regulate DNA transcription and, therefore, RNA and protein synthesis (Jaenisch and Bird, 2003; Wu and Zhang, 2014). Chromatin is a complex of proteins and DNA that is tightly bundled to fit into the nucleus (Figure 5). The fundamental unit of chromatin is the nucleosome which is composed of two copies of four core histones (H3, H4, H2A, and H2B). The DNA wraps around the histone octamer, regulating DNA access for gene transcription.

Figure 5 – Epigenetic mechanisms in gene expression

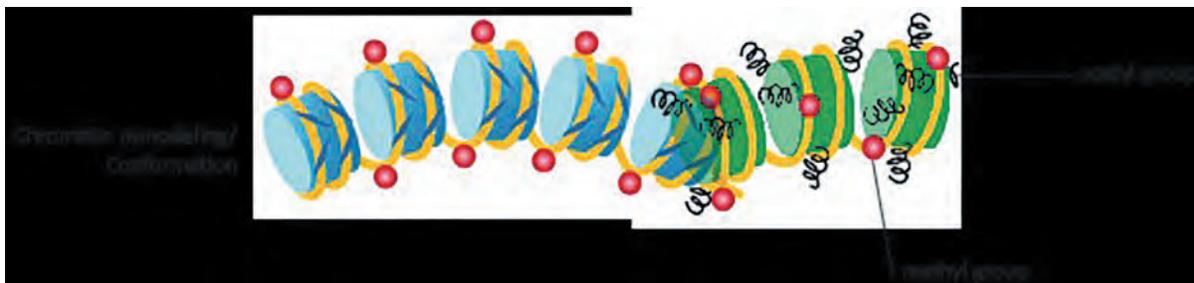


Figure 5 shows the chromatin structure, conformation, histone modification, DNA methylation and acetylation. Histone octamers with two copies of each of the histones H2A, H2B, H3, H4 (blue and green barrels) constitute the nucleosome which is the basic unit of chromatin. DNA (yellow) wraps around the histone octamers. Methylated octamers (blue); and methylated and

acetylated octamers (green). Chromatin/histone conformation and remodeling shown by spatial association of methylated (blue), and methylated and acetylated octamers.

Epigenetic mechanisms can influence the way an individual responds to infection with SARS CoV-2 and, hence, whether an individual develops mild, moderate or severe COVID-19 symptoms or never develops any symptoms at all (Saksena *et al.*, 2021; Moura *et al.*, 2021). SARS CoV-2 can influence COVID-19 symptom severity by altering the host epigenome, antagonizing the host's regulatory machinery of the epigenome for its own advantage and survival (Sen *et al.*, 202). Viruses can alter any and all known epigenetic mechanisms. The altered host epigenome can impair host immune response and could facilitate viral infection, replication, spread, and persistence. During a viral infection, epigenetic and transcriptional changes occur for both sides: the infected cell promotes an antiviral environmental response, leading to the induction of pathways to survive, while the virus switches off the expression of critical anti-viral host cell genes (Kgatle *et al.*, 2021; Sen *et al.*, 2020; Marazzi *et al.*, 2012; Flanagan, 2007)

Severe cases of COVID-19 are conceivably driven by SARS CoV-2 induced dysregulation of epigenetic processes, including DNA methylation and histone/chromatin alterations. These epigenetic phenomena may respond to enhanced viral replication and mediate persistent long-term infection and clinical phenotypes associated with severe COVID-19 cases and fatalities. Understanding the epigenetic events involved, and their clinical significance, may provide novel insights valuable for the therapeutic control and management of the COVID-19 pandemic (Salgado-Albarran, 2021).

6.1 DNA methylation dysregulation in COVID-19 etiopathogenesis:

Accumulating evidence demonstrates that the SARS CoV-2 virus, like other respiratory coronaviruses, exploits DNA methylation and histone modification to suppress immunoregulators such as type 1 IFN- γ -responsive genes (Kgatle *et al.*, 2021; Selgado-Albarran *et al.*, 2021; Steimle *et al.*, 1993). These genes include class II, major histocompatibility complex transactivator (CTIIA), antigen peptide transporter 2 (TAP2), and protein disulfide-isomerase A3 (PDIA3) (165). Abnormal regulation of these genes impedes the host immune system to fight infections effectively. This suggests that various epigenetic reprogramming phenomena may also occur during COVID-19 infection (Sawalha *et al.*, 2020; Kgatle *et al.*, 2021; Selgado-Albarran, 2020). Further, activation of the immunoregulatory cytoplasmic transcription factor aryl hydrocarbon receptor (AHR) has been shown to result in hypermethylation that contributes to COVID-19 pathogenesis. The AHR has been identified as a host factor in other viruses including Zika and Dengue viruses, and its inhibition was associated with significantly reduced viral replication and amelioration in the disease pathology (Giovannoni *et al.*, 2020, 2021).

It has been shown that the AHR becomes activated upon SARS CoV-2 infection (Giovannoni *et al.*, 2021) and that it impacts SARS CoV2 antiviral immunity and pathogenesis, promoting a pro-inflammatory response and participating in the severity of COVID-19. Furthermore, it

has been postulated that AHR activation may be the culprit behind the COVID-19-mediated cytokine storm (Dai *et al.*, 2020; Giovannoni *et al.*, 2020, 2021; Kgatele *et al.*, 2021). It has also been demonstrated that AHR activation is elevated in patients with COVID-19 (Cai *et al.*, 2020). This was shown to correlate with the cytokine storm, age, and low levels of T-cell responses, especially in males as compared to female patients, suggesting a sex-specific link to immune response and COVID-19 clinical outcome (Cai *et al.*, 2020). A strong correlation between COVID-19 clinical severity and AHR mediated dysregulation of DNA methylation of 44 CpG sites in genes involved in the inflammatory complex has been demonstrated (de Moura *et al.*, 2021). Other mechanisms of epigenetic dysregulation in COVID-19 include aberrant hyperactivation of cytotoxic cells by Ten Eleven Translocation (TET) enzyme erasure of DNA methylation (Kohli and Zhang, 2020). This has been observed in cases of severe pneumonia (Kang *et al.*, 2020), fatal inflammatory response, disease aggressiveness, and multiorgan disease COVID-19 phenotypes (Muhammad *et al.*, 2021; Pruiboomet *et al.*, 2020).

6.2 Histone acetylation/chromatin modification in COVID-19 etiopathogenesis

It is well established that SARS CoV-2-infected males had a significantly higher case fatality rate than females (Peckham *et al.*, 2020). It has been suggested that X-chromosome inactivation (XCI) may explain some of the disparities in infection susceptibility between female and male patients infected with SARS CoV-2. (Kgatele *et al.*, 2021) As an epigenetic hallmark of normal human development, XCI is regulated by a progressive and stepwise epigenetic phenomenon that ensures an equal dosage compensation of the X-chromosome encoded genes expression level between females and males. XCI has been demonstrated to be associated with chromatin modifications (heterochromatin changes) (Brockdorff *et al.*, 1992; Penny *et al.*, 1996). Histone deacetylation has been demonstrated as the earliest repressive epigenetic marks required for efficient XCI. Epigenetically subverted gene expression regulation of ACE2 and other X-chromosome linked genes, including toll-like receptors (TLRs), CD40 ligand (CD40L), and Forkhead box P3 (FOXP3)/Scurfin, expressed upon SARS CoV-2 infection, have been shown to play a critical role in COVID-19 pathogenesis and severity. Another histone epigenetic modification mark is related to human mature sperm DNA and the nuclear proteins known as protamines (Carrell, 2012). Protamines are sperm-specific basic nuclear proteins that function to package the sperm DNA for compaction necessary for sperm motility (Olivia, 2006). During spermatogenesis, the sperm genome is hyperacetylated to remove and replace histones with protamines. Dysregulation of this histone modification process has been associated with severe or critical cases of COVID-19, especially in individuals >80 years of age (Li *et al.*, 2020). SARS COV-2 has been demonstrated to positively dysregulate histone acetylation in the lungs of patients with severe COVID-19 co-morbidities such as lupus and concurrent treatment with certain drugs. For example, under conditions of metabolic stress, the ACE2 receptor is epigenetically dysregulated by an effect on histone acetylation (Clarke *et al.*, 2014) and, in patients treated with non-steroidal anti-inflammatory drugs, the ACE2 receptor expression is

affected (Dell Omo *et al.*, 2019). Thus, in the presence of certain co-morbidities and concurrent drug treatments, infection with the SARS COV-2 leads to more severe COVID-19 illness by an effect on epigenetic regulatory mechanisms (Sawala *et al.*, 2020; Salgado-Albarran *et al.*, 2021).

Other mechanisms of epigenetic dysregulation that impair immune defense mechanisms against pathogen insults and other hostile environments include dysregulated histone modification by histone acetyltransferases (HATs), damage-associated molecular patterns (DAMPs), complement binding, TLR alteration, and histone methyltransferases (HMTs) modification of chromatin (Kgatle *et al.*, 2021).

6.3 RNA methylation

While no extensive studies have conclusively demonstrated the effect of SARS CoV-2 infection on host RNA methylation, the non-structural proteins (nsp1–16) of SARS CoV-2 have been reported to have detrimental effect on host immune response (Wu 2019, 2020; Wang *et al.*, 2020; Dimitrova *et al.*, 2020; Krafcikova *et al.*, 2020). SARS CoV-2 replicates in the cytoplasm of infected host cells through a large membrane associated RNA replication/transcription machinery involving viral non-structural proteins (NSP1 to NSP16). NSP16 encodes a viral 2'-O-methyltransferase (2'-O-MTase), which functions with its co-factor NSP10 activator protein, in methylation of the 5'-end RNA cap2, resulting in the formation of 2'OMe at the 5'-end of SARS CoV-2 RNA to impede degradation by host 5' exoribonucleases. 2'OMe modification of SARS CoV2 RNA promotes uncontrolled viral replication, efficient translation, and evade recognition by the host cell innate immune system via inhibition of interferons production by immune system cells (Paramasivam, 2021; Züst *et al.*, 2011, Selvaraj *et al.*, 2020; Viswanathan *et al.*, 2020).

Viral epitranscriptomics refers to post-transcriptional modifications of RNA and plays an important role in the life cycles of SARS CoV-2. 2'-O-methylation (2'OMe) has been shown to play a role in modification of SARS CoV-2 RNA (Netzband and Pager 2020, Gonzales, van Horn *et al.*, 2017). This modification is functionally linked to all stages of RNA metabolism such as structure, stability and interactions, and plays a critical role in several biological processes such as modulating the replication of viruses and antiviral immune responses. Accumulating evidence indicate that 2'-O-methylation of viral RNA (2'OMe-RNA) plays an important role in evasion of cellular innate immune responses in the host cells. Non-methylated RNA in host cytoplasm is prone to degradation and cannot be efficiently translated. The lack of 2'-O-MTase activity results in a significant attenuation of SARS CoV infection, by decreased viral replication in vivo models (Paramasivam, 2021; Viswanathan *et al.*, 2020; Selvaraj *et al.*, 2020).

7. Ecogenetics: Host, viral, and environmental interactions

Simply stated, ecogenetics is the influence of the environment on gene expression and on epigenetic mechanisms. Ecogenetics can be defined as the study of genetic determinants that dictate susceptibility to environmentally influenced adverse health effects. The genetic and epigenetic landscape of an individual determines susceptibility to environmentally-influenced adverse health effects. Studies have now demonstrated that place, time, age, and even race-dependent patterns of the COVID-19 pandemic (Rentsch *et al.*, 2020; Price-Haywood, 2020; Ficetola and Rubolini, 2020). From an ecogenetic perspective, these variations in infection rates can be explained by the impact of environmental factors acting in concert with variable genetic factors to modulate various biologic processes involved in increasing risk for infection, illness severity, and mortality from COVID-19 (exposures involving air and water pollution, occupation, diet and obesity, stress and behavior).

7.1 What is the implication of ecogenetics in COVID-19?

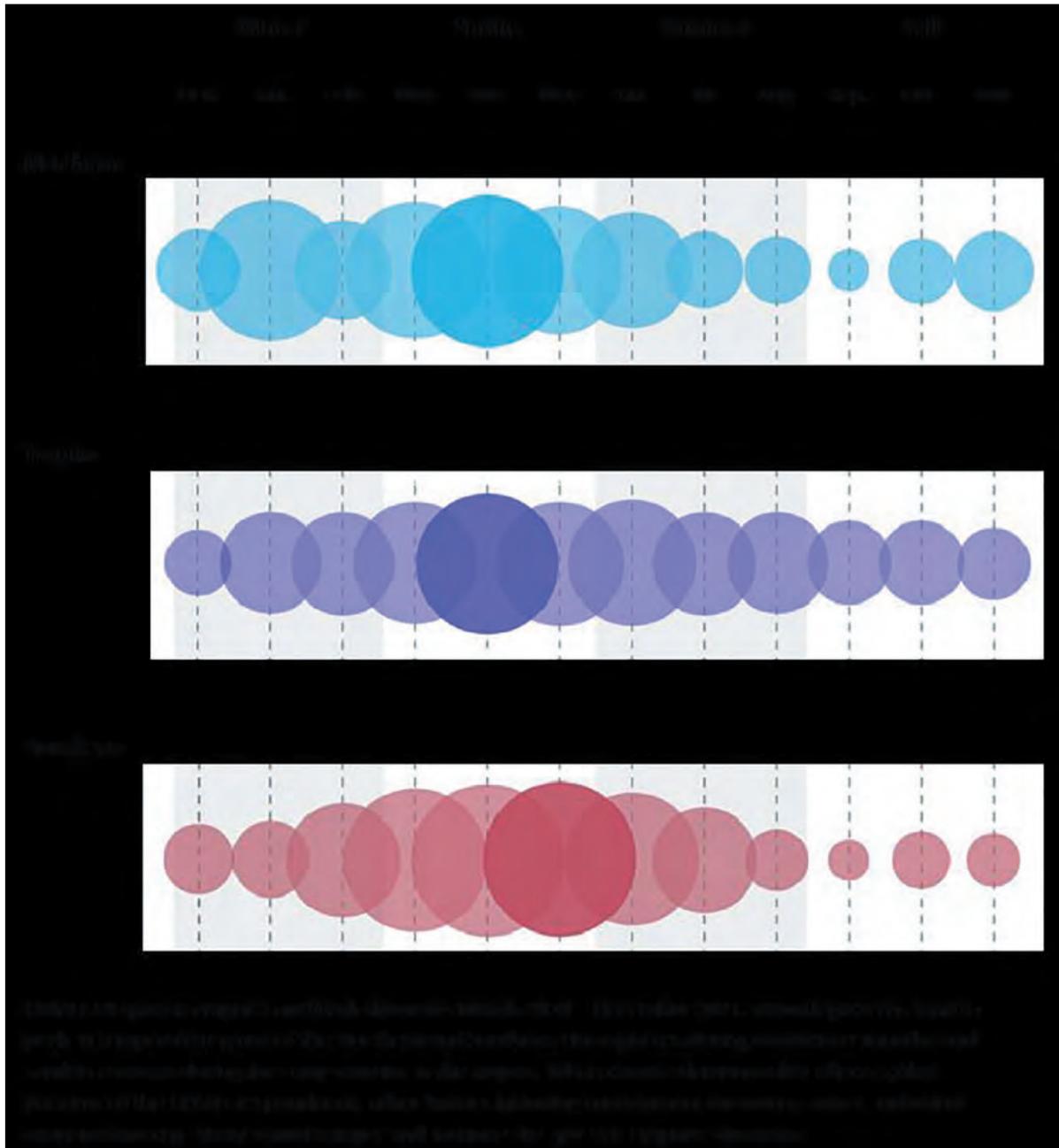
Environmental factors, including seasonal climatic variability and seasonal non-climatic abiotic conditions (examples; temperature, rainfall, water salinity) can influence pathogen transmission and strongly impact place-time patterns of infectious disease outbreaks (Morand *et al.*, 2013; Martinez, 2018; Cohen, 2020). The environmental drivers can influence seasonal variability in infectious disease outbreaks and incidence and prevalence rates directly via their effects on host and/or pathogen biology, or indirectly by affecting the transmission and pathogen survival, facilitating environmental conditions (Martinez, 2018; Ficetola and Rubolini, 2020; Seyed-Alighan *et al.*, 2020; Velavan *et al.*, 2020; Rentsch *et al.*, 2020; Sironi *et al.*, 2020).

Host-pathogen interaction dynamics can be significantly affected by environmental conditions either directly via, for example, improved pathogen growth and transmission rates, or indirectly by affecting host susceptibility to pathogen attacks (Ficetola and Rubolini, 2020; Martinez, 2018). In the case of directly transmitted diseases, such as influenza, respiratory syncytial virus, etc., multiple environmental parameters such as local temperatures and humidity impact, on virus growth, survival, and transmission with significant consequences for the seasonal and geographic patterns of outbreaks (Ficetola and Rubolini, 2020; Martinez, 2018). The COVID-19 pandemic has now lasted for 24 months, and there is an emerging seasonal and place variability in SARS CoV-2 infection rates (Figures 6, 7).

During this period, populations in the Northern Hemisphere experienced significant growth rates of SARS CoV-2 infections (so called second, third, and fourth waves) during the fall and winter months and ebbed in late spring and the summer months both in 2020 and 2021. For example, in mid- autumn of 2021, SARS CoV-2 infections rates were on the rise in most European countries and in several Canadian provinces including Ontario, Quebec, Manitoba, and Saskatchewan. In the same period, SARS CoV-2 infections rates remained steady in the tropics, even in populations with less than 5% vaccination rates. For example, the combined

24-month total reported cases of SARS CoV-2 infections in three African countries (Rwanda, Kenya, and Uganda) were less than the number of infections in Russia in the months of October and November 2021.

Figure 6 - Seasonal and geographic patterns of outbreaks



Even as early as October, 2020 – a mere six months into the pandemic - studies showed that at the beginning of the pandemic, COVID-19 growth rates peaked in temperate regions of the Northern Hemisphere with mean temperature of $\sim 5^{\circ}\text{C}$ and specific humidity of 4-6 g/

m³ during the outbreak period while they were lower both in warmer/wetter and colder/drier regions (Ficetola and Rubolini, 2020; Arauja *et al.*, 2020; Wu *et al.*, 2020; Zhang *et al.*, 2020). Confounding factors such as air pollution and socioeconomic variables (including population size, density, and health expenditure) did not affect the impact of temperature and humidity on the growth rate and transmission of COVID-19 in populations across the globe (Ficetola and Rubolini, 2020). The study concluded that temperature and humidity strongly impact the variation of the growth rate of COVID-19 cases across the globe. The strong relationship between local climate and COVID-19 growth rates suggests the possibility of seasonal variation in the spatial pattern of outbreaks with temperate regions of the Southern Hemisphere becoming at particular risk of severe outbreaks during the southern autumn-winter season (Ficetola and Rubolini, 2020). Even with widespread vaccinations and stringent containment measures in place, the seasonality of undulating SARS CoV-2 infections growth rates in the Northern Hemisphere has endured over the past 24 months.

Figure 7 - Emerging seasonal and place variability in SARS CoV-2 infection rates

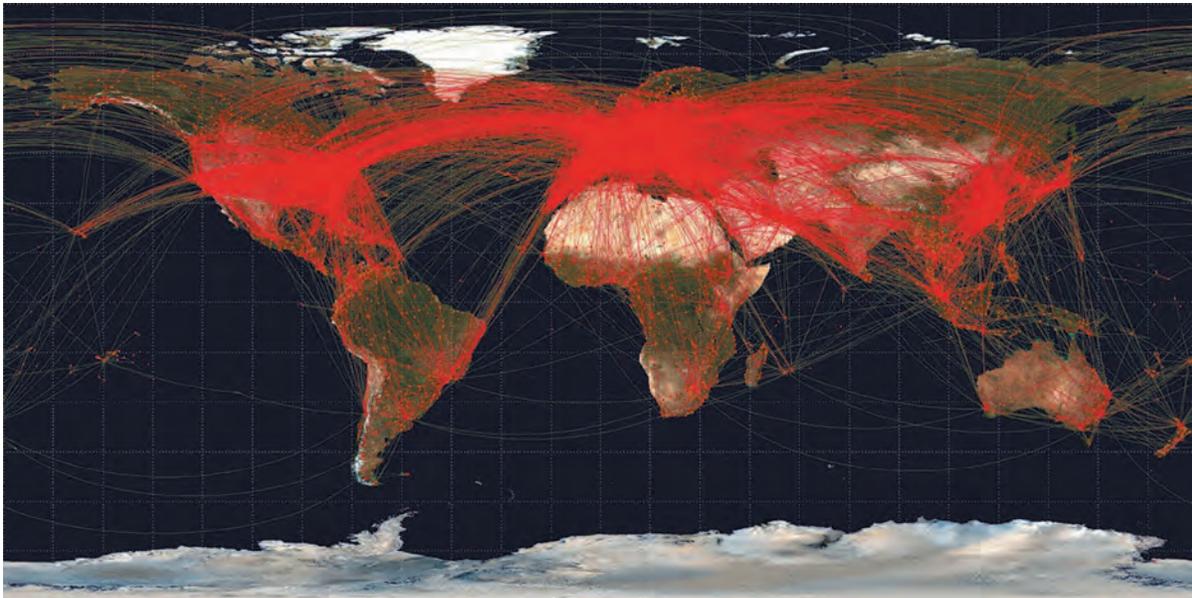


Figure 7 shows how the global transportation network plays a crucial role in pandemic expansion by facilitating the spread of viruses and their vectors. Travel reduces or even eliminates the relative importance of geographic distance in pandemic containment.

The totality of external environmental factors (referred to as the exposome) an individual is exposed to from conception onwards has a crucial impact on the totality of metabolic processes and the internal chemical environment (referred to as the metabolome). The metabolome is in turn looped to the genome (the totality of all genetic information of an organism) such that changes in the metabolome affects gene function by repressing and/or derepressing expression of

the genetic information. Different elements of the exposome present at the same time can interact synergistically to influence the metabolome and genome thus affecting the characteristics of disease etiopathogenesis. It is not inconceivable that the observed undulating seasonal SARS CoV-2 infections rates are influenced by seasonal exposome variability. A rigorous analysis of the exposome and genome in relation to SARS CoV-2 infections rates and risk for developing severe, critical and/or fatal COVID-19 could prove crucial in robust epidemiological modeling to predict future outbreak risks and effective management strategies.

8. Overall conclusions

Understanding the genetics and genomics of SARS CoV-2 is crucial in the development of reliable screening and diagnostic tests and effective vaccines and, hence, pandemic containment and prevention of COVID-19. Understanding host genetics and epigenetics, and the impact of these attributes on COVID-19 pathogenesis, is critical in the development of effective treatment and management of clinical disease. There is emerging comprehensive evidence that epigenetic therapy could aid in restoring the transcriptional changes observed during SARS CV-2 infection. By using epigenetic drugs, a therapeutic effect can be achieved due to their systemic effects, which can be advantageous to treat a disease that targets different tissues and cellular mechanisms, as observed in COVID-19 (Salgado -Albarran *et al.*, 2021). Understanding ecogenetics is crucial in environmental adaptation, pivotal in predicting the potential severity of disease outbreaks, and critical in populations transmission containment strategies. Understanding the environmental drivers of early growth rates is pivotal to predict the potential severity of disease outbreaks.

The continued progression of SARS CoV-2 transmissions, sustenance of the COVID-19 pandemic, and persistent emergence of new variants increases the likelihood of the emergence of variants, which could escape the immune response system and resist to currently available vaccines and/or therapeutic approaches. This augurs for a protracted fight against SARS CoV-2, perhaps over the next 10 years. To lessen the likelihood of this gloomy forecast, large-scale studies on different mutant types in various geographic regions around the world must be undertaken to pave the way for the development of multi-variant effective vaccines and efficacious therapeutic approaches.

References

- “ABO blood group predisposes to COVID-19 severity and cardiovascular diseases”. *Eur J Prev Cardiol.* 2020; **27**:1436-7.
- Andersen KG, Rambaut A, Lipkin WI, Holmes EC, and Garry RF (2020). “The proximal origin of SARS CoV-2”. *Nature medicine* **26**(4):450-2.
- Araújo MB, Mestre F, and Naimi B (2020). “Ecological and epidemiological models are both useful for SARS CoV-2”. *Nat. Ecol. Evol.* **4**:1153–4.

- Association of CXCR6 with COVID-19 severity: Delineating the host genetic factors in transcriptomic regulation (2021). *Hum Genet.* **140**:1313-28.
- Atlante S, Mongelli A, Barbi V, Martelli F, Farsetti A, and Gaetano C (2020). “The epigenetic implication in coronavirus infection and therapy”. *Clinical Epigenetics* **12**:156.
- Baker RE, Yang W, Vecchi GA, Metcalf CJE, Grenfell BT (2020). “Susceptible supply limits the role of climate in the early SARS CoV-2 pandemic.” *Science* **369**:315–9.
- Bannister AJ and Kouzarides T (2011). “Regulation of chromatin by histone modifications”. *Cell Res.* **21**:381–95.
- Banoun E (2021). “Evolution of SARS CoV-2: Review of mutations, role of the host immune system”. *Nephron* **145**:392–403.
- Benvenuto D, Giovanetti M, Ciccozzi A, Spoto S, Angeletti S, and Ciccozzi M (2020). “The 2019-new coronavirus epidemic: Evidence for virus evolution”. *J Med Virol.* **92**:455-
- Berger SL, Kouzarides T, Shiekhattar R, and Shilatifard A (2009). “An operational definition of epigenetics”. *Genes Dev.* **23**:781–3.
- Bloom JD (2021). “Recovery of deleted deep sequencing data sheds more light on the early Wuhan SARS CoV-2 epidemic”. bioRxiv.
- Boni MF, Lemey P, Jiang X, Lam TTY, Perry BW, Castoe TA, and Robertson DL (2020). “Evolutionary origins of the SARS CoV-2 sarbecovirus lineage responsible for the COVID-19 pandemic”. *Nature microbiology* **5**(11):1408-17.
- Casanova JL and Abel L (2018). “Human genetics of infectious diseases: Unique insights into immunological redundancy”, *Seminars in Immunolog* **36**:1-12 (April).
- Casanova JL and Su HC (2020). “A global effort to define the human genetics of protective immunity to SARS CoV-2 infection”. <https://doi.org/10.1016/j.Cell.2020.05.016>.
- (U.S.) Centers for Disease Control and Prevention (2021). “What is Epigenetics?” “24/7 (2021). [www.cdc.gov > genomics > disease > epigenetics](http://www.cdc.gov/genomics/disease/epigenetics).
- (U.S.) Centers for Disease Control and Prevention (2021). “SARS CoV-2 variant classifications and definitions”. Oct 4, 2021.
- Chakraborty C, Sharma AR, Bhattacharyac M, Agoramoorthy G, and Lee SS (2021). “Evolution, mode of transmission, and mutational landscape of newly emerging SARS CoV-2 Variants”. *mBio* **12**:e01140-21. <https://doi.org/10.1128/mBio.01140-21>.

- Chiotos K, Bassiri H, Behrens EM, et al. (2020). Multisystem Inflammatory syndrome in children during the coronavirus 2019 pandemic: A case series. *J Pediatric Infect Dis Soc*, **9**(3):393-8.
- Chlamydas S, Athanasios G, Papavassiliou, and Piperi C(2021). “Epigenetic mechanisms regulating COVID-19 infection”. *Epigenetics* **16**(3):263-70.
- Chlamydas S, Papavassiliou AG, and Piperi C (2021). Epigenetic mechanisms regulating COVID-19 infection. *Epigenetics* **16**, Issue 3.
- Coelho MTP, Rodrigues JFM, Medina AM, Scalco P, Terribile LC, Vilela B, Diniz JAF, and Dobrovolski R (2020). “Global expansion of COVID-19 pandemic is driven by population size and airport connections”. *Peerj*. **8**.
- Coronaviridae Study Group of the International Committee on Taxonomy of Viruses (2020). The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat Microbiol* **5**, 536–544 (2020). <https://doi.org/10.1038/s41564-020-0695-z>.
- Cosar B, Karagulleoglu ZY, Unalb S, et al. (2021). “SARS CoV-2 mutations and their viral variants: Cytokine and growth factor reviews”: <https://doi.org/10.1016/j.cytogfr.2021.06.001>.
- COVID-Host Genetics Initiative (2021). “Mapping the human genetic architecture of COVID-19”. *Nature*.
- (2020). “Genomewide association study of severe COVID-19 with respiratory failure”. *N Engl J Med*. **383**:1522-34.
- Dai X (2020). “ABO blood group predisposes to COVID-19 severity and cardiovascular diseases”. *Eur J Prev Cardiol*. **27**:1436-7.
- Dai Y, Wang J, Jeong HH, Chen W, Jia P, Zhao Z et al. (2021), “Association of CXCR6 with COVID-19 severity: Delineating the host genetic factors in transcriptomic regulation” *Hum Genet*. **140**:1313-28.
- Debnath M, Banerjee M, and Berk M (2020). “Genetic gateways to COVID-19 infection: Implications for risk, severity, and outcomes”. *FASEB J*. **34**: 8787-95.
- Dimitrova DG, Teyssset L and Carré C (2020). “RNA 2’-O-methylation (Nm) modification in human diseases”. *Genes* **10**:117.
- Dufort EM, Koumans EH, Chow EJ, et al., (2020). “Multisystem inflammatory syndrome in children in New York State”. *N Engl J Med* **383**(4):347-58.

- Feldstein LR, Rose EB, Horwitz SM, *et al.*, (2020). “Multisystem inflammatory syndrome in U.S. children and adolescents”. *N Engl J Med* **383**(4):334-46.
- Ficetola GF and Rubolini D (2021). “Containment measures limit environmental effects on COVID-19 early outbreak dynamics”. *Sci Total Environ*, **20**(761):144432.
- Frontera A, Cianfanelli L, Vlachos K, Landoni G, and Cremona G (2020). “Severe air pollution links to higher mortality in COVID-19 patients: The ‘double-hit’ hypothesis”. *J. Infect.* **81**:255–9.
- Gatto M, Bertuzzo E, Mari L, Miccoli S, Carraro L, Casagrandi R, and Rinaldo A (2020). “Spread and dynamics of the COVID-19 epidemic in Italy: Effects of emergency containment measures”. *Proc. Natl. Acad. Sci.* **117**:10484.
- Gomez J, Albaiceta GM, Garcia-Clemente M, Lopez-Larrea C, Amado-Rodriguez L, and Lopez-Alonso I (2020). “Angiotensin-converting enzymes (ACE, ACE2) gene variants and COVID-19 outcome”. *Gene* 762145102
- Guan WJ, Liang WH, Zhao Y, Liang HR, Chen ZS, Li YM, *et al.*, (2020). “Comorbidity and its impact on 1,590 patients with COVID-19 in China: A nationwide analysis”. *Eur Respir J.* **55**:2001227.
- Hadjadj J, Yatim N, Barnabei L, Corneau A, Boussier J, Smith N *et al.*, (2020). “Impaired type I interferon activity and inflammatory responses in severe COVID-19 patients”. *Science* **369**:718-24.
- Hidalgo A (2020). “A NET-thrombosis axis in COVID-19”. *Blood* **136**(10):1118–9.
- Hu B, Guo H, Zhou P, and Shi ZL (2021). “Characteristics of SARS CoV-2 and COVID-19”. *Nat Rev Microbiol.* **19**:141-54.
- Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y. *et al.*, (2020). “Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China”. *Lancet* **395**(10223):497–506.
- Jaenisch R and Bird A (2003). “Epigenetic regulation of gene expression: How the genome integrates intrinsic and environmental signals”. *Nat Genet.* **33**:245–54.
- Johns Hopkins University (2021). “Coronavirus research center: Mortality analyses”. Accessed on March 4, 2021. <https://coronavirus.jhu.edu/data/mortality>.
- Kaina B (2021). “On the origin of SARS CoV-2: Did cell culture experiments lead to increased virulence of the progenitor virus for humans?”. *In vivo* **35**(3):1313-26.

- Kgatle MM, Lawal IO, Mashabela G, Moshoeu T, Boshomane G, Koatale PC, Mahasha PW, Ndlovu H, Vorster M, Rodrigues HG, Zeevaart JD, Gordon S, Moura-Alves P, and Sathekge MM. (2021). “COVID-19 Is a multi-organ aggressor: Epigenetic and clinical marks”. *Front. Immunol* **12**: 08 October 2021 | <https://doi.org/10.3389/fimmu.2021.752380>.
- Kaushik SI, Aydin K.R, Derespina, et al. (2020). Multisystem inflammatory syndrome in children associated with severe acute respiratory syndrome coronavirus 2 infection: A multi- institutional study from New York City. *J Pediatr* **10**.1016.
- Krafcikova., Silhan J, Nencka R, and Boura E (2020). “Structural analysis of the SARS CoV-2 methyltransferase complex involved in RNA cap creation bound to sinefungin”. *Nat. Commun.* **11**, 3717.
- Latham J and Wilson A (2021). “Phylogeographic mapping of newly discovered coronaviruses pinpoints the direct progenitor of SARS CoV-2 as originating from Mojiang, China”. *Independent Science News*, August 2021.
- Lee J, Hughes T, Lee MH *et al.*, (2020). “No evidence of coronaviruses or other potentially zoonotic viruses in Sunda pangolins (*Manis javanica*) entering the wildlife trade via Malaysia. *Ecohealth* **17**(3):406-18. [doi: 10.1007/s10393-020-01503-x](https://doi.org/10.1007/s10393-020-01503-x). Epub 2020 Nov 23.
- Li L, Wang J, Ma X, Li J, Yang X, Shi W, and Duan Z (2021). “A novel SARS CoV-2 related virus with complex recombination isolated from bats in Yunnan province”, China. *BioRxiv*.
- Li W, Shi Z, Yu M, Ren W, Smith C, Epstein JH, Wang H, Crameri G, Hu Z, Zhang H, *et al.*, (2005): “Bats are natural reservoirs of SARS-like coronaviruses”. *Science* **310**:676-9.
- Liu P, Chen W, and Chen JP (2020). “Viral metagenomics revealed sendai virus and coronavirus infection of Malayan Pangolins (*Manis javanica*)”. *Viruses* **11**:979.
- Lu R, Zhao X, Li J, Niu P, Yang B, Wu H, Wang W, Song H, Huang B, and Zhu N (2020). “Genomic characterization and epidemiology of 2019 novel coronavirus: Implications for virus origins and receptor binding”. *Lancet* **395**:565-74.
- Lytras S, Hughes J, Martin D, de Klerk A, Lourens R, Pond SLK, and Robertson DL (2021). “Exploring the natural origins of SARS CoV-2 in the light of recombination”. *bioRxiv*.
- Lytras S, Xia W, Hughes J et al. (2020). “The animal origin of SARS COV-2: Trading of animals susceptible to bat coronaviruses is the likely cause of the COVID-19 pandemic”. *Science* **373** (6558) 968-70.
- Maggipinto GC and Minon JM (2020). “COVID-19 and ABO blood group: Another viewpoint”. *Br J Haematol.* **190**: e93-ee4.

- Martinez ME (2018). The calendar of epidemics: Seasonal cycles of infectious diseases. *PLoS Pathog* **14**(11): e1007327. <https://doi.org/10.1371/journal.ppat.1007327>.
- McCullough PA, Paul E. Alexander PE, Armstrong R, *et al.*, (2020). Multifaceted highly targeted sequential multidrug treatment of early ambulatory high-risk SARS-CoV-2 infection (COVID-19)". *Cardiovascular Medicine***21**(4): 517-30. [doi: 10.31083/j.rcm.2020.04.264](https://doi.org/10.31083/j.rcm.2020.04.264).
- Migliore L, Nicoli V, and Stoccoro A (2021). "Biomedicines. 2021 Jun 8; Gender specific differences in disease susceptibility: The role of epigenetics". **9**(6):652. [doi: 10.3390/biomedicines9060652](https://doi.org/10.3390/biomedicines9060652).
- Mittal A, Manjunath K, Ranjan RK, Kaushik S, Kumar S, and Verma V (2020). "COVID- 19 pandemic: Insights into structure, function, and hACE2 receptor recognition by SARS CoV-2". *PLoS pathogens* **16**(8), e1008762. <https://doi.org/10.1371/journal.ppat.1008762>.
- Mori H, Obinata H, Murakami W, Tatsuya K, Sasaki H, Miyake Y, *et al.*, (2020). "Comparison of COVID-19 disease between young and elderly patients: Hidden viral shedding of COVID-19". *J Infect Chemother.* <https://doi.org/10.1016/j.jiac.2020.09.003>.
- de Moura MC, Davalosa V, Planas-Serra L *et al.*, (2021). "Epigenome-wide association study of COVID-19 severity with respiratory failure".
- Mueller AL, McNamara MS, and Sinclair DA (2020). "Why does COVID-19 disproportionately affect older people?" *Aging* **12**:9959–81.
- Naqvi AAT, Fatima K, Mohammad T *et al.*, (2020). "Insights into SARS CoV-2 genome, structure, evolution, pathogenesis and therapies: Structural genomics approach". *Biochimica et Biophysica Acta (BBA) - Molecular Basis of Disease* **1866**(10):165878.
- Netzband R and Pager CT (2020). "Epitranscriptomic marks: emerging modulators of RNA virus gene expression". *Wiley Interdiscip. Rev. RNA* **11**, e1576 (2020).
- Obata Y, Furusawa Y, and Hase K (2015). "Epigenetic modifications of the immune system in health and disease". *Immunol Cell Biol.* **93**:226–32.
- Opriessnig T and Huang YW (2021). "Third update on possible animal sources for human COVID-19. *Xenotransplantation* **28**(1).
- Ovsyannikova IG, Haralambieva IH, Crooke SN, Poland GA, and Kennedy RB (2020). "The role of host genetics in the immune response to SARS CoV-2 and COVID-19 susceptibility and severity". *Immunol Rev.* **296**(1):205-19.

- Paramasivam A (2020). “RNA 2'-O-methylation modification and its implication in COVID-19 immunity”. *Cell Death Discov.* **6**:118. <https://doi.org/10.1038/s41420-020-00358-z>.
- Piplani S, Singh PK, Winkler DA *et al.* (2021). “*In silico* comparison of SARS CoV-2 spike protein- ACE2 binding affinities across species and implications for virus origin”. *Sci Rep* **11**, 13063.
- Radia T, Williams N, Agrawal P, Harman K, Wealec J, Cook J, Guptab A (2021). Multi- system inflammatory syndrome in children & adolescents (MIS-C): A systematic review of clinical features and presentation. *Paediatric Respiratory Reviews* **38**: 51-7.
- Rahalkar MC and Bahulikar RA (2020). “Lethal pneumonia cases in Mojiang miners (2012) and the mineshaft could provide important clues to the origin of SARS CoV-2”. *Frontiers in public health* **8**:638.
- Rahimi A, Mirzazadeh A, and Tavakolpour S (2021). “Genetics and genomics of SARS CoV-2: A review of the literature with special focus on genetic diversity and SARS CoV-2 genome detection”. *Genomics* **113**(1 Pt 2):1221-32.
- Ramakrishnan V (1997). “Histone structure and the organization of the nucleosome”. *Annu. Rev. Biophys. Biomol. Struc*
- Rampal L and Liew BS (2020). “Coronavirus disease (COVID-19) spreads situation reports”. *WHO* **75**:95–7.
- (The) REMAP-CAP Investigators (2021). “Interleukin-6 receptor antagonists in critically ill patients with COVID-19”. *N Engl J Med.* **384**:1491-502.
- Rentsch CT, Kidwai-Khan F, Tate JP, Park LS, King JT Jr, Skanderson M, *et al.*, (2020). “Patterns of COVID-19 testing and mortality by race and ethnicity among United States veterans: A nationwide cohort study”. *PLoS Med* **17**(9): e1003379. <https://doi.org/10.1371/journal.Pmed.1003379>.
- Roseboom T (2019). “Epidemiological evidence for the developmental origins of health and disease: effects of prenatal undernutrition in humans external” *J Endocrinol.* [242:T135-T144](https://doi.org/10.1093/endo/bwz014).
- Sajadi MM, Habibzadeh P, Vintzileos A, Shokouhi S, Miralles-Wilhelm F, and Amoroso A (2020). “Temperature, humidity, and latitude analysis to estimate potential spread and seasonality of coronavirus disease 2019 (COVID-19)”. *JAMA Netw. Open* **3**:e2011834.

- Saksena N, Bonam SR, and Miranda-Saksena M (2021). “Epigenetic Lens to Visualize the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS CoV-2). Infection in COVID-19 pandemic”. *Front. Genet.* 22 March 2021. <https://doi.org/10.3389/fgene.2021.581726>.
- Salgado AM, Navarro-Delgado EI, Del Moral-Morales A et al. (2021). “Comparative transcriptome analysis reveals key epigenetic targets in SARS CoV-2 infection. *Npj Syst Biol Appl* 7(21). <https://doi.org/10.1038/s41540-021-00181>.
- “SARS-CoV-2 spike protein impairs endothelial function via downregulation of ACE 2”. *Circ Res.* **128**:1323-6.
- Selvaraj C et al., (2020). “Structure-based virtual screening and molecular dynamics simulation of SARS CoV-2 guanine-N7 methyltransferase (nsp14) for identifying antiviral inhibitors against COVID-19”. *J. Biomol. Struct. Dyn.* **16**: 1–12.
- Sen R, Garbati M, Bryant K, and Lu Y (2021). “Epigenetic mechanisms influencing COVID-19 genome” **64**(4):372-85. [doi: 10.1139/gen-2020-0135](https://doi.org/10.1139/gen-2020-0135). Epub 2021 Jan 4.
- Sethumadhavan DV, Jabeena CA, Govindaraju G, Soman A, and Rajavelu A (2021). “The severity of SARS CoV-2 infection is dictated by host factors? Epigenetic perspectives”. *Curr Res Microb Sci.* (Dec 2) 100079. [doi: 10.1016/j.crmicr.2021.100079](https://doi.org/10.1016/j.crmicr.2021.100079). Epub 2021 Oct 27.
- Seyed-Alinaghi SA, Mehrtak M, Mohssenipour M et al., (2021), “Genetic susceptibility of COVID-19: a systematic review of current evidence”. *Eur J Med Res* **26**:46.
- Shang J, Wan Y, Luo C, Ye G, Geng Q, Auerbach A, et al., (2020). “Cell entry mechanisms of SARS CoV-2”. *Proc Natl Acad Sci.* **117**:11727-34.
- Shereen MA, Khan S, Kazmi A, Bashir N, and Siddique R (2020). “COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses”. *J Adv Res.* **24**:91–8.
- “Signal pathways and treatment of cytokine storm in COVID-19”. *Signal Transduct Target Ther.*
- Sironi M, Hasnain SE, Rosenthal B, Phan T, Luciani F, Shaw MA, Anice Sallum M, Mirhashemi ME, Morand S, and González-Candelas F. (2020): “SARS CoV-2 and COVID-19: A genetic, epidemiological, and evolutionary perspective”. *Infect Genet Evol* **84**:104384.
- Tamerius JD, Shaman J, Alonso WJ, Bloom-Feshbach K, Uejio CK, Comrie A, Viboud C (2013). “Environmental predictors of seasonal influenza epidemics across temperate and tropical climates”. *PLoS Pathog.* **9**:12.

- Tzika E, Dreker T, and Imhof A (2018). “Epigenetics and metabolism in health and disease”. *Front. Gen.* **9**:361.
- Ulhaq ZS and Soraya GV (2020). “Anti-IL-6 receptor antibody treatment for severe COVID-19 and the potential implication of IL-6 gene polymorphisms in novel coronavirus pneumonia”. *Med Clin Barc.* **155**:548-56.
- van Dorp L, Richard D, Tan CC, Shaw LP, Acman M, and Balloux F (2020). “No evidence for increased transmissibility from recurrent mutations in SARS CoV-2”. *Nature communications* 11(1), 1-8.
- Velavan TP, Pallerla SR, Rüter J, Augustin Y, Kreamsner PG, Krishna S, and Meyeret C (2021). “Host genetic factors determining COVID-19 susceptibility and severity”. *Ebiomedicine* 72: 103629.
- Verdoni L, Mazza A, Gervasoni A, *et al.*, (2020). “An outbreak of severe Kawasaki-like disease at the Italian epicenter of the SARS CoV-2 epidemic: An observational cohort study.” **395**(10239):1771-8.
- Viswanathan T *et al.*, (2020). “Structural basis of RNA cap modification by SARS CoV-2”. *Nat. Commun.* **11**:3718.
- Wacharapluesadee S, Tan CW, Maneeorn P, Duengkae P, Zhu F, Joyjinda Y, and Wang LF (2021). “Evidence for SARS CoV-2 related coronaviruses circulating in bats and pangolins in Southeast Asia”. *Nature communications* **12**(1), 1-9.
- Wang MY, Zhao R, Gao JM *et al.*, (2020). “SARS CoV-2: Structure, biology, and structure-based therapeutics development”” *Front. Cell. Infect. Microbiol.*, 25 November 2020. <https://doi.org/10.3389/fcimb.2020.587269>.
- Wang Q, Zhang Y, Wu L, Niu S, Song C, Zhang Z, *et al.*, (2020). “Structural and functional basis of SARS CoV-2 entry by using human ACE2”. *Cell* **181**:894–904.
- Wickenhagen A, Sugrue E, Lytras S, *et al.*, (2021). “A prenylated dsRNA sensor protects against severe COVID-19”. *Science* **374**:579.
- Wool GD and Miller JL (2021). “The impact of COVID-19 disease on platelets and coagulation”. *Pathobiol J Immunopathol Mol Cell Biol.* **88**:15-27.
- World Health Organization, Multisystem inflammatory syndrome in children and adolescents temporally related to COVID-19, WHO/2019nCoV/Sci_Brief/Multisystem_Syndrome_Children/2020.1.

World Health Organization (2020). Coronavirus disease (COVID-19) outbreak. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>.

World Health Organization (2021). “Tracking SARS CoV-2 variants”. WHO.int. <https://www.who.int/en/activities/tracking-SARS-CoV-2-variants/>

Wu F, Zhao S, Yu B, Chen YM, Wang W, Song ZG, Hu Y, Tao ZW, Tian JH, Pei YY, Yuan ML, Zhang YL, Dai FH, Liu Y, Wang QM, Zheng JJ, Xu L, Holmes EC, and Zhang YZ(2020). “A new coronavirus associated with human respiratory disease in China. *Nature*. **579**:265–9.

Wu F, Zhao S, Yu B, Chen YM, Wang W, Song ZG, Hu Y, Tao ZW, Tian JH, Pei YY, Yuan ML, Zhang YL, Dai FH, Liu Y, Wang QM, Zheng J-J, Xu L, Holmes EC, and Zhang YZ(2020). “Complete genome characterization of a novel coronavirus associated with severe human respiratory disease in Wuhan, China”. bioRxiv: the preprint server for biology. 2020.2001.2024.919183.

Wu L (2019). “HIV evades immune surveillance by methylation of viral RNA”. *Biochemistry* **58**:1699–700.

Wu Y, Jing W, Liu J, Ma Q, Yuan J, Wang Y, Du M, and Liu M (2020). “Effects of temperature and humidity on the daily new cases and new deaths of COVID-19 in 166 countries”. *Sci. Total Environ*. **729**:139051.

Xiao X, Newman C, Buesching CD *et al.*, (2021). “Animal sales from Wuhan wet markets immediately prior to the COVID-19 pandemic.” *Sci Rep* **11**:11898. <https://doi.org/10.1038/s41598-021-91470-2>.

Yang L, Xie X, Tu Z *et al.*, (2021). “Signal pathways and treatment of cytokine storm in COVID-19”. *Sig Transduct Target Ther* **6**:255. <https://doi.org/10.1038/s41392-021-00679-0>.

Ye Q, Wang B, and Mao J (2020). “The pathogenesis and treatment of the ‘cytokine storm’ in COVID-19”. *J. Infect*. **80**(6):607–13.

Ye ZW, Yuan S, Yuen KS, Fung SY, Chan CP, and Jin DY (2020). “Zoonotic origins of human coronaviruses”. *Int. J. Biol. Sci*. **16**:1686–97.

Yildirim Z, Sahin OS, Yazar S, and Cetintas VB (2021). “Genetic and epigenetic factors associated with increased severity of COVID-19”. *Cell Biol Int*. **45**:1158-74.

Zhan SH, Deverman BE, and Chan YA (2020). “SARS CoV-2 is well adapted for humans. What does this mean for re-emergence?”. bioRxiv. doi: <https://doi.org/10.1101/2020.05.01.073262>.

Zhang T, Qunfu Wu Q, and Zhang Z (2020). “Probable pangolin origin of SARS CoV-2 associated with the COVID-19 outbreak”. *Current Biology* **30**:1-6.

Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, *et al.*, (2020). “Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: A retrospective cohort study”. *Lancet* **395**(10229):1054–62.

Zhou H, Ji J, Chen X, Bi Y, Li J, Hu T, and Shi W (2021). “Identification of novel bat coronaviruses sheds light on the evolutionary origins of SARS-CoV-2 and related viruses”. BioRxiv. (Now published in *Cell* **184**:4380–91.

Zhou P and Shi ZL (2021). “SARS CoV-2 spillover events”. *Science* **371**(6525):120-2.

Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, Si HR, Zhu Y, Li B, Huang CL, Chen HD, Chen J, Luo Y, Guo H, Jiang RD, Liu MQ, Chen Y, Shen XR, Wang X, Zheng XS, Zhao K, Chen QJ, Deng F, Liu LL, Yan B, Zhan FX, Wang YY, Xiao GF, and Shi ZL (2020). “A pneumonia outbreak associated with a new coronavirus of probable bat origin”. *Nature* **579**(7798):270-3.

Zhou S, Zhang J, Xu J, Zhang F, Li P, He Y, Wu J, Wang C, Wang X, Zhang W, Ning K, Pan Y, Liu T, Zhao J, Yin L, Zhang R, Gao F, Zhao J, and Dong L (2021). “An epigenome-wide DNA methylation study of patients with COVID-19”. *Ann Hum Genet.* **85**(6):221-34. [doi: 10.1111/ahg.12440](https://doi.org/10.1111/ahg.12440). Epub 2021 Jun 29.

Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P, Zhan F, Ma X, Wang D, Xu W, Wu G, Gao GF, and Tan W (2019). “A novel coronavirus from patients with pneumonia in China”. *N. Engl. J. Med.* **382**:727–33.

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Chapter Twenty-One

Predicting and preventing the next pandemics

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Abstract – During the current COVID-19 pandemic, our world remains under-prepared to predict, detect, respond, and even less prevent infectious disease outbreaks and *a fortiori* pandemics. This is the case whether they are naturally occurring, accidental, or deliberately released. It may surprise some of us but SARS CoV-2 (the causal virus) was predictable in some limited sense. There were reports, briefings, warnings about viruses bearing traces of their animal origins and of emerging infectious diseases... but, for various reasons, they have not been heeded. Yet, the cost of failing to control outbreaks, ruining and losing lives, destabilizing the social fabric, and decimating economies is considerably greater than the cost of prevention. It is therefore in each country’s security interest to strengthen global health security and manage the risk of infectious disease outbreaks that might further develop into full-blown pandemics. In this Chapter, after a brief perspective on past pandemics, I identify the ten cardinal socioecological factors responsible for the occurrence of pandemics. I set forth the needed infrastructures and international developments for the effective prediction and prevention and pandemics. After identifying the organizations pursuing a global health agenda, I extend the “One health” paradigm to the “One-World-One *ecoHealth*” paradigm. I further provide some remarks on decision-making of policies driven by epidemiological modeling and review enabling technologies for predicting and preventing the next pandemics, I lastly outline the needed research program for such a capability.

Keywords: *COVID pandemic; SARS CoV-2 virus; cardinal sociological factors; zoonotic diseases; “One-World-One *ecoHealth*” paradigm; Global Human Virome Project; epidemiological modeling; pandemic prediction & prevention; global health security.*

Abbreviations

AI : Artificial intelligence
CDC : (U.S.) Center for Disease Control and Prevention

CFR	: Case Fatality Ratio
CoV	: Coronavirus
CPEAH	: Communities of Practice in Ecosystem Approaches to Health
EHA	: EcoHealthAlliance
EHI	: EcoHealth International
EWS	: Early Warning System
GHSA	: Global Health Security Agenda
GHSS	: Global Health Security System
GISL	: Global Immune System-Like
GVP	: Global Virome Project
GHVP	: Global Human Virome Project
IAEH	: International Association for Ecology and Health
IRA	: The International Resilience Alliance
ISID	: International Society for Infectious Diseases
MERS	: Middle East Respiratory Syndrome
ML	: Machine learning
MSF/DWB	: Medecins sans Frontieres/Doctors without Borders
OIE/WOAH	: Office International des Epizooties in Paris/World Organization for Animal Health
PAC-MAN	: Prophylactic Antiviral Crispr in huMAN cells
ProMED	: Program for Monitoring Emerging Diseases
SAES	: Severe Acute Respiratory Distress
SME	: Subject Matter Expert
SORMAS	: Surveillance, Outbreak Response Management and Analysis System
USAID	: United States Agency for International Development
VSF/VWB	: Veterinaires sans Frontieres/Veterinarians without Borders
WHO	: World Health Organization

1. Introduction

According to the World Health Organization (WHO), more than 70% of pathogens capable of causing symptoms and even killing humans originate in animals. Indeed, all new, emerging, or re-emerging diseases affecting humans at the beginning of the 21st century are zoonotic, i.e. they are transmitted from animals to humans through direct or indirect contact or through food, water, and the environment

These threats endanger lives, disrupt families and societies, and wreck havoc on economies. They do not respect national boundaries, do not discriminate between different ethnicities, religions, social or economic status or even age, and can spread rapidly jeopardizing the health, security, and prosperity of all world countries. Indeed, physical distance alone no longer provides protection as pathogens can move from one point on Earth to almost any other place in the world within less than 36 hours!

Yet, the cost of failing to control outbreaks, ruining and losing lives, destabilizing the social fabric, and decimating economies is considerably greater than the cost of prevention. It is therefore in each country's security interest to strengthen global health security and manage the risk of infectious disease outbreaks that might further develop into full-blown pandemics.

It may surprise some of us but SARS CoV-2 (the virus causing COVID-19) was predictable in some limited sense. There were reports, briefings, warnings about viruses bearing traces of their animal origins and of emerging infectious diseases... but, for various reasons, they have not been heeded. Nonetheless, the manner in which COVID-19 spread to (and in many cases killing) older people, immunocompromised people, but also younger adults or even infants and children has taken us all by surprise. It should not have been so!

Now, perhaps more than ever before, we should recognize and seize this moment as the most opportune time to address the prevention and management of health crises. Highlighting global health security, strengthening multidisciplinary engagement and multisectoral coordination while emphasizing the importance of financial preparedness will be paramount for containing the current pandemic and facing future health threats and pandemics. Further, improvements in early warning and detection, timely data sharing, laboratory testing, and joint outbreak response capacities will create and strengthen the mechanisms necessary to effectively detect and respond to emerging zoonotic threats, prevent pandemics, and thereby enhance global health security.

But first, what do I mean by “pandemic prevention”? It is the organization and management of preventive measures to prevent pandemics. It seeks four measures: (1) to prevent outbreaks and epidemics from becoming pandemics, (2) to reduce causes of new infectious diseases, (3) in some measure, to prepare for potential future pandemics that could not be prevented, and (4) to ensure that the causing virus does not re-emerge (e.g., by sustaining itself in domestic animals). Pandemic prevention should not be mistaken for “pandemic preparedness” or “pandemic containment” or “pandemic mitigation”, which largely seek to reduce the severity and negative impacts of pending or established pandemics.

2. A brief perspective from past pandemics

But, before getting engrossed in these topics, let us first sit back and have a brief perspective from past pandemics starting from identifying their root cause(s), reviewing our present guidelines for pandemic response, and identifying the several international organizations that are pursuing a global health agenda. This will allow us to focus on the health paradigm shift we are witnessing to “one-world, one-health”, or better yet “one world-one *ecohealth*” that, together with the Global Human Virome Project, has the potential to be the beginning of the end of pandemics.

As already stated, all pandemics are zoonotic viral diseases, the viruses having jumped directly from their animal habitat to humans or indirectly from animals to other animals to humans. Some of them (mostly the influenzas) took the direct route from chickens or pigs to people.

Others, such as Ebola, SARS, and COVID-19 took a circuitous route from bats, pausing at “rest stops” in one or two other animals (civets, monkeys, perhaps pangolins) before finding their ways into humans.

To be sure, endemics, epidemics, and pandemics have been with us since the beginnings of time. Whereas lack of data up until 1500 would preclude meaningful searches for outbreaks in the more distant past, Table 1 nonetheless provides a distant historical perspective:

Table 1 – Distant historical perspective of pandemics

Date	Case fatality ratio	Characteristics
~ 6000 BCE		Possibly the first pandemic in China
~ 2,400 BCE		Hippocrates described a pandemic of influenza
1492		Spread from Europe to the Americas (early European colonizations)
8 th century BCE		Homer’s <i>Odyssey</i> describes a flu epidemic
430 BCE		Hippocrates’ writings
429-426 BCE	Plague of Athens	Thucydides
1493		Almost entire indigenous population of the Antilles was killed by an epidemic resembling influenza after the arrival of Christopher Columbus
1510	1%	First convincing record of an influenza pandemic. It begun in East Asia before spreading to North Africa and then to Europe
1557		First reliably recorded pandemic (killed Queen Mary I of England and the Archbishop of Canterbury within 12 hours of each other)
1580	>1,000 in Rome, several Spanish cities saw large scale deaths (including the Queen of Spain, Anna of Austria)	Begun in East Asia, pandemic spread to Europe through Africa, Russia, and the Spanish and Ottoman Empires
17th-18th century		Pandemics continued sporadically
1830-1833	25% of people exposed were infected	Particularly wide-spread pandemic

Closer to us, Table 2 shows the characteristics of flus and pandemics since the end of the 19th century. In particular, the **1918-1920 Spanish flu** pandemic that caused ~75-100 million deaths was described as “the greatest medical holocaust in history”, perhaps as many people as the Black Death. That flu killed 2.5%-5% of the world’s population of which 25 million in the first 25 weeks. By contrast, HIV/AIDS has killed 25 million in its first 25 years! The Spanish flu spread even to the Arctic and the remote Pacific Islands, killing 2%-4% of those infected, as opposed to the more usual flu epidemic mortality rate of 0.1%. Unusually, it mostly killed young adults (99% of people under 65, and more than half of young adults aged 20-40). This is unusual since influenza is normally most deadly to the very young (under age 2) and the very old (over age 70).

Table 2 – Characteristics of recent flus and pandemics

Name	1889-90 flu	Spanish pandemic flu	Asian flu	Hong Kong pandemic flu	Swine pandemic flu	Typical seasonal flu
Date	1889-90	1918-20	1957-58	1968-69	2009-10	Every year
World population	1.53 billion	1.8 billion	2.9 billion	3.53 billion	6.85 billion	7.75 billion
Subtype	Likely H3N8 or H2N2	H1N1	H2N2	H3N2	H1N1/09	A/H3N2, A/H1N1. B,
R0	2.10 IQR: 1.9-2.4	1.80 IQR: 1.47-2.27	1.65 IQR: 1.53-1.70	1.80 IQR: 1.56-1.85	1.46 IQR: 1.30-1.70	1.28 IQR:1,19-1,37
Infected (est.)	20-60% (300-900 million)	33% or >56% (500 million or >1 billion)	>17% (>500 million)	>14% (>500 million)	11-21% (0.7-1.4 billion)	5-15% (340 million-1 billion) 3-11% or 5-20% (240 million-1.6 billion)
Deaths worldwide	1 million	17-100 million	1-4 million	1-4 million	151,700-575,400	290,000-650,000/year
CFR	0.10-0.28%	2-3% or ~4% or ~10%	<0.2%	<0.1%	0.01%	<0/1%
Pandemic severity	2	5	2	2	1	1

R0= reproduction number; CFR: Case Fatality Rate. *Data source: Wikipedia*

Before 2020, the only WHO-declared pandemics were in 1918 (the *Spanish flu*), 1968 (the *Hong Kong flu*), and 2009 (the *swine flu*). This overlooks the **Black Death** (75-100 million deaths or 30% of Europe's population), and the six choleras, especially the **Third cholera** (1 million deaths) and the **Sixth cholera** (> 800,000 deaths). According to the WHO, as of 16 August 2021 (at 6:41 pm CEST), there have been 207,173,086 confirmed COVID-19 cases and 4,361,996 deaths worldwide, that is a ratio (deaths/confirmed cases) of 2.11%. In addition, to that same date, 4,452,111.854 vaccine doses were dispensed for a global population of 7,886,655,820, that is a ratio (number of doses/global population) of 56.45%.

Other notable reminders of how vulnerable our increasingly interconnected world is to the global impact of new emerging diseases include: *HIV/AIDS*; *SARS* (Severe Acute Respiratory Syndrome), the 21st Century's first pandemic) *MERS* (Middle East Respiratory Syndrome); *MERS-CoV* (MerS Coronavirus); *Ebola*; *Marburg*; and *Nipah*,

We understand, therefore, why the increase in the number of naturally occurring outbreaks over the past 15 years (e.g., influenza, Ebola, Zika, and Rift Valley fever) and the risk posed by an accidental or deliberate release of pathogens are highlighting the critical need for robust prevention, detection, and response mechanisms. However, achieving global health security requires a sustained, coordinated, multidisciplinary and multisectoral approach that incorporates an understanding of the linkages between human, animal, and environmental health.

3. Global patterns of zoonoses – the ten cardinal socioecological factors

Global patterns of zoonoses reflect social and ecological changes that go well beyond individuals and communities. If we look over the natural history of zoonoses and their emergence or re-emergence in the early 21st century, the general causes are a mixture of the following 10 factors, which I shall call the “ten cardinal socioecological factors”:

- ✓ ***Rapid growth of the global human population***: Advances in medicine, eradication of certain diseases, lifespan increases, and lack of birth control (especially in poor areas);
- ✓ ***Human's creation of new urban or agricultural ecosystems***: In the ruins of older, non-human dominated ecosystems. Ebola, Marburg, Chagas, SARS CoV, and SARS CoV-2 emerged in part because people invaded new territories where other animals and their microbes have lived in some rough kind of harmony for millenia;
- ✓ ***Economies of scale and monocultures in agriculture***: Have created ideal conditions for the generation of epidemics of avian influenza, salmonellosis, and SARS-CoV2;
- ✓ ***Dysfunctional agri-food system***;
- ✓ ***Loss of biodiversity***;
- ✓ ***Human-induced climate change***: Is contributing to the destabilization of ecosystems and the dispersal of animals and microbes into new areas.
- ✓ ***Fast global travel and unfettered free trade***: Have fostered the spread of epidemics;

- ✓ *Social inequities;*
- ✓ *Marginalization of poor people;* and
- ✓ *Rapid sprawl of slums:* With bad housing, inadequate water, and standing sewage.

They have irremediably originated ecosystems that change the patterns of old infectious diseases and created opportunities for new ones. Thus, to overcome pandemics, it would appear that we may need to palliate some or all of the above factors. For this, we need to develop needed infrastructures and national/regional/international organizations to pursue a global health agenda... a “one-world, one-health” agenda or, better yet, a “one-word-one *ecohealth*” agenda.

4. Needed infrastructures and international developments

To stop contagions promptly, we need robust and collaborating public health systems that have the dual capacity for (a) active surveillance for early detection of cases and (b) mobilization of their health care coordination capacity. After an outbreak, there is a certain window of time during which a pandemic can still be stopped by the competent authorities isolating the first infected individuals and/or fighting the pathogen. In that effort, a good global infrastructure, established information exchange processes, a supporting and streamlined bureaucracy, and effectively targeted treatment measures can be prepared.

Often local authority carers or doctors in “hot spot” regions (Africa, Asia, Latin America) register uncommon accumulations (or clusterings) of symptoms but lack options for more detailed investigations. For that reason, in 2012, it has been proposed to consider pandemic prediction and prevention as an aspect of international development. Such a development would include both the health-care infrastructure and changes to dynamics between humans and their environment (including animals) as it relates to pathogen-dynamics. Such organizations and their programs are reviewed in the following sections.

5. Selected organizations pursuing a global health agenda

In addition to the WHO, organizations pursuing a global health agenda are the (U.S.) Government Global Health Security Strategy (GHSS), the (U.S.) Agency for International Development (USAID), the (U.S.) Centers for Disease Control & Prevention (CDC), their international counterparts, and the Global Health Security Agenda (GHSA).

- ✓ **GHSS:** It aims to prevent, detect, and respond to infectious disease threats at home and abroad, whether naturally occurring, unintentional, or deliberate. It strengthens global health security, including accelerating the capabilities of targeted countries to prevent, detect, and respond to infectious disease outbreaks domestically and globally.
- ✓ **USAID:** After completing its program on emerging pandemic threats, the USAID has just initiated a 5-year “Strategies to prevent spillover” project to anticipate and address

threats posed by the emerging zoonotic diseases that pose the greatest risk of jumping from animals to humans.

- ✓ **CDC:** Through its Global Disease Detection Operations Center, the CDC monitors disease outbreaks and other health emergencies of potential international importance, historically providing verification and early warning of more than 300 outbreaks/year.
- ✓ **GHSA:** Importantly, the GHSA serves as “a catalyst for progress toward the vision of attaining a world safe and secure from global health threats posed by infectious diseases”. Launched by a consortium of 39 countries in 2014, as of 2018, it has grown to 69 participating countries representing nearly 6 billion people, and is anticipated to include more than 100 countries by 2024. Its Kampala Declaration (October 2017) has extended its existence by 5 additional years (till 2024). These countries have come together to achieve the vision of a world safe and secure from global health threats posed by infectious diseases (the “*one-world- one health*” paradigm). It addresses priorities and gaps in efforts to build and improve country capacity and leadership in the prevention and early detection of, and effective response to, infectious disease threats. It emphasizes the need for strong multisectoral engagement, including human and animal health, agriculture, security, defense, law enforcement, development assistance, foreign affairs, research, and finance sectors among others.

In 2020, in the context of globalization, human-induced climate change, ecological collapse, species extinctions, human overpopulation, huge economic and political disparities, and unintended consequences of well-meaning interventions, the above paradigm needs to be further extended to “one-world, one *ecohealth*” paradigm.

Other organizations or institutions that are active in this paradigm are:

- **IRA:** The International Resilience Alliance;
- **OIE/WOAH** (Office International des Epizooties in Paris/World Organization for Animal Health): Created in January 1918-24 from the “need to fight animal diseases at the global level”. It has a total of 182 Member Countries, maintains permanent relations with nearly 75 international and regional organizations, and has Regional and subregional Offices on every continent;
- **IAEH:** The International Association for Ecology and Health;
- **EHA:** EcoHealthAlliance;
- **EHI:** EcoHealth International;
- **CPEAH:** The Communities of Practice in Ecosystem Approaches to Health;

- **MSF/DWB:** Medecins sans Frontieres (Doctors without Borders);
- **VSF/VWB:** Veterinaires sans Frontieres (Veterinarians without Borders);
- **GVP:** It aims to identify the causes of fatal new diseases before emergence in human hosts by genetically characterizing viruses found in wild animals. It consists in collecting hundreds of thousands of viruses, mapping their genomes, characterizing and risk-stratifying them to identify the risky ones; and
- **GHVP:** It aims to sequence the genome of all known and to be discovered viruses. Between 631,000 and 827,000 (actually one million or more) unknown viruses might be zoonotic and, thus, have the potential to infect humans after spillover from host animal populations. The big idea is to gradually build a global atlas of most of the planet's naturally occurring, potentially zoonotic viruses by systematically creating the missing maps.

Some infectious diseases experts have criticized the GHVP project for being too broad and expensive due to limited global scientific and financial resources and also because only a small percentage of the world's zoonotic viruses may cross into humans and pose a threat. They argue for prioritizing rapidly detecting diseases when they cross into humans and improving the understanding of their mechanisms.

Together with the GVP and the GHVP, and with due consideration of the 10 cardinal socio-ecological factors, the new paradigm of “one world-one *ecohealth*” may have the potential to be the beginning of the end of pandemics.

Prior to concluding, I would like to offer some remarks on decision-making in health policies that are driven by epidemiological modeling through mathematical (differential) equations and numerical simulations.

6. On health policies decision-making driven by epidemiological modeling

To make science-based decisions regarding the containment and abatement of a pandemic (including the current one), policymakers have resorted to epidemiological modeling (a tool in mathematical biology). Based on experiences with past epidemics, increasing knowledge of the SARS-Cov2 virus, and the drivers of the current pandemic, several modelers have used their models to numerically simulate how the disease spread and, unfortunately, may continue to spread. (This is much like weather and climate prediction as they are well know to all.)

These science-based predictions can be (and have been) applied to various geographical locales and even globally. I will not describe them here. However, it must be kept in mind that they

are only mathematical/statistical simulations that aim to mimic but may not actually describe reality. Further, all models and their results are beset by their underlying assumptions, the uncertainties of the data employed to run them and, at times, the lack of critical data. At the start of an epidemic, such uncertainties include:

- The average proportion of infected people who die and the number of people that can be infected by one person (the so-called *reproduction number*, R_0);
- The number of days the virus takes to infect a person (so-called *incubation period*);
- The number of asymptomatic people who can still spread the virus;
- The proportion of people having natural immunity to the virus; etc.

The decision comes as to which model to choose. The answer would be to use more than one (perhaps even all) model(s), hoping they will lead to consistent results. However, although projections might not diverge wildly depending on the approach chosen, it is natural to wonder how reliable any of the simulations are. Indeed, many scientists have voiced their reservations or even objections and disapprovals of them especially since during an epidemic, it is hard to get data — such as on infection rates — against which to judge a model's projections. In addition, the uncertainties associated with the validity and accuracy of the tests administered and the resulting numbers of cases and deaths reported (in other words, our whole surveillance system) may be questionable and in need of further research. Further, reliance on the models can lead to drastic measures on society as a whole (such as allowing the disease to spread while protecting the oldest in society; the ability of the healthcare infrastructure to handle the number of infected people; social/physical distancing; widespread testing; the use of pressurized oxygen outside intensive care units versus invasive mechanical ventilators that require such units; contact tracing; lockdowns). It behooves us to develop as accurate and predictive models as possible. To avoid too much reliance on any one model, policy makers and governments should take advice from several modeling groups.

Nonetheless, the models represent a useful quantitative tool that has assisted policymakers and guided the responses of the various countries and the world to the current pandemic.

7. Enabling technologies for predicting and preventing the next pandemics

7.1 Principle

In 2012, Morse *et al* claimed that:

“.... new mathematical modeling, diagnostic, communications, and informatics technologies can identify and report hitherto unknown microbes in other species, and thus new risk assessment approaches are needed to identify microbes most likely to cause human disease”.

The study investigated challenges in **moving the global pandemic strategy from response to pre-emption**. Note, however, that despite recent advances in pandemic modeling, some experts using mostly experience and intuition have been more accurate in predicting the spread of disease than strictly mathematical models.

7.2 Technologies

- **Early warning system (EWS) and artificial intelligence (AI):** Could be constructed for pathogen detection mechanisms. After sufficient data would have been gathered, AI could be used for surveillance and outbreak investigation by identifying common features and developing countermeasures and vaccines against whole categories of viruses.
- **Machine learning (ML):** To predict viral evolution. In April 2020, researchers developed a predictive algorithm which can show in visualizations how combinations of genetic mutations can make proteins highly effective or ineffective in organisms, including for viral evolution viruses like SARS CoV-2.
- **Artificial “global immune system-like” (GISL):** A system that includes pathogen detection may be able to substantially reduce the time required to take on a biothreat agent. The system should also involve a network of well-trained epidemiologists who could be rapidly deployed to investigate and contain an outbreak.
- **PAC-MAN (Prophylactic Antiviral Crispr in huMAN cells):** a CRISPR-Cas13d based immune subsystem (Stanford University, March 2020). PAC-MAN can find and destroy viruses *in vitro*. It has not been tested on the actual SARS CoV-2. It needs further development and clinical trials. It could be used prophylactically as well as therapeutically. The system could be **agnostic** to which virus it is fighting so novel viruses would only require a small change. It can be used as a reliable real-time option for taxonomic classification of novel pathogens.
- **ProMED (Program for Monitoring Emerging Diseases):** This is a program of the International Society for Infectious Diseases (ISID). It was launched in 1994 as an Internet service *“to identify unusual health events related to emerging and re-emerging infectious diseases and toxins affecting humans, animals and plants”*. It is the largest publicly-available system conducting global reporting of infectious diseases outbreaks. It produces reports and commentaries provided by a multidisciplinary global team of

subject matter expert (SME) moderators in 50 subject matters in various fields including virology, parasitology, epidemiology, entomology, and veterinary and plant diseases. Located across 34 countries, it constantly scans for, reviews, and posts information related to global security (human, animal, and plant health) security.

ProMED is an important and longstanding contributor to the global emerging and re-emerging infectious disease surveillance landscape. Over the last 25 years, it has been the first to report on numerous major and minor disease outbreaks including SARS, MERS, Ebola, the early spread of Zika, and many others.

In addition:

Screening blood samples from wildlife for new viruses.

Testing and containment systems for novel viruses: These include:

- a. **InfectControl 2020 program** (Germany) seeks to develop strategies for prevention, early recognition, and control of infectious diseases. It aims to detect infections without molecular-biological methods during passenger screening.
- b. **Surveillance and mapping:** Monitoring people who are exposed to animals in viral hotspots (including via virus monitoring stations) can register viruses at the moment they enter human populations - this might enable prevention of pandemics. The “Surveillance, Outbreak Response Management & Analysis System” (SORMAS) (of Germany and The Netherlands with collaboration from Nigeria) gathers and analyzes data during an outbreak, detects potential threats, and allows to initiate protective measures early.

Prior to concluding, I would like to chart some needed research.

8. Needed research vistas

Research is essential for understanding how pathogens spread and cause disease, and to generate safety and efficacy data to support regulatory decisions on clearance, approval, licensure, and emergency use. Recent outbreaks of diseases such as Lassa fever, Ebola, Zika, and Nipah have highlighted gaps in the knowledge base needed to optimally stem the outbreak. These gaps can be addressed through the integration of infectious disease research into global preparedness and response activities. Research during an emergency response is often the only available and most effective opportunity for determining the safety and efficacy of a vaccine, therapeutic, or diagnostic (which may expedite licensure and access to safe, effective countermeasures).

Since 2015, global institutions such as the WHO and the World Bank, and public-private partnerships have been responding to deficiencies in research by ensuring it is integrated into global health security preparedness and response efforts.

In the area of epidemiological simulation, it would be necessary to conduct retrospective analyses to assess the actual performance of the models and inform on updating them and their simulations. Further, the codes, models, data, and results should also be open and made available to many.

Priorities should also be allocated to research relevant to countries with weaker surveillance, laboratory facilities, and health systems, vaccine manufacturing and supply routes, and diagnostics that should be available at the point of care.

9. Conclusions

On the basis of the above considerations, the following conclusions devolve:

- Promoting global health security to detect and mitigate outbreaks early should remain a core tenet in global health security. It can help prevent the spread of human and animal infectious diseases and protect populations.
- Investments that focus on prevention and preparedness are far more cost-effective than responding to infectious disease epidemics.
- To maximize global health security and preparedness for infectious disease threats, all countries must address global health security challenges.
- The cost of failing to control outbreaks, ravaging and losing lives, destabilizing the social fabric, and decimating economies is considerably greater than the cost of prevention.
- There is a need for the development of comprehensive disease detection and response capacities, particularly in “hot spot” areas such as Central Africa, South and Southeast Asia, and Latin America where a confluence of risk factors may contribute to disease emergence.
- Improvements in early warning and detection, timely data sharing, laboratory testing, and joint outbreak response capacities in the human, animal health, and wildlife sectors will create and strengthen the mechanisms necessary to effectively detect and respond to emerging zoonotic threats, and thereby enhance global health security.
- We now live in a microbially-unified planet. Our radically mobile world gives infectious agents a truly global stage on which to act.
- The new paradigm “one-world, one-health” or better “one-world, one-ecohealth” together with due consideration of the ten cardinal socioecological factors and the Global Human Virome Project, may hopefully represent the beginning of the end of pandemics.

- While useful in offering science-based assistance to health policy decision-making during epidemics/pandemics, epidemiological models remain limited in their mimicry of reality and are beset by their basic assumptions and the lack of some critical data. Nonetheless, they are a useful tool for policy-makers and governments.

References

- Andersen KG, Rambaut A, Lipkin WI, Holmes EC and Garry RF (2020). “The proximal origin of SARS CoV-2”. *Nature medicine* **26**(4):450-2.
- Barry, JM (2005). “The Great Influenza”. Penguin Books, pp. 546. ISBN: 0143036491; n 978-0143036494.
- Branswell H (2016) a. “Finding the world’s unknown viruses—before they find us”, <https://www.statnews.com/2016/12/13/world-viruses-global-virome-project/>
- Branswell H (2016b). “There are more than 1 million viruses that we know absolutely nothing about”. <https://theweek.com/articles/667704/>
- Carroll D, Daszak P, Wolfe ND, Gao GF, Morel CM, Morzaria S, Pablos-Mendez A, Tomori O, and Mazet JAK (2018). “The Global Virome Project”, *Science* **359** (6378):872-4, [doi: 10.1126/science.aap7463](https://doi.org/10.1126/science.aap7463).
- Crook C (2001). “Globalization and its critics: A survey of globalization” in *The Economist* 360, no. 8241.
- Deese D (2012). “Globalization: causes and effects” (edited collection).
- Desforges M, Le Coupanec A, Dubeau P, Bourgouin A, Lajoie L, Dubé M, et al. (2019). “Human coronaviruses and other respiratory viruses: underestimated opportunistic pathogens of the central nervous system? *Viruses* **12**:1–28. [10.3390/v12010014](https://doi.org/10.3390/v12010014).
- Dolgin E (2021). “Stocking the shelves for the next pandemic”, *Nature* **592**:340-3.
- Fymat AL (2020). “Predicting and preventing the next pandemics”. Presented at the Joint International Seventh Annual Scientific Conference of the Society for the Advancement of Science in Africa - Ugandan Ministry of Health (Kampala, Uganda (26 October 2020).
- Fymat AL (2021a). “Paradigm for pandemic prediction and prevention”, Proceedings European Union Academy of Sciences Pandemics (e2021 Symposium), *Universal Journal of Mathematics & Computation* **9**:27-42, 2021.
- Fymat AL (2021b). “Algorithm for Predicting and Preventing the Next Pandemics” presented at the European Union Academy of Sciences (July 2021).
- Fymat AL (2021c). “Pandemics: Prescription for Prediction and Prevention”, *Tellwell Talent Publishers*, published October 2021, 352 pages. ISBN: 978-0-2288-6721-0 (hardcover); 978-0-2288-6720-3 (softcover).
- He F, Deng Y, and Li W (2020). “Coronavirus disease 2019: What we know?” *Journal of Medical Virology*, March, 1–7. <https://doi.org/10.1002/jmv.25766>
- Holmes EC, Rambaut A, and Andersen KG (2018). “Pandemics: Spend on surveillance, not prediction”, *Nature*, June 2018.

- Holloway R, Rasmussen SA, Zaza S, Cox NJ, and Jernigan DB(2014). “Updated preparedness and response framework for influenza pandemics”, *Morbidity and Mortality Weekly Report* **63**:RR-6. <https://www.cdc.gov/mmwr/pdf/rr/rr6306.pdf>.
- Honigsbaum M (2020). “The Pandemic Century – A History of Global Contagion from the Spanish Flu to COVID-19”. *W.H Allen*.
- Jinas O and Seifman R (2019). “Do we need a global human virome project”, *The Lancet* **7**(10): E1314-E1316 (October 1, 2019). “Coronavirus models: The basics” (2020). *Nature* **580**:316-8. doi: [10.1038/d41586-020-01003-6](https://doi.org/10.1038/d41586-020-01003-6).
- Kenny C (2021). “The Plague Cycle – The Unending War between Humanity and Infectious Diseases”. *Scribner*.
- Klimek P and Schiermeier Q (2021). “Deducing which pandemic policies work best”. *Nature* **591**:189.
- Mackenzie D (2021). “The Pandemic that should never have Happened and How to Stop the next One”, *Hachette*.
- Maxmen A (2021b). “Why U.S. coronavirus tracking can’t keep up with variants”, *Nature* **590**:336-7.
- Morens DM, Folkers GK, Fauci AS (2009). “What is a pandemic?” *J Infect Dis.* **200**:1018–21. [10.1086/644537](https://doi.org/10.1086/644537).
- Peduzzi P (2019). “**The speed at which temperatures are increasing is alarming. At this rate, we may reach +1.5°C in the next 15 years**”, *The United Nations Environment Program (UNEP)*.
- Philips N (2021). “The coronavirus will become endemic”. *Nature* **590**:382-4 (18 February 2021).
- Roberts L (2021). “How COVID hurt the fight against other deadly diseases”, *Nature* **592**:502-4. [Sala E, Mayorga J, Bradly D et al. \(2021\). “Protecting the global ocean for biodiversity, food, and climate, *Nature* **592**:397-402.](https://doi.org/10.1038/d41586-021-01003-6)
- Scoville H (2021). “The 5 Major Mass Extinctions”. *ThoughtCo* (Jul. 27), [thoughtco.com/the-5-major-mass-extinctions-4018102](https://www.thoughtco.com/the-5-major-mass-extinctions-4018102).
- Stohr K and Cox N (2021). “COVID-19 vaccines: Call for global push to maintain efficacy”. *Nature* **590**:36.
- Tollefson J (2021). “United States pledges dramatic cuts to greenhouse emissions”. *Nature* **592**:673-80.
- Waltner-Toews D (2010). “One Health for One World: Veterinarians without Borders”.
- Waltner-Toews D (2007, new edition 2020). “On Pandemics: Deadly Diseases from Bubonic Plague to Coronavirus”, Greystone Books, pp 262. ISBN 978-1-77164-811-0 (pbk); n978-1-77184-812-7 (epub).
- Wang C, Horby PW, Hayden FG, and Gao GF (2020). “A novel coronavirus outbreak of global health concern”. *Lancet.* **395**:470–3. [10.1016/S0140-6736\(20\)30185-9](https://doi.org/10.1016/S0140-6736(20)30185-9).
- Wolf M (2005). “Why globalization works?”.
- Wolfe ND (2012). “The Viral Storm: The Dawn of a New Pandemic Age”. St Martin’s Griffith, pp320. ISBN:125001221X; 978-1250012210.

- World Health Assembly (2020). “Resolution 73.1: COVID-19 response”. https://apps.who.int/gb/ebwha/pdf_files/WHA73/A73_R1-en.pdf.
- World Health Organization (2017). “Pandemic Influenza Risk Management.”
- World Health Organization (2019). “Strategic Preparedness and Response Plan- 2019 Novel Coronavirus (2019-nCoV).
- WorldHealthOrganization(2020).“WHO-convenedglobalstudyoftheoriginsofSARS-CoV-2”www.who.int/publications/m/item/who-convened-global-study-of-the-origins-of-sars-cov-2.
- World Health Organization (2021a). “WHO-convened global study of origins of SARS-CoV-2: China part”. www.who.int/publications/i/item/who-convened-global-study-of-origins-of-sars-cov-2-china-part.
- World Meteorological Organization (2020). “Provisional report on the State of the Global Climate 2020”.
- World Organization for Animal Health (2020). “COVID-19 Portal: Events in Animals”. www.oie.int/en/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus/events-in-animals/.
- Zinstag J, Schelling E, Waltner-Toews D, Whittaker M, and Tanner M, eds (2015). “One-Health: The Theory and Practice of Integrated Health Approaches”, Wallingford, UK: CAB International.
- Zou S, Caler L, Colombini-Hatch S, Glynn S, and Srinivas P (2016). “Research on the human virome: where are we and what is next”, *Microbiome* 4:32.

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SASA PANAFRICAN PANDEMIC PROCLAMATION

We, the Executive Council Members of the Society for the Advancement of Science in Africa (SASA), hereinafter “the Society”, virtually assembled during the Society’s 7th International Annual Scientific Conference in Kampala, Uganda:

HAVING IDENTIFIED the following 10 intertwined cardinal factors that strongly favor the perennial occurrence of pandemics, including the current COVID-19 pandemic:

- a) Rapid growth of global human world population;
- b) Increased globalization (fast global travel, population mobility, unfettered free trade);
- c) Environmental degradation and destabilization of ecosystems;
- d) Creation of new urban or agricultural ecosystems;
- e) Economies of scale and monocultures in agriculture and dysfunctional agrifood system;
- f) Loss of biodiversity;
- g) Water scarcity;
- h) Human-induced climate change;
- i) Societal inequities; and
- j) Irrational mass denialism of hard-won facts of science (vaccinations, antimicrobial overuse, etc.).

PROCLAIM the following for the ultimate purpose of helping mitigate the effects of future pandemics on African populations:

- a) The Society’s leadership and membership, serving as assets and resources, will offer free services to any requesting African government and other organizations working on the African continent.
- b) The Society’s studies will be conducted in a scientifically-independent, ethical, equitable and apolitical manner, and cooperatively with African governments and other organizations working on the African continent.
- c) Together with interested African governments and other Agencies, the Society will promote the advancement of the new paradigm “One Africa-One *ecohealth*” system.

- d) African governments and other organizations, institutions, and individuals are invited to endorse, support, and participate in this Proclamation.

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Human history has been befallen by a long chain of famines, epidemics, and pandemics. During this current COVID-19 pandemic, our world remains under-prepared to predict, detect, respond, prevent infectious disease outbreaks, and a *fortiori* pandemics - whether naturally occurring, accidental, or deliberately released. These threats endanger lives, disrupt families and societies, and wreak havoc on economies. They represent the ultimate equal opportunity condition! They do not respect national boundaries, do not discriminate between different ethnicities, religions, social or economic status or even age, and can spread rapidly jeopardizing the health, security, and prosperity of all world countries. Indeed, physical distance alone no longer provides protection as pathogens can move from one point on Earth to almost any other place in the world within less than 36 hours! Yet, the cost of failing to control outbreaks, ruining and losing lives, destabilizing the social fabric, and decimating economies is considerably greater than the cost of prevention. It is therefore in each country's security interest to strengthen global health security and manage the risk of infectious disease outbreaks that might further develop into full-blown pandemics. Having hosted several variants of the original causal coronavirus, this global warning applies particularly to the African continent where health security needs particular highlighting, multidisciplinary engagement and multisector coordination need strengthening, and financial preparedness is direly needed. Against this background, COVID-19 was naturally selected as the main theme for the 2020-2021 SASA International Conference that was jointly co-hosted by the Society for the Advancement of Science in Africa, the Uganda Ministry of Health, and other partners (World Health Organization). This volume encapsulates a range of perspectives and associated recommendations. The health as well as socio-economic challenges glaringly manifested by the pandemic are discussed for preparation and control to render African societies more resilient including response and treatment to meet the African contexts; education and transformation to address poverty concerns; envisaging and shaping new futures to cater for a more holistic and inclusive wellbeing; and adoption of scientific innovation to meet future demands for disease control.



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