INVESTIGATING COVID-19 TWITTER SENTIMENTS DURING THE 2021 VACCINE ROLL-OUT IN SOUTH AFRICA

by

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DECLARATION

I, Sinenhlanhla Jimoh, hereby declare that this is my own and personal work, except where the work(s) or publications of others have been acknowledged by means of reference techniques. I further declare that I submitted the dissertation to originality checking software, Turnitin. The result summary is attached.

I further declare that I have not previously submitted this work or part of it for examination at UNISA for another qualification or at any other higher education institution.

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ABSTRACT

Vaccination is a vital component in the control of a pandemic like COVID-19. However, to a certain extent, COVID-19 vaccines have been met with public fear and scepticism, thereby making it difficult for communication practitioners, health authorities and health experts to communicate science-based information on the vaccines. Social media have been proven to play a significant role in the low acceptability of vaccines. The fundamental objective of this research was to investigate the sentiment of tweets and themes within those tweets on COVID-19 vaccines in South Africa, from January to May 2021.

Twitter is one of the most effective platforms for monitoring vaccine sentiments with the view of informing communication campaigns of the proactive use of social media during disease outbreaks and identifying, responding to and avoiding vaccine misinformation. The results of the study hold potential interest for organisations responsible for the uptake of vaccines, such as the Department of Health, regional health organisations, like the Africa Centres for Disease Control and Prevention, global health organisations, such as the World Health Organization (WHO), and social science researchers.

The study employed both qualitative and quantitative research methodologies, while Meltwater Media Intelligence was utilised to collect data. The Meltwater Media Intelligence tool was programmed to track and identify tweets concerning COVID-19 vaccines in South Africa, from January to May 2021. To acquire relevant tweets, the program browsed and indexed tweets by using machine-learning algorithms and an online Boolean searches. Tweets were extracted by using prominent hashtags, which resulted in the creation of a research string. After the data had been cleaned, the remaining tweet collection – which consisted of 20 841 original tweets and individual users' quoted tweets – was analysed.

The sentiment analysis of tweets on COVID-19 vaccines resulted in demonstrating that the majority (85%) of tweets from January 2021 to May 2021 expressed neutral emotions around COVID-19 vaccinations.

Furthermore, tweets with neutral sentiments were the most prevalent during the entire period, whereas tweets with positive sentiments were the least prevalent during this period. Between February and May 2021, negative and positive attitudes were balanced. Furthermore, the thematic analysis of 150 tweets (which have been equally sampled from negative, neutral and positive tweets), between January 2021 to May 2021, on COVID-19 vaccines, revealed a total of 25 topics, which were grouped into seven overarching themes. In descending order, based on the number of tweets, the *vaccine delivery and roll-out* theme has 37 tweets, which accounts for 24.7%. The next theme, *vaccine acceptance*, included 30 tweets, which accounted for 20%. The third theme, *government trust,* had 29 Tweets which accounted for 19.33%. *Knowledge of vaccines and vaccination information* theme comprised of 19 Tweets accounting for 12.67%. *Vaccine hesitancy* was the fifth theme with 15 tweets accounting for 10% of the overall sample. The sixth theme, *vaccine efficacy and safety*, totalled 12 tweets, which accounted for 8.00%. Finally, the theme *economic impact* gathered the least number of tweets, accounting for eight tweets to make 5.33%.

This study contributes to the emerging picture of COVID-19 related sentiments on Twitter in South Africa. The study shows that Twitter sentiment and thematic analyses can be leveraged by studying the varying sentiments during the roll-out of critical health interventions such as the COVID-19 vaccine.

Keywords: COVID-19 vaccines, National Department of Health, resource mobilisation theory, social cognitive theory, social media, tweets, theory of reasoned action, Twitter, vaccine delivery, vaccine hesitancy, vaccine roll-out, vaccine safety, vaccine sentiments

DEDICATION

This dissertation is dedicated to my late father, Fanfan Mlambo.

Your kind and loving words have left an indelible imprint on my heart.

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This dissertation is the culmination of many years of effort, sacrifice and endurance. I am grateful for the encouragement and support of several people, without whom this project would not have been feasible.

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LIST OF ABBREVIATIONS

ACME	Audience-Channel-Message-Evaluation
API	Application programming interface
AU	African Union
CAPRISA	Centre for the AIDS Programme of Research in South Africa
CDC	Centers for Disease Control and Prevention
eWOM	Electronic word-of-mouth
EPI-SA	Expanded Programme on Immunisation in South Africa
EU	European Union
EVDS	Electronic Vaccination Data System
FD	Food and Drug Administration
HPV	Human Papillomavirus
JnJ	Johnson & Johnson
ICTV	International Committee on Taxonomy of Viruses
NDoH	National Department of Health
NICD	National Institute for Communicable Diseases
NLP	Natural Language Processing
RAMS	Risk amplification through the media spread
RO	Research objective
RQ	Research question
RT	Retweet
SAHPRA	South African Health Products Regulatory Authority
SAMRC	South African Medical Research Council
SARF	Social amplification risk framework
SII	Serum Institute of India
SMCC	Social-mediated crisis communication
STD	Sexually transmitted disease
TA	Thematic analysis
URL	Uniform Resource Locator
USA	United States of America
WHO	World Health Organization
WWW	World Wide Web

CHAPTER 1: INTRODUCTION

1.1   Introduction

Vaccination is a highly significant part of reducing morbidity and mortality resulting from serious infections in communities: vaccines are estimated as having prevented 6 million deaths from vaccine-preventable diseases each year (Rodrigues & Plotkin 2020:1526). Health communication is critical in raising community members' awareness of the benefits of vaccination; the role of vaccination in their setting; vaccine effectiveness; and potential side effects (Ames, Njang, Glenton, Fretheim et al 2017:1).

However, it can be expected that vaccines for a novel virus, such as COVID-19, may be met with a certain extent of public fear and scepticism, thereby making it difficult for communication practitioners, health authorities and health experts to reach their communication objectives when sharing science-based information on vaccines. The use of social media has been proven to play a significant role in sharing vaccine information (Alfatease, Alqahtani, Orayj & Alshahrani 2021:2674). The fundamental objective of this study is to investigate the sentiment of tweets and to uncover themes within those tweets on COVID-19 vaccines in South Africa, from January to May 2021. South African studies that examine Twitter sentiments are in short supply, which supports the importance of the study.

The purpose of this chapter is to provide the background to and explain the rationale for the study. This chapter provides the following: definitions of the key terms used in the dissertation; the background of the study; the theoretical and empirical approaches; the ethical considerations; and an outline of the chapters in the dissertation.

The principles of health communication, social media and theories forms the foundation of the study. The next section provides definitions of key concepts that are used in this study.

1.2   Definitions of key concepts

The key concepts involved in this study are defined in the following sections.

1.2.1   Social media

Cornelissen (2020:39) defines *social media* as "… any forms of online or digital tools via which individuals produce, share and exchange information and ideas."

1.2.2   Twitter, Twitter users and tweets

Twitter is a micro-blogging tool that enables users to opt-in to receive and send meaningfully short tweets (McFedries 2007:100).

Tweets are brief messages sent by a tweeter (Twitter user) to their followers (Nelson 2012:6).

Twitter users are organisations and individuals who are subscribed to and use Twitter as a social media platform.

1.2.3   Sentiments and sentiment analysis

According to Stets (2003:309) sentiments are "… socially constructed patterns of sensations, expressive gestures and cultural meanings organised around a relationship to a social object".

Thelwall (2017:2) describes *sentiment analysis* as "… the process of computer learning to identify, extract, and describe the sentiment content of a text unit." Similarly, Feldman (2013:82) regards sentiment analysis as the challenge of finding the opinions of authors about certain subjects. According to He and Zheng (2019:1208), sentiment analysis is also known as *opinion mining* and is concerned with describing emotions from the text. Furthermore, sentiment analysis is the field of study that analyses the opinions, feelings, assessments, attitudes and emotions of individuals towards a plethora of aspects, including products, services, organisations, individuals, issues, events, topics and their attributes (Liu & Zhang 2012:415; Thelwall 2017:2).

1.2.4 Misinformation

According to Wu, Morstatter, Carley and Lui (2020:1) *misinformation* is false or inaccurate information that is deliberately created and intentionally or unintentionally propagated.

1.2.5 Vaccine acceptance and hesitancy

Dube, Ward, Verger and Macdonald (2021:177) view *vaccine acceptance* as the degree to which individuals accept, question, or refuse vaccination.

Vaccine hesitancy refers to a delay in acceptance or refusal of vaccination, despite the availability of vaccination services (MacDonald 2015:4163).

1.3 Context of the study

In this section, the context of the study is described, as well as the background informing the research.

Since the onset of the COVID-19 pandemic, social media have rapidly become a critical communication tool for information generation, dissemination and consumption and, as such, have become a pivotal communication tool for governments, organisations and universities to disseminate critical information to the public (Tsao, Chen, Tisseverasinghe, Yang et al 2021:175). Within that context, this study emanates from the need and desire to understand COVID-19 vaccination sentiments on Twitter, with the view of identifying possible opportunities for improving public health communication in the future.

In order to follow the development of sentiments, this South African study aims at examining tweets posted by Twitter users – January to May 2021 – to describe and explore the opinions expressed during the vaccination roll-out. Understanding and addressing public concerns regarding vaccination through communication campaigns may be imperative in the development of effective immunisation policies to control the spread of infectious diseases and reduce morbidity and mortality (Nicholson & Leask 2012; Witteman & Zikmund-Fisher 2012). Therefore, this study focuses on the early stages of the COVID-19 vaccine roll-out.

although vaccinations are widely regarded as an effective means of preventing infectious illnesses, a rising number of people have opposing views on vaccination (Shetty 2010:971; Kata 2021:3778; Mavragani & Ochoa 2018; Dzinamarira, Nachipo, Phiri & Musuka 2021:2). Furthermore, emerging COVID-19 vaccination hesitancy has been identified as a source of concern that may be an important consideration of the National Department of Health (NDoH) in the country (Cooper, Van Rooyen & Wiysonge 2021).

The use of social media has created a platform on which these vaccination sentiments can be shared (Steffens, Dunn, Leask & Wiley 2019). However, it is argued that information sharing between social network users may lead to misinformation of which clinical and public health professionals are not aware (Germani & Biller-Andorno 2021:1). It is feared that information sharing may also result in these users contesting the recommendations of public health policies and guidelines (Kata 2021; Griffiths, Dobermann, Cave, Thorogood et al 2015:475; Mitra, Counts & Pennebaker 2016:269). Understanding individual sentiments pertaining to COVID-19 vaccines and related information is critical to guide interventions aimed at promoting and maintaining COVID-19 vaccine acceptance, while encouraging compliance with other COVID-19 preventive measures in South Africa (Tulloch, Jong & Bardosh (2021:1).

1.4   South African context

In the midst of the COVID-19 pandemic, South Africa's National Department of Health (NDoH) launched a COVID-19 vaccine roll-out campaign to vaccinate as many South Africans as possible, beginning with healthcare workers (Reddy, Dangor, Lala, Johnstone et al 2021:610). The NDoH, health institutions, such as the National Institute for Communicable Diseases (NICD), and other government organisations launched public awareness campaigns concerning COVID-19 vaccination to support the vaccine roll-out strategy. The campaigns were created with the primary goal of informing and educating the public and communicating the vaccination benefits, in order to ensure that targeted populations received the vaccine. These campaigns were promoted by the Government and entities on social media – particularly Twitter.

However, considering that this is a cross-sectional study, the focus does not fall on evaluating these campaigns. Therefore, researcher thus regarded it key to investigate Twitter sentiments during the roll-out to obtain an indication of the success of these efforts.

Online sentiments concerning vaccination have been shown to affect individuals' or parents' vaccination decision-making processes profoundly (Jones, Omer, Bednarczyk, Halsey et al 2012; Robichaud, Hawken, Beard, Morra et al 2012:3770). As such, it is deemed crucial to investigate South Africa COVID-19 sentiments on Twitter to obtain insight into the trends and themes.

1.5 Rationale of the study

According to Gohil, Vuik and Darzi (2018:2), patients express their views on health issues by using online platforms, such as blogs, social media and websites. Moreover, individuals use social media and the Internet to write about their illness experiences and their perspectives on various health interventions (He & Zheng 2019:1208). This position is supported by Baccouche, Garcia-Zapirain and Elmaghraby (2019:382), who contend that the exponential increase in social media users results in vast numbers of brief messages and micro-blogging that are being posted.Therefore, the goal of this study is to employ sentiment and thematic analyses to investigate and comprehend Twitter users' sentiments towards vaccinations.

Liu (2012:5) argues that, as key influencers of human behaviour, opinions are essential to almost all human activities. Therefore, more often than not, individuals consider the views of others when making decisions. The growth of social media has enabled Internet users to contest the limited attention of other users and to influence them by spreading information (Romero, Galuba, Asur & Huberman 2011:1). As observed by Betsch, Brewer, Brocard, Davies et al. (2012:3728), advances in technology – particularly in social media – provide Internet users with multiple channels through which to share individual opinions and health experiences regarding vaccines.

In health-related disciplines, sentiment analysis has been widely applied in investigating topics, such as public sentiments, toward health interventions similar to this study. For the foregoing reasons, it may be imperative for both health authorities and advocates of vaccines to consolidate and analyse vaccination sentiments, so as to understand the potential impact of opinions on vaccination (Gu et al 2017:8).

According to Goldschmidt (2020), computer technologies offer significant prospects for combating infectious disease epidemics and play an important role, particularly in sentiment analysis for social media (Alamoodi, Zaidan, Zaidan, Albahri et al 2021:2). However, there is still a scarcity of research in South Africa on leveraging these technologies to understand the nature of vaccine views expressed on social media, notably during the COVID-19 roll-out.

The studies conducted by Singh, Singh and Singh (2018) and Alamoodi et al (2021:2) show that, if specialists had examined social media data, many epidemics and pandemics could have been quickly halted. COVID-19 is still a contentious global topic on social media (Pastor 2020) and, therefore, the current study investigates COVID-19 vaccine sentiments on Twitter, from the start of the South African vaccine roll-out in January 2021 to May 2021.

Given the scarcity of literature on vaccine sentiments in South Africa at the time, the data presented in this dissertation may assist researchers in obtaining a better understanding of the nature of COVID-19 vaccine sentiments related to the COVID-19 vaccine roll-out, as well as the themes emanating from the shared sentiments on Twitter. It is also envisaged that the findings of this study would aid in the development of recommendations for health communication on Twitter and potentially other social-media platforms for future vaccination deployments.

Following the introduction, the next two sections aim at contextualising the research purpose and objectives and outlining the research problem.

1.6 Purpose of study

Sentiments with regard to the COVID-19 vaccination roll-out in South Africa in 2021 are investigated in this study. According to Du Plessis and Satar (2021:152), social media have been shown to be a trustworthy indication of popular sentiment, with Twitter even being used to predict the outcomes of major events such as elections. As a result, this research arises from a desire to understand COVID-19 vaccination sentiments on Twitter better, in order to discover challenges and potential opportunities for improving public health communication.

In order to follow the developments in sentiments since the announcement of the COVID-19 vaccine roll-out in South Africa, this study aims at examining posts and conversations on Twitter from January 2021 to May 2021, as that should allow the researcher to explore the effects of communication efforts by health authorities with regards to the COVID-19 vaccine roll-out during this period.

1.7 Research approach

This section introduces the research strategy, which is discussed in detail in Chapter 5. COVID-19 vaccine sentiments on Twitter in South Africa during the first five months of the vaccination roll-out are investigated by using a mixed methods research methodology to gain a better understanding of the issue under consideration. This period was the initial stages of the vaccine intervention and the study aimed to investigate the early impact on public sentiment. According to Regnault, Willgoss, and Barbic (2018:2), combining the standardised, generalisable data of quantitative research with qualitative inquiry may provide rich, subjective insights into complicated realities. The major research aim of this study will be achieved by employing quantitative and qualitative approaches.

1.7.1 Research problem

The general research problem of this study is expressed as follows:

> A cross-sectional study to describe and explore COVID-19 vaccination
> sentiments shared on Twitter, from January 2021 to May 2021, in
> South Africa, with the aim to investigate the sentiments that are

expressed in tweets and to understand themes that could contribute
to these sentiments.

The general research question that guided this study is as follows:

Which sentiments and themes were raised on Twitter during the 2021 COVID-
19 vaccine roll-out in South Africa?

1.7.2   Research objectives

The research objectives of this study are both descriptive and exploratory. Within the
context of the overall research goal, the research involves a number of specific
objectives and research questions, which are outlined in Table 1.1:

Table 1.1: Research objectives and questions

Research objectives (ROs)	Research questions (RQs)	Research Method Used
RO1: To describe the theoretical foundations of the study.	**RQ1:** Of which aspects does the theoretical foundation of this study consist?	**Qualitative (Literature Review)**
RO2: To investigate the nature of COVID-19 vaccination sentiments raised on Twitter during the vaccine roll-out in South Africa.	**RQ2:** What is the nature of vaccination sentiments raised on Twitter during the vaccine roll-out in South Africa?	**Quantitative (Sentiment Analysis)**
RO3: To explore the key themes behind COVID-19 vaccination sentiments, based on the data on Twitter during the vaccine roll-out in South Africa.	**RQ3:** What are the key themes that were raised on Twitter during the COVID-19 vaccine roll-out in South Africa?	**Qualitative (Thematic Analysis)**
RO4: To recommend guidelines for future vaccine roll-out strategies.	**RQ4:** What guidelines could the NDoH consider for future vaccine roll-out strategies?	**Qualitative**

The figure below presents the research design with the research questions, theoretical arguments, concepts and constructs as well as the methods applied to address the concepts and constructs of the study.
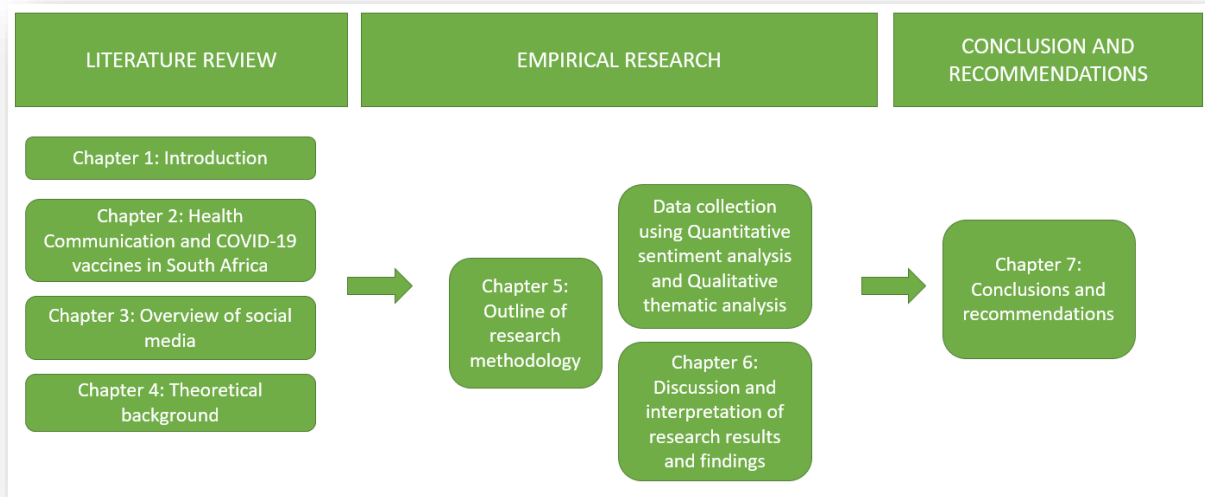
Figure 1.1: Methodological overview of the study (Author's own conceptualisation)

1.8   Theoretical approach

This study is broadly situated in the field of communication studies – particularly in health communication. Due to the nature of the topic, no single theory has been found that could serve as the theoretical foundation. Therefore, four theories are considered to understand the concepts linked to the topic and to address the research problem and are investigated in Chapter 4. The main focus of each theory is briefly stated in this section.

The study's primary theoretical approaches are presented in Chapter 4. The *theory of social impact* proposes that social media users' offline behaviour may be influenced by their online interactions with other users. Following that is the *social cognitive theory*, which explains why people develop and maintain certain behaviours. Furthermore, the *theory of reasoned action* can be used to predict behaviour, especially in the health field, and *resource mobilisation theory* asserts that movement supporters, such as anti-vaccine activists, may act on internalised ideals and sentiments of individuals, resulting in the formation of a social movement.

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1.9   Demarcation of chapters and research process

The study is introduced and contextualised in the present chapter. Chapter 2 explores important aspects and presents viewpoints on health communication and COVID-19 by referring to and summarising prior research on these discourses. This is followed by a consideration of literature pertinent to social media in Chapter 3. Chapter 4 provides an overview of suitable theories that serve as the theoretical foundation for investigating COVID-19 vaccination sentiments on Twitter. In Chapter 5, the research methodology is specified and the findings are interpreted and presented in Chapter 6. Finally, Chapter 7 presents a conclusion of the overall research. Figure 1.2 illustrates the research process followed to meet the research objectives:
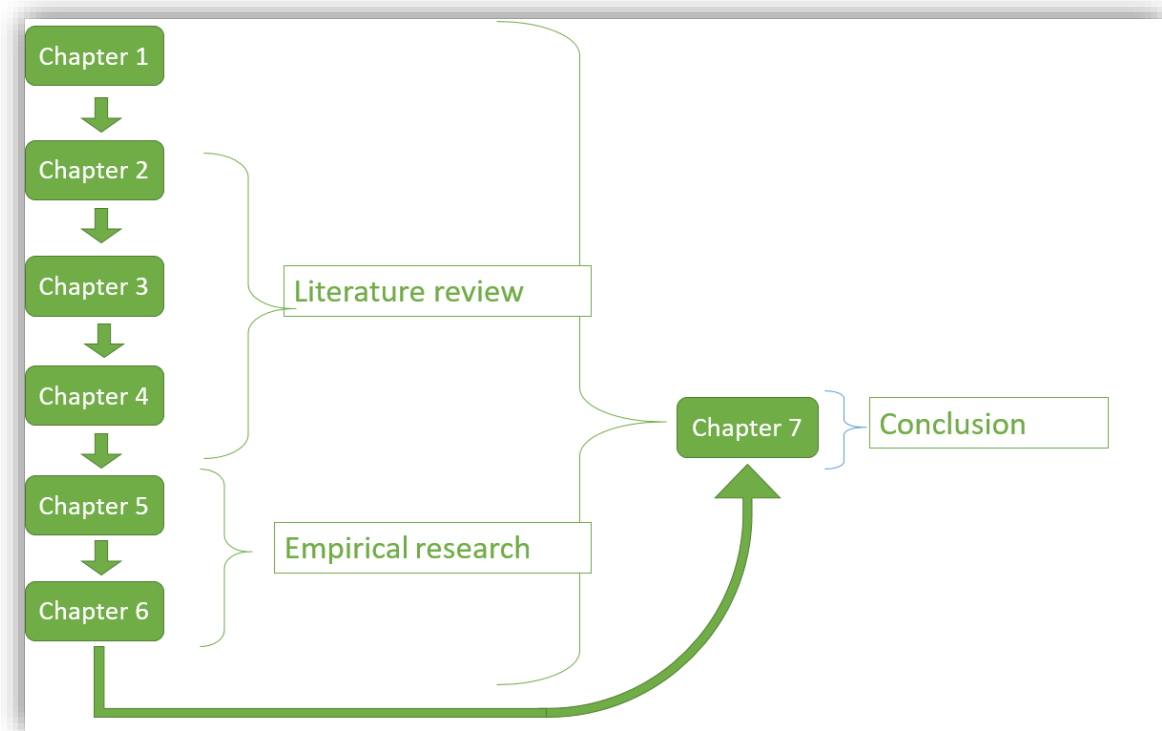
Figure 1.2: Operationalisation of the study (Author's own conceptualisation)

1.10   Ethical considerations

This study uses data in the public domain that is freely available on the Internet. As a result, there is no possibility of harm or inconvenience to individuals, because the study does not collect any personal information that can be connected to the data in any way. Ethical issues are further discussed in Section 5.13 (Chapter 5).

1.11   Summary

The purpose of this chapter was to describe the context and rationale for this research. In doing so, the chapter presented brief definitions of key concepts, the background of the study, and a brief explanation of the research approach. Theoretical and empirical approaches were also briefly introduced, and the ethical considerations were briefly described. This chapter concluded with the demarcation of the chapters in this dissertation.

In the following chapter, the setting of the study – namely aspects related to health communication and COVID-19 in South Africa – are discussed.

CHAPTER 2: HEALTH COMMUNICATION AND COVID-19 VACCINES IN SOUTH AFRICA

2.1   Introduction

It is widely acknowledged that health communication and health communication campaigns play a critical role in influencing public perception, behaviours and acceptance of health interventions. This has been demonstrated during the current coronavirus outbreak (COVID-19), where effective health communication has been considered to be crucial for affecting behavioural change to slow the spread of the virus (Finset, Bosworth, Butow, Gulbrandsen et al 2020: 874).

This chapter, in conjunction with Chapters 3 and 4, attends to the following research objective:

RO1: To describe the theoretical foundations of the study.

This chapter contextualises the current study in the field of health communication to explore COVID-19 vaccine sentiments. Firstly, it provides a broad overview of health communication. Secondly, it explores communication campaigns, with a particular focus on health communication campaigns and relevant aspects regarding their planning. Thirdly, an overview of the background and epidemiology of COVID-19 is given; and, lastly, the vaccination roll-out programme in South Africa, vaccine acceptance and factors contributing to vaccine hesitancy are discussed.

2.2   Overview of health communication

Communication on health-related issues has existed for centuries. However, as observed by Kreps (2014:2), the formal acceptance of health communication as a social construct can be traced back to the "humanistic psychology movement" of the early 1970s. Since then, health communication has been influenced by different disciplines, including marketing communication, social marketing, sociology, health education and Anthropology (Bernhardt 2004:2051; Parrot 2004:767; Kreps 2014:2). Given the wide and varied range of influences and views, it is not surprising that different definitions of health communication exist.

2.2.1 Health communication definitions

An early definition of *health communication* states that it is "… the art and technique of informing, influencing, and motivating individual, institutional, and public audiences about important health issues; its scope includes disease prevention, health promotion, health care policy, business, as well as enhancement of the quality of life and health of individuals within the community" (Ratzan 1994:230). This definition relates to this study, in that it encompasses a range of activities that could be used to enhance awareness of important health issues, such as vaccination against COVID-19.

Numerous scholars have since attempted to refine the meaning of health communication by ensuring a comprehensive view that incorporates every facet of the rapidly evolving field of health communication. Another relevant definition that emphasises the critical role of health communication states that communication is the strategic and timely art, science and method of educating, shaping, encouraging and influencing individuals, organisations and government audiences on specific health issues (Bernhardt 2004:2051; Thomas 2006:1; Nkanunye & Obiechina 2017:1). As such, health communication can be regarded as essential in influencing individuals' health-related choices (Thomas 2006:2; Nkanunye & Obiechina 2017:2).

To accommodate the multidimensional nature of health communication and its ability to affect and sustain positive behavioural change, Schiavo (2007:7) defines *health communication* as "… a multifaceted and multidisciplinary approach to reach different audiences and share health-related information to influence, engage, and support individuals, communities, health professionals, special groups, policymakers and the public to champion, introduce, adopt, or sustain a behaviour, practice, or policy that will ultimately improve health outcomes". As Schiavo (2007:6) indicates, it involves numerous approaches and a range of disciplines that play an important role in having the desired effect on health and the challenges of communicable diseases, such as COVID-19. This definition by Schiavo (2007) provides a broader view of health communication and is, therefore, adopted for this study.

2.2.2 Importance of health communication

It is evident from the available literature that health communication is a fundamental component of an effective public health system (Bernhardt, 2004:2051; Lowbridge & Leask 2011:34). During a mass vaccination roll-out, the primary goal of health communication and its intrinsic disciplines is to promote self-efficacy, so that individuals can make informed health-related decisions for themselves, their families, and communities (Thomas 2006:4; Ratzan 2015:193; Nkanunye & Obiechina 2017:1).

Self-efficacy involves the beliefs about the capabilities of performing specific behaviours (Strecher, DeVellis, Becker & Rosenstock 1986:74). Health communication could, therefore, be a key tool in understanding the views of stakeholders about vaccinations and, ultimately, vaccine hesitancy. In the context of this study, there are different approaches, such as disease prevention, health safety and promotion, health policy, emergency response, behaviour change communication and public health campaigns that can be applied to change vaccine sentiments and reduce morbidity and mortality with regards to COVID-19 (Parrott 2004:751; Ratzan 2015:193).

Hornik (2002:332) and Wakefield, Loken and Hornik (2010:11) maintain that health communication is one of the principal instruments for the promotion of good health by informing the public of health problems, treatment options and prevention measures. By using mass media, multimedia and other technological innovations to disseminate helpful health-related content to the public, health communication is believed to raise an understanding of elements of individual and collective health, as well as the significance of sustainable public health (Rojas-Rajs & Soto 2013:4). As such, health communication may be considered for effective communication on COVID-19 vaccines.

To conceptualise health communication campaigns, the following sections will attend to communication and health campaigns, and their value and principles.

2.3   Communication and health campaigns

With communication campaigns being used to reach people with COVID-19 vaccine information, this study needed to explore literature pertaining to campaigns. This section broadly explores the concept of communication campaigns and the available literature on health communication campaigns. This section also explores health communication campaigns in the South African context.

2.3.1   Communication campaigns

Communication campaigns are broadly defined as "… purposive attempts to inform or influence behaviours in large audiences within a specified time period using an organised set of communication activities and featuring an array of mediated messages in multiple channels generally to produce non-commercial benefits to individuals and society" (Rice & Atkin 2013:526). According to Day and Monroe (2000:79), "… campaigns are complex, varied, strategically orchestrated and systematically organised media symphonies designed to raise awareness, educate or improve behaviours within target audiences". Based on the views of Day and Monroe (2000:79), and Randolph and Viswanath (2004:420), communication campaigns must adopt a sound approach that involves setting a realistic expectation; evaluating the audience; selecting the correct media; and creating a message that effectively resonates with the target audience.

Through communication, campaigns aim at influencing behaviour positively to reduce the risk of illness (Dorfman & Krasnow 2014:295). As communication is considered as the process of transmitting information and common understanding from one person to another (Keyton 2011:13), its importance in campaigns is clear and supported by Rice and Atkin (2013:21), who indicate that communication campaigns have become a familiar and essential part of society.

2.3.2   Health communication campaigns

Although health communication campaigns include mass media campaigns, public communication campaigns are seemingly the most commonly used form of health communication (Parvanta 2011:40; Rice & Atkin 2013:113; Robinson, Tansil, Elder, Soler 2014:361). Noting the limited consensus concerning a single definition of health

communication campaigns or what they should entail, this study endorsed the above-mentioned viewpoint, namely that an investigation into the sentiments raised on Twitter during the COVID vaccine roll-out could be key to identifying aspects for similar future campaigns and strategies.

Thompson (2014:549) suggests that health campaigns are one approach that uses communication activities over a specified period to affect specific results among a large volume of people, mainly target audiences. Other researchers explain health communication campaigns as organised, purposeful and distinct, although supplementary to the use of public health advocacy media, which use a range of media channels to educate, convince or motivate the public (Wakefield, Loken & Hornik 2010:2).

Despite the absence of a uniform definition of health communication campaigns, it seems that the overall objective of a health communication campaign is to achieve a specific outcome – predominately a behaviour change – in a comparatively large group of people within a predefined timeframe and via a defined sequence of communication activities (Watson & James 1991:3). Similarly, Snyder argues that (2007:32) campaigns have fostered a wide variety of health behaviours, including the utilisation of public care facilities and infectious disease screening and vaccine uptake.

2.3.3   Value of health communication campaigns

Health communication campaigns have made important contributions to the advancement of public health worldwide and are frequently used as essential components of comprehensive prevention strategies (Zhao 2020:1). Accordingly, this section explores the key benefits of health communication campaigns.

2.3.3.1   Disseminating information

Communication campaigns on health are believed to be among the most powerful tools for encouraging or improving health by disseminating information about health concerns and keeping critical public health issues on the agenda (Parrott 2004:751; Thomas 2006:2).

Cottin, Ashbaugh, Brooke, Gavazzi et al (2020:2) argue that the growing global hesitancy about vaccinations needs to be resolved through effective communication on vaccinations and vaccination programmes. As with any communication, it is important to ensure the appropriate dissemination of information and that information is understood by the target audience.

2.3.3.2 Sentiment and behavioural change

Literature suggests that the effectiveness of health communication campaigns has a direct impact on its capacity to decrease mortality and morbidity through behavioural change (Hornik, 2002:1; Sood, Shefner-Rogers & Skinner 2014:83; Robinson et al., 2014:360). Although health communication strategies are usually pragmatic in their ability to improve health behaviour, a large scale campaign can still change the health behaviour of thousands for the better (Zhao 2020:3). In other words, despite the heightened frequency of COVID-19 vaccination messaging for the period, it is imperative to remain constant in reaffirming vaccine messaging that appeals to a diverse audience. Intelligible messaging that is delivered by credible and trusted entities have the potential to influence vaccine acceptance among the public and, ultimately, determine the success of the vaccine programme.

To support the importance of health communication campaigns, a study conducted by Potter, Jardine, Morrissey and Lindsay (2019:10) established that the *Fight the Bite* Campaign substantially increased awareness and preventive practices to improve mosquito awareness and preventive practices in Western Australia. The study evaluated a health communication campaign that focused on persons exposed to the campaign. A study examining how exposure to an obesity campaign called school-based buzz improves positive attitudes to health issues in pupils found moderate improvement in the awareness and health behavioural attitudes (Wang & Struthers 2018:162).

In an Australian study, conducted in 2014 and called *I Immunise*, it was found that, after being exposed to the campaign, respondents from both the alternative lifestyle group and the non-alternative lifestyle group reported more positive feelings or thoughts than negative feelings about immunisation (Attwell & Freeman 2015:6237).

2.3.3.3 Awareness

Although it seems as if the value and effectiveness of different health communication campaigns vary, it is believed to be an essential component of promoting and protecting the health of the public (Bernhardt 2004:2051). To this end, a variety of initiatives have used health campaign strategies and principles in a range of environments and contexts to encourage vaccine adoption by increasing awareness of guidelines for immunisation and presenting vaccinations and vaccination requirements in ways that improve understanding and motivate behavioural change (Nowak, Gellin, MacDonald, Butler et al 2015:4209).

2.3.3.4 Disease prevention

The value of effective health communication is believed to enhance the prevention of diseases through communication about the direct benefits of vaccination (Cottin et al 2020:1). In an effort to prevent disease burden and to reduce mortality, health campaigns could be instrumental in dealing with issues such as vaccine hesitancy, anti-immunisation rumours and insufficient knowledge of vaccines and immunisation (Hornik 2002:1; Wiysonge, Ngcobo, Jeena, Madhi et al 2012:5).

The need for effective health communication has become even more urgent with the emergence and rapid spread of anti-vaccine activism. These activists are propagating scepticism through fake news, misinformation and inconsistencies (Ratzan 2015:196; Biasio, Corsello, Costantino, Fara et al 2016:2984).

If South Africa is to establish population immunity to COVID-19 in the near future, it is evident that health communication should be a key component of the outbreak response (Staunton, Swanepoel & Labuschaigne 2021:10). According to Desai and Majumder (2020:2113), population immunity, also known as *herd immunity*, occurs when a significant portion of a population becomes immune to an infectious disease and the risk of transmission from person-to-person decreases, while those, who are not immune, are indirectly protected, because ongoing disease spread is minor. Health communication campaigns can be used to educate and influence choices that strengthen disease prevention through effective culturally appropriate messaging (Nkanunye & Obiechina 2017:1).

2.3.4   Principles of health communication campaign planning

When addressing health issues, communication should focus on legitimate, evidence-based approaches and consistent behaviours that can change perceptions and increase vaccination acceptance (Biasio et al 2016:2985). In the opinion of Shiavo (2007:12), there are specific attributes that are critical for effective health communication, including audience-focused, research-based, multidisciplinary, strategic, process-oriented, cost-effective and creative in support of the strategy, audience and media-specific, relationship building, and those aimed at behavioural change. Wakefield, Loken and Hornik, (2010:11) state that health communication campaigns can only be successful in effectively transmitting health messages to large segments of the population, if they are strategically developed and informed by principles and theories of effective communication.

It is accepted that the development of communication campaigns should follow a basic process that incorporates careful planning to influence health habits and practices effectively. Nevertheless, there are usually variations in processes and planning methodologies followed in developing and implementing health communication campaigns (Ratzan 1993:20; Schiavo 2007: 2018; Parvanta 2011:19).

Day and Monroe (2000:79) suggest four stages that need to be followed in a communication campaign. The first stage is formative research, which helps to identify the targets and target markets, as well as the media interest of the target audience. The second stage involves defining targets; designing and pretesting messages and creating the overall campaign strategy. The third stage involves executing the campaign, while the fourth stage entails evaluating the results and optimising the plan as required. It is further argued that the duration of communication campaigns must not be linear; nor should it be replication and execution of previous campaigns, but rather a continuous organic phase (Parvanta 2011:20). In other words, health campaigns should be based on research, aimed at specific audiences, with pretested messages, that are continuously measured and adjusted to ensure that the set objectives are met.

Parvanta (2011:22) and the National Cancer Institute (2001:11) also identify the following four phases in the process of health communication, which mostly incorporates the same stages as proposed by Day and Monroe (2000): planning, developing, implementing and evaluating. In their definition of the cyclical stages of the health communication process, the National Cancer Institute (United States of America) further emphasises the importance of incorporating assessment processes throughout the preparation, development and implementation phases of the campaign (United States of America. Department of Health and Human Services. National Institutes of Health. National Cancer Institute 2001:5). The National Cancer Institute recommends that the relevant stakeholders should ensure that the campaign materials and activities have been designed to meet the needs of the target audience; that assessment mechanisms have been incorporated and relevant, achievable; and that time-specific goals have been set (Parvanta 2011:22; United States of America. Department of Health and Human Services. National Institutes of Health. National Cancer Institute 2001:11). Therefore, the importance of two-way communication and the development of original campaigns are underlined.

The Audience-Channel-Message-Evaluation (ACME) Framework for health communication campaign planning, proposed by Noar and Head (2011:426), is deemed to be valuable for the planning of health communication campaigns. This can be ascribed to its integration of the campaign principles, which, among other aspects, support communication practice in the emerging digital and social media with regards to the dissemination of information (Noar 2012:48). The ACME Framework makes the essential links between the design, execution and evaluation facets of the campaigns explicit by considering formative, process and outcome evaluation, whereas most designs focus on the latter only (Noar & Head 2011:428; Parvanta 2011:503).

As discussed in this section, health communication campaigns should be based on sound, ethical and analytical frameworks that establish or promote public health interventions, such as the upsurge in negative opinions about vaccines on social media (Schiavo 2007:2017). Considering the context of the study, the next section explores the COVID-19 pandemic epidemiology and impact on South Africa.

2.4   Background to COVID-19

Due to its high prevalence, pre-symptomatic transmission and long incubation periods, which are often without symptoms, the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has infected millions of people worldwide, causing the COVID-19 pandemic (Chung, Thone & Kwon 2021:1). COVID-19 remains a global health concern –more so on account of the growing hesitancy among communities to vaccinate against SARS-CoV-2 (Burger, Buttenheim, English, Maughan et al 2021:8). In the endeavour to explore and describe COVID-19 vaccination sentiments on Twitter in South Africa, the following section will provide an epidemiological overview of COVID-19.

2.4.1   COVID-19: an epidemiological overview

On 30 December 2019, the Program for Monitoring Emerging Diseases notified the world about pneumonia with an unknown cause (Bloom, Chan, Baric, Bjorkman et al 2021:1). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has since been confirmed the causative virus of the coronavirus disease, or COVID-19 for short (International Committee on Taxonomy of Viruses 2020).

According to Hubner (2021), the cluster outbreak was originally linked to a wet market, the Huanan Seafood Wholesale Market in the Wuhan City, Hubei Province of China (Bloom et al 2021:1). However, presently great uncertainly surrounds the origins of SARS-CoV-2.

On 4 January 2020, the World Health Organization (WHO) released a tweet, confirming a cluster of pneumonia cases in Wuhan, indicating that the event was being monitored closely (Figure 2). On 30 January 2020, the WHO declared the outbreak a public health emergency of international concern and, on 11 March 2020, COVID-19 was declared a pandemic (Cucinotta & Vanelli 2020:157).

Figure 2.1: WHO tweets confirming a cluster of pneumonia cases in Wuhan (World Health Orgaization (WHO) 2020a & 2020b)

2.4.2   COVID-19 in South Africa: Patient Zero

The first positive COVID-19 case on the African continent was confirmed on 14 February 2020 in Egypt (Medhat & El Kassas 2020:1). On 3 March 2020, a suspected COVID-19 case was reported in South Africa, which was later confirmed by the National Institute for Communicable Diseases (NICD). The announcement was made by the National Department of Health (NDoH) on 5 March 2020 (National Institute for Communicable Diseases 2021).

2.4.3   Overview of the COVID-19 vaccine roll-out strategy in South Africa during the period of this study

On 3 January 2021, South Africa announced its plan to reach two-thirds of the population once COVID-19 vaccines had reached its shores (Karim 2021). The South African Government intended to roll out its COVID-19 vaccine strategy in three phases, commencing with the most vulnerable members of the country's population. According to Dzinamarira et al (2021), widespread vaccination would allow countries such as South Africa to manage the spread of the virus and revive their ailing economies, while enabling people to return to normal life.

The three phases described were as follows:

Phase 1

The South African Government set out to vaccinate the country's estimated 1.2 million frontline healthcare staff. The Sisonke 1 study, an open label Phase 3b study, essentially aimed at providing access to COVID-19 vaccinations to health care workers. While South Africa had initially planned to roll out the Oxford/AstraZeneca vaccine, results from a study indicated that the Oxford/AstraZeneca was not highly effective in protecting against mild-moderate COVID-19 disease caused by the Beta variant (B.1.351) circulating in South Africa at that time (Ellis 2021). As no other vaccine was approved by the South African Health Products Regulatory Authority (SAHPRA), the use of an alternative Johnson & Johnson (JnJ) vaccine, which was available, could only be used as part of a study. Sisonke 1 participants were included as part of Phase 1 of the Government roll-out. In Sisonke 1, just over 477,000 healthcare workers received the JnJ vaccine between 17 February and 17 May 2021. Sisonke 2, a similar pragmatic study of JnJ boosters is currently ongoing. The NDoH, the South African Medical Research Council (SAMRC), the Desmond Tutu Health Foundation, the Centre for the AIDS Programme of Research in South Africa (CAPRISA) and JnJ were all involved in the Sisonke Study (Sisonke 2021). It enabled the Government to use a research programme to make the Ad26.COV2.S COVID-19 vaccine (JnJ vaccine) readily available to healthcare personnel.

Phase 2

During this phase, the roll-out was aimed at essential employees, people in communal settings, the elderly, and those over the age of 40 years.

Phase 3

The last phase entailed the roll-out of vaccines to younger age groups, with a target population of 22.5 million people. The goal was to attain population immunity at this stage.

2.4.4   Sequence of the COVID-19 vaccine roll-out

In January 2021, the Minister of Health announced that the NDoH and the South African Health Products Regulatory Authority (SAHPRA) were fine-tuning and aligning all regulatory processes to ensure that there were no unnecessary delays or regulatory impediments to activating the COVID-19 vaccine roll-out (Mkhize 2021). Nonetheless, South Africa's COVID-19 vaccine roll-out was initially challenged and stalled by procurement delays and regulatory concerns (Daniel 2021) and, as such, it did not go according to plan.

The sections below highlight some of the key events and milestones pertaining to the COVID-19 vaccine roll-out programme in South Africa.

2.4.4.1   January 2021

The vaccine roll-out programme, which was to be overseen solely by the NDoH, was set to start in January, after the South African government reached an agreement with the Serum Institute of India (SII) to deliver 1 million doses of the Oxford University-AstraZeneca vaccine (National Institute for Communicable Diseases 2021a). The one million doses did not arrive until February 2021.

Shortly thereafter, South Africa entered into negotiations with pharmaceutical manufacturers and secured both the single-dose JnJ and double-dose Pfizer-BioNTech vaccines, the latter of which had shown the highest levels of protection from both infection and severe illness against non-Beta variants (Polack, Thomas, Kitchin, Absalon et al 2020:2604).

2.4.4.2   February 2021

On 1 February 2021, South Africa welcomed the arrival of the Oxford AstraZeneca vaccines from the SII. However, before the roll-out of these vaccines could start, Government announced on 7 February that the trial data revealed that it was less effective in preventing mild to moderate COVID-19 against the B.1.351 variant. This resulted in a delay in the roll-out (Madhi, Baillie, Cutland, Voysey et al 2021:1885).

As a consequence, the Oxford AstraZeneca vaccines from the SII were sold to the African Union (AU) while the NDoH explored ways in which it could provide alternative vaccines and start the roll-out.

On 16 February 2021, South Africa received its first shipment of 80,000 doses of the JnJ vaccine and SAHPRA authorised a Phase IIIb study under the Sisonke trial, for all health professionals (Browdie 2021). Phase1 of the country's vaccine roll-out programme began on 17 February. Vaccine roll-out plans were immediately revived as part of the Sisonke programme (JnJ vaccine trial) and, on 17 February 2021, a Cape Town nurse made history by becoming the first South African to receive the single dose JnJ COVID-19 vaccine at the Khayelitsha District Hospital (Meldrum 2021). This marked the start of Phase 1 of the three-phased vaccine roll-out programme, which aimed at focusing on the country's estimated 1.2 million healthcare workers.

2.4.4.3   March 2021

On 5 March 2021, *Timeslive* (2021) reported that the number of doses provided to healthcare workers surpassed 100,000. The procured COVID-19 vaccine supplies were only shipped in consignments, and South Africa received Part 1 of its third consignment of 40,000 on 13 March. On 17 March, the South African Health Products Regulatory Authority (SAHPRA) approved the use of the Pfizer coronavirus vaccination in the country. (Mahlati 2021).

South Africa received Part 2 of its third shipment of 66,000 JnJ vaccines on 18 March. (Republic of South Africa. Department of Health. 2021c). South Africa sold and began delivering 1 million doses of Oxford-AstraZeneca vaccine that it had procured from India to other African Union members on 21 March. Around the end of March, the manufacturing of 220 million doses of the JnJ vaccine was permitted by SAHPRA to commence on 29 March 2020, at the Aspen Pharmacare manufacturing site in Gqeberha, Eastern Cape (Daniel 2021).

2.4.4.4 April 2021

The JnJ vaccine obtained Section 21 approval on1 April 2021, enabling it to be used for the general public and not exclusively for healthcare workers (outside of the Phase IIIb Sisonke Study), as was originally approved (Mukherjee 2021). Following that, on 6 April 2021, the Government formally signed a contract with Pfizer 20 million vaccine doses, which were supposed to arrive by the end of April (Winning, Mukherjee, Elgood & Williams 2021). The Jansen COVID-19 vaccine, which had been stopped in South Africa, owing to health concerns, was reintroduced on 13 April (Ellis 2021). The NDoH released a statement in which it placed a temporary halt to the JnJ Sisonke Study in South Africa. The statement came after the US Food and Drug Administration (US FDA) and the Centers for Disease Control and Prevention (CDC) decided to suspend the distribution of the JnJ vaccine in the United States, after six female patients developed a rare clotting problem (Weiland, LaFraniere & Zimmer 2021).

On 16 April 2012, the Minister of Health began the Electronic Vaccination Data System (EVDS) registration for COVID-19 immunisation of persons aged 60 and up (Mkhize 2021). Aspen Pharmacare stated on 24 April that 1.1 million doses of the JnJ vaccine would be available for use by South Africa (Steinacker 2021). On 26 April, the Government declared that the use of the Janssen COVID-19 vaccine would recommence on 28 April, with vaccination locations being extended to 95 sites around the country.

2.4.4.5 May 2021

In May, a large number of COVID-19 vaccinations were shipped to South Africa. On 2 May, Dr Zweli Mkhize, the Minister of Health at the time, announced on Twitter that the first 1.1 million doses of the Janssen vaccine would be subjected to an extended safety assessment in accordance with international regulators and that stock would be available in mid-May (Mkhize 2021). Part 1 of a consignment of 325,260 doses of the Pfizer vaccine landed at O.R. Tambo International Airport on 3 May, allowing South Africa to administer both Pfizer and JnJ vaccines. Until that point, JnJ was the only COVID-19 vaccine being distributed in South Africa. The immunisations were then transferred to the National Control Laboratory for quality assurance (Mlaba 2021). Part 2 of 325,260 Pfizer vaccine doses arrived on 9 May.

On 10 May the Sisonke study was expanded to non-patient-facing healthcare personnel, including administrative and other staff, due to sufficient capacity and doses (South African Medical Research Council 2021). The Sisonke study enrolled its last participant on 17 May.

The second phase of the vaccination deployment began on 17 May with those aged 60 and older receiving either the JnJ or Pfizer-BioNTech vaccines (Matshoba 2021). The start of Phase 2 of the COVID-19 vaccination roll-out to persons over the age of 60 was scheduled for 16 May (Sacoronavirus 2021). On 23 May, the minister was implicated in allegations of corruption at the NDoH (Myburgh 2021). Sisonke, which finished in mid-June, vaccinated little under 500 000 (479 768) healthcare workers.

The fourth and final batch of 325,260 doses of the Pfizer vaccine arrived at O.R. Tambo International Airport on 24 May (Sacoronavirus 2021), while the first batch of 636,480 doses of the Pfizer vaccine arrived on 31 May. By the end of May, the total number of administered vaccine doses surpassed 1 million (National Institute for Communicable Diseases 2021).

Based on the discussions about health awareness campaigns and various relevant aspects, it can be concluded that achieving acceptance of vaccines is a key goal. Nevertheless, it is clearly a common challenge that requires a brief overview.

2.5   Vaccine acceptance and hesitancy

The concepts vaccine acceptance and hesitancy are often used interchangeably. However, for the purposes of this study, these concepts require differentiation, as the aim was not essentially to determine acceptance, but rather to uncover sentiments and themes that could point to hesitancy during the vaccine roll-out.

Vaccine acceptance is defined as the degree to which individuals accept, question, or refuse vaccination, whereas *vaccine hesitance* is defined as a refusal to receive recommended vaccination due to worries and reservations regarding vaccines (Dube et al 2021:176).

As mentioned earlier, a significant number of challenges have been identified in different immunisation programmes and, therefore, it is reasonable to expect that this will be the same for the COVID-19 vaccination roll-out in South Africa. Vaccine hesitancy is regarded as critical to the effectiveness of vaccination campaigns – a viewpoint that is supported by Madhi and Rees (2018:2337), who argue that, although innovations are occurring to reduce obstacles to vaccination uptake, addressing reasons for vaccine hesitancy is crucial.

Vaccine hesitancy relates to the delay in or denial of vaccination, despite existing accessibility to and availability of vaccine services (Larson, Jarrett, Eckersberger, Smith et al 2014:2150; MacDonald 2015:3; Getman, Helmi, Roberts, Yansane et al 2018:599). Furthermore, it is context-specific and is influenced by complacency, convenience and confidence, and the view is that vaccine hesitant individuals display varying degrees of indecision regarding specific vaccines or vaccination in general (Dubé, Laberge, Guay, & Bramadat 2013:1765, Getman et al 2017:599). Dubé et al (2021:177) maintain that vaccine hesitancy is markedly different from the term "anti-vaccine", and is regarded as indicating a reluctance to be vaccinated, based on certain concerns and doubts, rather than a complete refusal to receive it. Therefore, in the present context, hesitancy is a critical concept to explore.

The *Lancet Child and Adolescent Health Journal* states that vaccine hesitancy presents a serious threat to past accomplishments that have significantly decreased the burden of vaccine-preventable diseases that have plagued humanity for millennia (Vaccine hesitance: a generation at risk 2019:5). The refusal to be vaccinated increases the health-related risk – not only for the vaccine-hesitant individual, but also for the community at large, should the vaccine-preventable organism begin to circulate within the community (Dubé et al 2013:107; Cooper et al. 2018:2355). Vaccination delays and rejections render populations unable to achieve the required vaccine uptake levels that confer herd immunity, thereby increasing the probability of an epidemic (Dubé et al 2014:108; Cooper et al. 2018:2356).

Although vaccination programmes, such as the Expanded Programme On Immunisation in South Africa (EPI-SA), have been very successful (Machingaidze, Wiysonge & Hussey 2013:02; Hardt, Bonanni, King, Santos et al 2016:6691).

Cooper et al. (2018:2355) some studies have found that specific communities and individuals in Africa have delayed – and in some instances denied – vaccinations due to controversies surrounding a specific vaccine, rendering them more susceptible to disease outbreaks. The WHO has identified digital misinformation through social media as a significant driver of vaccine hesitancy and a major threat to global public health (Cooper et al. 2018:2355).

It is clear that global vaccine hesitancy is on the rise – particularly in Africa, given the unprecedented global attention the topic is receiving (Cooper et al. 2018:2355). While research findings and relevant literature in this area have significantly increased, there are still major knowledge gaps pertaining to the nature and causes of vaccine hesitancy in Africa (Madhi & Rees 2018:2337). Most research on vaccine hesitancy has been conducted in developed countries and, as pointed out by Cooper et al (2018:2355), African countries should urgently expand their understanding of vaccine hesitancy within their context, so that it can be addressed effectively.

Studies have shown that vaccine hesitancy can be mitigated by increasing community knowledge and awareness through social mobilisation, healthcare worker training, non-financial incentives and reminder-recalls (Larson et al 2014:2156; Dubé et al 2015:100). Although numerous studies provide health communication strategies that address this phenomenon to a certain extent, it is not yet clear how such interventions have worked in developing countries, such as South Africa.

2.6   Factors contributing to vaccine hesitancy

Since this study aimed at investigating vaccine sentiment on Twitter during the roll-out of the COVID-19 vaccine, it investigated vaccination hesitancy determinants, which "… involves concepts related to obstacles and vaccine acceptance enablers, grounds for vaccine rejection, views and sentiments towards vaccination' (Williams 2014:2584; MacDonald, 2015:3).

These determinants can be categorised into three broad groups, namely: contextual, individual and group factors, and specific problems related to vaccine and vaccination. As discussed in the previous chapter, numerous studies have consistently shown multi-level factors (individual, community and national) that are determined from and influenced by contextual nuances (Dubé, Vivion & MacDonald 2015:99). For the purpose of this review, the next section discusses the three specific categories of vaccination hesitancy determinants intending to define factors that relate to adverse perceptions about vaccines that may lead to vaccine hesitation.

2.6.1   Contextual factors

Contextual variables that lead to vaccine hesitancy are thought to be apprehensions, such as the lack of trust in people and organizations involved in vaccination programmes. The lack of engagement in vaccine effectiveness and safety problems and the subsequent side effects of vaccination are among the prominent issues that feature in the literature (Dubé et al 2015:100; Sobo, Huhn, Sannwald & Thurman 2016:8). Contextual factors affecting vaccine hesitancy also include historical, social, cultural, environmental, economic, political and institutional factors. According to Dubé and MacDonald (2018:1), the most prevalent "contextual impact" represented in the literature involves conspiracies or rumours, which include the fear of vaccines being introduced to serve the financial and political objectives of pharmaceutical firms, Western nations and governments, and a conviction that vaccines are introduced as a global population reduction strategy, among others (Dubé, Laberge, Guay, Bramadat et al 2013:1765; Cooper et al 2018:2356; MacDonald 2015:3).

2.6.2   Individual and group influences

The most prevalent determinant of non-vaccination is the lack of knowledge, personal perceptions or beliefs pertaining to vaccines and their potential impact on the social environment (Madhi & Rees 2018:2337). When individuals and communities conclude that vaccination may cause dangerous illnesses and/or undescribed side effects, vaccine resistance rates increase remarkably (Larson et al 2014:2153).

The inability to access the relevant information and knowledge about a vaccine or the disease that it targets often leads to misconceptions about vaccination, which, in turn, influences the vaccination decision-making processes (Williams 2014:2584; MacDonald 2015:2).

Another notable factor that is ascribed to individual and group influences affecting vaccine decision-making, and specifically vaccine hesitancy, is the mistrust of healthcare suppliers (Dubé et al 2015:100; Dubé & MacDonald 2018:1). Social norms, peer pressure and social interactions, including debates and casual conversations with friends, family members, colleagues, co-workers or community members, have also been identified as determinants of hesitancy (Dubé et al. 2013:1765).

2.6.3   Vaccine or vaccination specific issues

The limited number of African studies on issues related to vaccine and vaccination that influence vaccine acceptance identify vaccine availability, the timing of vaccine delivery and accessibility to vaccinations as major determinants of vaccine hesitancy (Cooper et al. 2018:2355). Some studies concentrate on refusals in reaction to the vaccine's ingredients and authenticity, resulting in fear of inadequate testing and understanding (Dubé at al 2015:100).

Based on the discussion in this section, it can be deduced that vaccine hesitancy is influenced by several factors, some of which were discussed in this section. The rise of social media has created platforms on which contextual factors, individual and group influences and vaccination specific issues are highlighted that appear to affect vaccine decisions, thereby potentially intensifying vaccine hesitancy (Dubé et al., 2013:1763; Sabahelzain, Moukhyer, Dubé, Hardan, et al 2019:13).

2.7   Summary

This chapter provided an overview of health communication, health communication campaigns and the essential principles of health communication campaign planning. Although the purpose of this chapter was to conceptualise the fundamental aspects relating to the study, it was also critical to discuss COVID-19 as an illness.

Therefore, the disease was explained by highlighting the essential features surrounding COVID-19, notably symptoms, and disease burden and challenges in creating vaccine awareness and acceptance. Furthermore, vaccine hesitancy and factors contributing to this phenomenon were discussed. The next chapter reviews the literature on the role of social media in the sharing of vaccine-related opinions.

CHAPTER 3: OVERVIEW OF SOCIAL MEDIA

3.1   Introduction

To explore COVID-19 vaccination sentiments on Twitter in South Africa, from January to May 2021, this chapter aims at investigating viewpoints about social media and to draw on the essential concepts regarding this discourse. In this chapter, social media, social media networks and other essential concepts in this study are explored. This is followed by an overview of social media characteristics, social media and their implications for health, the role of social media in the amplification of health risk information, as well as electronic word-of-mouth in propelling vaccination sentiments on social media.

The following sections explore the definitions of social media, based on available literature and present the foundations, classifications and characteristics of social media.

3.2   Defining social media

Because of the rapidly changing and complex nature of social media, there is no single, comprehensive conception that illustrates the complexity of social media (Swart 2018:89; Chan-Olmsted, Cho & Lee 2013:159). To emphasise, Roland (2017:149) states that social media are universally understood, but not easily defined.

Kietzmann, Hermkens, McCarthy and Silvestre (2011:241) define *social media* as new media that employ "… mobile technologies to create highly interactive networks via which individuals and communities share, co-create, discuss and modify user-generated content". Similarly, McCay-Peet and Quan-Haase (2018:23) define *social media* as "… web-based services that allow individuals, communities and organisations to collaborate, connect, interact and build communities by enabling them to create, share and engage with user-generated content that is easily accessible". These definitions emphasise the engagement aspects of social media, which are particularly relevant in this study.

Another definition of social media, which highlights the multifaceted types of communication tools, can be drawn from Treem, Dailey, Pierce and Biffl (2016:4), as they state that "… in practice, most scholars and practitioners invoking social media are referring to a specific set of online platforms that have emerged over the past three decades, for example, blogs, social networking sites, and microblogging".

Kapoor, Tamilmani, Rana, Patil et al (2017) identify the abilities of such social media platforms and remark that "… social media is made up of various user-driven platforms that facilitate the diffusion of compelling content, dialogue creation, and communication to a broader audience. It is essentially a digital space created by the people and for the people and provides an environment that is conducive for interactions and networking to occur at different levels (for instance, personal, professional, and business, marketing, political, and societal)".

Despite the lack of consensus on the definitions, social media have evolved to become the mainstream channel for the instantaneous distribution of information throughout the world (Kietzmann, Hermkens, McCarthy & Silvestre 2011:244; Mitra, Counts & Pennebaker 2016:269). McCay-Peet and Quan-Haase (2016:2) observe that social media have become established in society as an integral part of public communication and everyday life discussions. This is particularly relevant to this study, as the tweets that were analysed about the COVID-19 vaccination in South Africa were expressed unrestrictedly by Twitter users.

Roland (2017:151) suggests that social media are a rapidly maturing medium of communication that can be used to propagate health policy decisions and provide supporting evidence for those decisions. This largely emphasises the value of this study, explored and described the COVID-19 vaccine sentiments expressed on Twitter. Giustini, Ali, Fraser and Boulos (2018:14) also note that the use of social media in public health has expanded to educate the public about the prevention of infectious diseases and public health threats. Given the relevance of social media in society and public health, this study explored sentiments relating to COVID-19 during the first few months of South Africa's COVID-19 vaccine roll-out.

To gain a broader understanding of the social media concept, the following section builds on the origins of social media emerging from the literature.

3.2.1   Origins of social media

It is difficult to understand the origins of social media and their effect on health behaviours, without providing a brief historical context on the emergence of the World Wide Web (WWW), because the origins of social media and WWW are closely linked. The introduction of the WWW provided a new medium of worldwide human communication and revolutionised access to information and knowledge with implications in all aspects of daily life, e.g. religion and health (Hu & Lin 2013:187). The initial purpose of the WWW was essentially to promote information exchange between users and the emergence of social media is viewed as an extension thereof (Swart 2018:94).

While various technologies have been developed throughout human history to promote easier communication between people (Carton 2009:02), the advent of the WWW enabled the creation of the social networking site called Classmates.com in 1995 and Six Degrees in 1997 (Hu & Lin 2013:187; Dhingra & Mudgal 2019:4). The WWW technology successfully integrated information on social media into a global network, thereby making information accessible worldwide through new media. According to Steele (2009:1), "… new media include technologies that move, store, manage and allow digitised information to be manipulated, whether for news, entertainment, communication, visual or other purposes," which points to social media.

Zemmels (20212:2) notes that "new media" have become a general word used to describe any emerging and developing digital technologies, mainly those products of the last two decades of progress in personal computing, the Internet and mobile phone. Both these definitions of new media point to digital technologies such as the WWW and social media. In this way, new media can be viewed as forms of mass (communication) media that apply digital technologies to provide features such as interactivity and two-way communication (Ariel & Avidar 2015:23).

While Dickey and Lewis (2010:140) suggest that social media are still evolving, Hu and Lin (2013:187) opine that the earliest origins of social media can be traced back as far as 1792, when the first telegraph was sent. The table below highlights the developments of some of the popular social media platforms.

Table 3.1: Summary of various important developments in the evolution of social media since 2006

Item	Year	Platform	Important inventions/ developments	Name of inventor/s or founder(s)
1	2006	Twitter	Social networking and online news services on which people post and interact with "tweets".	Jack Dorsey, Noah Glass, BizStone, Evan Williams
		Spotify	A music and podcast streaming platform pay royalties based on the number of artists' streams out of total songs streamed.	Daniel Ek, Martin Lorentzon
2	2007	SlideShare	A service that permits users to upload files privately or publicly in the form of PowerPoint, PDF, word etc. The uploaded slide files can be viewed on the site itself or can be linked to other sites.	Rashmi Sinha
		Tumbler	A microblogging and social networking website that permits users to post content like multimedia etc. to a short blog. Users can make their blogs private and can also follow the blogs of others.	David Karp
3	2007	BizSugar	A social networking platform for small businessman, entrepreneurs and managers that permits users to share content like articles, videos, blog posts, podcasts and also permit users to view and vote on submissions done by other members.	John Holsen
4	2009	WhatsApp	A cross-platform immediate messaging system that uses the Internet to share texts, images, documents, audio and video messages among users who have installed the app on their devices like mobiles, PCs and tablets	Brian Acton and Jan Koum
5	2010	Pinterest	A social network that permits users to visually share, getting information about their interests by posting images or videos to their own or others' boards and surfing what other users have pinned.	Ben Silbermann, Evan Sharp and Paul Sciarra
6	2010	Instagram	A photo and video-sharing social networking service.	Kevin Systrom and Mike Krieger

Item	Year	Platform	Important inventions/ developments	Name of inventor/s or founder(s)
7	2010	Viber	A Voice over IP (VoIP) and immediate messaging app that permits sending and receiving of images, audio and video through mobile devices between users.	Talmon Marco and Igor Magazinnik
8	2014	Periscope	A live video streaming mobile app that permits sharing and experiencing live video streams direct from a tablet or smartphone.	Joe Bernstein and KayvonBeykpour
9	2015	Minds	A federated social networking service has open-source and it integrates the blockchain to provide the community with ERC-20 tokens as rewards for several contributions to the network. Tokens can be used by users for several purposes like endorsing their content or to crowdfund and tip other users for the exchange of exclusive content and services by subscribing to them monthly.	Bill Ottman, John Ottman, Mark Harding
10	2016	Gab.ai	A social media website that permits its users to read and write English-language multimedia messages of up to 3,000 characters, called "gabs".	Andrew Torba
11	2016	Mastodon	An online self-hosted social media and social networking service that permits anyone to host their server node in the network, and its various separately operated user bases are federated across many different sites (called "instances").	Eugen Rochko

According to Dhingra and Mudgak (2019:7), the growth trend of social media is likely to rise at an exponential pace in the future, and as far as health literacy is concerned, Zhao and Zhang (2017:270) note that social media have become pervasive, making them the main platform for Internet users to acquire and share health information that informs their health behaviours. As more people are becoming dependent on social media for different purposes, including seeking information on vaccines, it is vital to understand the sentiments pertaining to COVID-19 vaccines.

3.3.2 Characteristics of social media

Social media platforms, such as Twitter, which is the focus at hand, are characterised by the assumption that "… communication on any subject will occur without experts' participation or approval" (Kietzmann et al 2011:244). Similarly, Chan-Olmsted et al (2013:150) note that social media use has changed from passive consumption to active content creators, thereby highlighting social media characteristics such as user-centricity, interactivity, and collaboration which may have implications for health authorities who wish to improve vaccine acceptance.

According to Mayfield (2008:05), the attributes of social media platforms may vary to some degree, but there are certain fundamental features that all social media platforms share, such as participation, openness, conversation, community and connectedness. In addition, Witteman and Zikmund-Fisher (2012:3735) suggest that social media characteristics such as user participation and interactivity, openness, and network effects have severe consequences for the vaccine debate on social media, due to the platforms' ability to share both confirmed and unverified information. Moreover, it must be expected that these characteristics allow people to express and thus share their opinions with others freely. As such, user participation, openness, network effects and the amplification of information are regarded key characteristics of social media platforms such as Twitter and will be discussed in the following section.

3.3.2.1 User participation and social media interactivity

Firstly, *user participation* is defined as "… the extent to which users are involved in the real-time modification of the form and content of a mediated environment" (Steuer 1992:76; Chan-Olmsted et al 2013:154). User participation on social media indicates that the user can share data or content with individuals with comparable interests in distinct formats, such as videos, pictures, text or previous experiences (Patino, Pitta & Quinones 2012:232). Social media messaging is to a certain extent unregulated and can be generated by both formal organisations and the general public (Kane, Alavi, Labianca & Borgatti 2014:29). According to Eysenbach (2008:22), participation is not only a function of social media, which is essential for public users and patients, but also applies to health professionals and researchers.

This two-way communication characteristic of social media may provide direct audience feedback that reveals social media users opinions on vaccination to organisations like public health institutes and health departments. In context, the focus does not necessarily fall on two-way communication or feedback *per se,* but rather on the discovery of negative, neutral or positive sentiments through the analysis of original and quoted tweets, and the investigation of themes raised in these tweets.

Another important characteristic of social media is interactivity. However, there is no consensus on the definition of interactivity in social media and various researchers use various conceptualised and operationalised meanings to describe it (Qiao 2019:13). Rogers (1986:4) provides one of the early definitions applicable to the social media context, stating that *interactivity* "… is the ability of new communication systems to talk back to the user, almost like an individual participating in a conversation". Similarly, Ariel and Avidar (2015:19), state that social media help people to interact with other users with whom they have varying degrees of familiarity.

Social media provide more interactive features for the public to understand the government's policies and interventions even in the areas of public health according to Hao, Zheng, Zheng and Fan (2016:82). A study conducted by Glanz, Wagner, Narwaney, Kraus et al (2017:6), found that web-based social media intervention by providing accurate online information with interactive technologies during pregnancy has a positive impact on infant-vaccine acceptance.

3.3.2.2 Social media knowledge sharing and openness

Another characteristic of social media and social media networks is that of openness. In the health sector, this implies that the user can find relevant information more rapidly and with far fewer difficulties, compared to a session with a healthcare provider (Patino et al. 2012:234; Ventola 2014:495), and expand his/her sources of knowledge and get the required information as far as health issues are concerned (Sarasohn-kahn 2008:2; Hill & Moran 2011:819; Zhao & Zhang 2017:268). The openness characteristic of social media implies transparency with regards to health information, in that most social media services are open to feedback and participation and they encourage voting, comments and the sharing of information (Eysenbach 2008:22).

Social media users can freely access health information, as noted by Jansson, Lövheim Paasonen and Sumiala (2013:26), who suggest that social media have become increasingly ubiquitous to the point that they have become invisibly integrated into social life.

3.3.2.3 Network effects and platform quality

The last feature, which is particularly relevant to this study is network effects, which involves the "… user's capacity to continue communicating and sharing information with relatives and friends" (Hill & Moran 2011:822). Network effects and platform quality in social media mean that there are rarely any barriers to access and use of health information and that users can connect, making use of links to other sites, resources and people (Chou 2014:132). This suggests that the user can use a variety of information sources for free access to information on social media (Patino et al. 2012:234).

Considering the characteristics of social media as discussed in the sections above, it is evident in literature that, social media have been analysed and studied by numerous scholars and researchers who agree that information sharing and dissemination of information is one of the essential elements of social media (Kazama, Imada & Kashiwagi 2012:85). Although there may be different types of information, needs of users or social media involved, social media platforms can inform participants about important health information (Westerman, Spence & Van der Heide 2012:171).

3.3.2.4 Amplification of opinions through social media

In addition to independence, the key characteristics of social media that give it an edge over conventional media in terms of content dissemination and the ability to share people's thoughts and emotions are speed and interactivity (Melnychenko 2020:23), which leads to amplification of opinions.

Amplification is the process by means of which audience members communicate health-risk information across their social networks, therefore expanding the reach of the material and engaging others (Pidgeon, Kasperson & Slovic 2003:129). Information consumers who actively remark on a topic raise the issue's relevance for other members of their social media network, so serving as disseminators of the

original message and amplify message effects (Strekalova 2016:2). According to Hopfer, Fields, Lus, Ramakrishnan et al (2021:4), social media context provides a space where risk messages are not only shared, but also edited or passed on with additional affordances and meanings ascribed to them, which shapes risk interpretation and subsequent risk prevention behaviour adoption.

However, for health communication and education, social media provides both distinct benefits and unique challenges. For example, they provide a platform for rapid information dissemination about public health risks, but they may have unintended consequences when audiences actively share their interpretations of information and contribute to the amplification of risk perceptions (Merchant, Elmer & Lurie 2011).

3.3   Risk amplification through the media spread model

As our knowledge of the impact of social media on infectious disease outbreak risk communication is limited, this study proposes the risk amplification through the media spread model (RAMS) as a relevant model considering that the model provides a strategy for health organisations to combine traditional and social media when communicating information about infectious diseases in line with RO2 of this study. The RAMS model, according to Vijaykumar, Jin and Nowak (2015:663), draws key ideas from the social amplification risk framework (SARF) and the social-mediated crisis communication (SMCC) models and clarifies communication processes, media influence pathways, and the role of social media in influencing risk perceptions among the general public in the event of an infectious disease outbreak. The RAMS model is considered for this study because it adopts a holistic approach to handling risks by capturing the amplification of risk messages and perceptions across media platforms, including social media platforms like Twitter, which is critical in this context.

Furthermore, the RAMS model considers both computer interfaces and mobile technologies when examining the development, process, and effect of infectious diseases outbreak information virality (Vijaykumar, Jin & Nowak 2015:673).

3.4 Twitter as a social media platform

Social media platforms are enabling users to connect with other users on the WWW, by enabling profiles of personal information to be uploaded on these platforms and inviting others to have access to those profiles (Davel 2013:21).

Some of the prominent social media platforms, include Facebook, Twitter, YouTube LinkedIn and Pinterest according to Kapoor et al (2017:2). It is evident in literature that Twitter is among social media platforms that provide a multitude of benefits for the establishment of a two-way conversation between members of the general public and are also viewed as facilitating access to information on public health (Capurro, Cole, Echavarría, Joe et al 2014:2; Syed-Abdul, Gabarron & Lau 2016:2). Accordingly, the primary focus of this research is to describe and explore COVID-19 vaccination sentiments on Twitter during the first five months of the COVID-19 vaccine roll-out in South Africa.

While social media platforms like Twitter have the potential to significantly increase access to public health information, they are also efficient platforms for communicating unverified health messages (Fayoyin 2016:2). The latter is often exploited by individuals opposed to certain health interventions like the anti-vaccination pressure groups (Burki 2019:258). Most organisations – particularly anti-vaccination pressure groups – understand that social media networking has become a familiar and efficient form of communicating unverified health messages (Ozturk, Li & Sakamoto 2015:2407; Mitra et al 2016:269).

Twitter is a micro-blogging tool that enables users to opt-in to receive and send meaningfully short tweets (McFedries 2007:100). Microblogging is a kind of blogging that is used for purposes such as encouraging users to compose and publish short texts (mostly less than 280 characters) for public viewing and also to be viewed by specific groups that the user has chosen (Abdekhoda, Sattari, Mohammadi & Salih 2020:100). As observed by Sparks (2019), Twitter facilitated the engagement of 328 million users in April 2017, providing them with a platform to create a personal profile and to connect with other users by following them on Twitter (Weeks & Holbert 2013:4).

According to Twitter, its mission is to provide a platform for its users to produce, exchange and share ideas and information instantaneously (Twitter 2019). As a consequence of the enormous amount of information on Twitter, which is estimated at 50 million tweets a day, the platform uses hashtags to enable a larger audience to send and view tweets instead of followers of one user only (Small 2011:872).

The rapid rise of Twitter in popularity and adoption can be attributed to a variety of factors. One major factor is that Twitter connects and supports users during live events in a conversation, thereby creating subculture expression, which is desirable for posting unverified and even unsubstantiated information (Highfield, Harrington & Bruns 2013:1). Twitter also gives users a live, communal discussion, which makes it possible for their Twitter feeds to update in real-time resulting in increased impressions of the messaging (Highfield, Harrington & Bruns 2013:2).

Numerous researchers (Kwak, Lee, Park & Moon 2010:591; Petrović, Osborne, McCreadie, MacDonald, Ounis et al 2013:2) have investigated the power of information sharing on Twitter. In their investigation of Twitter and information diffusion, Kwak, Lee, Park and Moon (2010:595) established that trending themes – including anti-vaccination topics – often make headline news. An examination of retweeted tweets revealed that any retweeted message typically reaches over 1,000 users, regardless of the original tweeter's number of followers. After being retweeted, a tweet may be retweeted again, suggesting rapid information spread after the first retweet (Kwak et al. 2010:598).

Tavoschi, Quattrone, D'Andrea, Ducange et al (2020:6) established that vaccination as a topic received growing attention on Twitter in Italy between September 2016 and August 2017. Another study mining Twitter to assess the determinants of health behaviour toward Human Papillomavirus vaccination in the United States found that there was a need to develop innovative ways of leveraging social media in the changing health communication landscape (Zhang, Wheldon, Dunn, Tao et al 2020:225).

Furthermore, in their study on public reaction to COVID-19 on Twitter Mustafa, Ansari, Mohanta and Bella (2020:356) discovered that social media platforms such as Twitter can be used to undertake infodemiological studies connected to public health events such as COVID-19. As a result, it's critical for this study to look into and describe COVID-19 vaccine sentiments on Twitter in South Africa.

3.5 Role and characteristics of the online audience

The *audience* is defined as "… receivers of various conventional types of media products or spectacles which have been designed for them" (Danesi 2013:34). Although the idea of the audience was useful in the run-up to the advent of new media, Zhao (2018:133) notes that the term is no longer relevant because of the fast-changing role of audiences in light of the digital age. These developments in the online environment have resulted in more organisations recognising the need to strategically integrate their communication efforts to accommodate what will be called an *online audience* hereon due to its changing role (Finne & Grönroos 2009:179).

Moreover, McQuail (1997:130) notes that the role of the audience as a passive consumer and media receiver has declined and that the audience "… aspires to be engaged in the process of information communication; to be conversationalist; to learn; to feel included – not targeted– and to be updated on a timely basis". As such, the term that will be used is the *online audience* to refer to Internet users who express their sentiments on vaccinations on social media.

The next section explores the roles of online audiences.

3.5.1 Content creators

Online audience members around the world have become active information creators, generating content, such as product reviews and health-related information to be shared on social media platforms such as Twitter and also re-using the content (Du Plessis 2010:2; Zhao 2018:134).

Given the accelerated growth and power of digital platforms and social media, people are rapidly changing the way they use and channel information, creating and sharing content online about the products of an organisation and services (Chan-Olmsted et al 2013:154). This allows online audiences to not only consume content but to actively produce content that resonates with them.

Scholars agree that audiences have evolved into digitally sophisticated members of society (Elias 2007:7; Eysenbach 2008:1; Chou 2014:128; Masip, Ruiz-Caballero & Suau 2019:2), who are characterised by their ability to research and find information, which enables them to be informed and to share content (Hanekom 2009:16; Zhao 2018:134). Thereby, forming online communities as they organise themselves around common interests. Bachl and Link (2020:3) opine that online communities provide parents with ample resources for health-related conversations concerning vaccine discussions online: "in particular, online communities can provide different kinds of social support for decision-making related to vaccines".

3.5.2 Active participants

In the information value chain, online audiences are highly empowered, as they require a two-way engagement with organisations (Chan-Olmsted et al 2013:154; Zhao 2018:135). Consumers are now characterised by their active participation in the consumption of information, thereby taking charge of their media experience (Eysenbach 2008:5; Zhao 201:135). In many instances, communication about subject matters, including public health and vaccinations, is being sourced, sustained, organised and even owned by consumers (Shao 2009:10; Ventola 2014:495).

Online audiences are no longer passive consumers of information but instead engage with each other and organisation on public objectives, engagement and industry decision-making. Social media enables consumers to create content in the form of product reviews, product use descriptions, homemade advertisements, blogs and other consumer-initiated inputs (Fader & Winer 2012:369). The veracity of the user-generated information on vaccines information on social media may differ significantly, thereby affecting vaccine attitude forming and subsequent intentions and actions (Weber et al 2019:5.

3.5.3   Selective media users

Consumers can actively visit and engage with organisations on social media platforms at their convenience, using and discarding information as they wish (Seraj 2012:213; Zhao 2018:133). Social media offers the online audience member a choice of tools such as online audience forums and blogs among others to communicate their opinions on matters of interest and to co-create content relevant to them (Zhao 2018:135). As such, government agencies seeking to attract and reach media users with information on vaccinations may strive to use relevant channels and incorporate information and sentiments from online audiences into policy-making (Hao et al 2016:82).

In conclusion, organisations desiring the attention of consumers need to keep up with the changing consumer and consumer demands. Scholars share the view that that the advancement of technology in society has caused a fundamental power shift – to the point that audiences can dictate the rules of engagement to organisations and health authorities alike (Hopkins 2014:2; Willman-Iivarinen 2017:11).

Because of the confluence of political, economic and technological changes that resulted in a myriad of challenges, audiences and health authorities seem to have moved from an essential relationship of existence to that of survival; particularly on the side of the public health organisations wishing to spread a pro-vaccination message (Steffens, Dunn, Kerrie, Wiley & Leask 2019:10). For this reason, organisations should be concerned with communication trends that appeal to their customer segments (Russo & Watkins 2008:228; Willman-Iivarinen 2017:1) such as the increasing number of online audiences who rely on other online audience members as the principal source of information to inform their decision making (Weber, Muehling & Kareklas 2019:5).

3.6   Electronic word-of-mouth and vaccination information on social media

Litvin, Goldsmith and Pan (2008:461) maintain that technology advances, which include social media, allow communication between producers and consumers as well as those between consumers themselves.

The authors *(ibid)* refer to such communication as *electronic-word-of-mouth (e-WOM)* and define it as, "… all informal communications directed at consumers through Internet-based technology related to the use or characteristics of specific products and services or their sellers".

Ho and Dempsey (2010:1000) also define *e-WOM* as the act of transmitting electronic content to other people using the internet. This view stresses the importance of E-WOM to the study as Twitter users actually freely transmitted their opinions during the vaccine roll-out. Consequently, many acknowledge that internet users are more inclined to believe other users' opinions of their health experiences and side effects than those of medical authorities (Erkan & Evans 2014:03). Fundamentally, Internet users consider word-of-mouth as the most significant source of information, as it allows shared information to be visible instantaneously to potentially millions of viewers, who then share it on their social media platforms.

By using social media networks such as Twitter, online users worldwide are generating and sharing content on different subjects (Huete-Alcocer 2017:1). As the viral nature of social media allows for the rapid distribution of opinions– an occurrence known as the electronic word-of-mouth, vaccine advocates must engage with social media users reluctant to take vaccines through social media (McGee & Suh 2019:6). Twitter supports online interactions, and with minimum platform access limitations, any users or accounts may become opinion leaders or influential by serving as an information or communication centre in the network (Chong & Park 2021:6480). As a consequence, social media provides insights into internet vaccine debates, which could be instrumental in informing communications campaigns concerning attempts to promote vaccination. Although e-WOM may include negative sentiments about vaccination, it is perceived by users to be neutral and, therefore, reliable (Cruz & Fill 2008:744).

In today's age of information overload, anyone with access to the internet can express their opinions on vaccination and other subject matters. In addition, anyone with access to the internet can reach out to the internet for information to help them make medical decisions (Kata 2021:3779; Gu, Badger, Su, Zhang et al 2017:9). Due to the open nature of the Internet-enabled social media platforms, health information, apprehensions and distortion can go unverified.

According to McGee and Suh (2019:7), vaccine-related content currently available online is of mixed quality and users are sometimes taken to anti-vaccine websites that spread misinformation and conspiracy theories. As such, social media may adversely influence parents' and caregivers' vaccination decisions as this may lead to instances where a person may find anti-vaccine literature disguised as evidence-based and accurate while searching for reliable information about vaccines (Evrony & Caplan 2017:2; Mavragani & Ochoa 2018:2). However, the role of e-WOM in amplifying vaccination messages requires further exploration.

3.7   Social media implications for health

Not only have social media empowered the online audience to engage, but they have also empowered the online audience member to participate in the sharing of content about vaccines and health in the online environment (Hussain et al. 2018:3).

The rise of social media has presented public health advocates, who want to prevent the spread of infectious diseases, opportunities to facilitate and encourage healthy behaviours in the online environment (Strømme, Mosdøl, Nordheim & Vist 2014:7; Giustini, Ali, Fraser & Boulos 2018:14). A study conducted between 2011 and 2017, which examined online behavioural changes concerning the EU (European Union) measles outbreak and anti-vaccination sentiments, found that there was a positive correlation between monthly measles cases and Google searches (Mavragani & Ochoa 2018:1). Similarly, in a study examining how health-related social media campaigns could reach Malaysian youth, Ayub, Manickam, Hamzah, Suanda et al (2017:5) found that, when used systematically, social media provide an excellent platform for communicating health messages to Malaysian youth – owing to their effects on people's behaviour. Another study that looked at social media to see how people felt about the COVID-19 vaccination discovered that vaccine opinions are largely influenced by online information, particularly content on social media (Boucher, Cornelson, Benham, Fullerton et al 2021:8).

In terms of designing public awareness strategies, Glanz et al (2017:7) found that web-based vaccine information through social media platforms may have a beneficial impact on parental vaccine decisions.

While it is evident that social media provide a space for sharing accurate health-related information, it is worth noting that since social media is unregulated, misinformation related to public health can also spread through social media. The role of social media platforms in the dissemination of anti-vaccination messages potentially threatens public health efforts by reducing the prospects of disease eradication (Steffens, Dunn, Kerrie, Wiley & Leask 2019:2). Furthermore, public health messages from health organisation are spread more quickly through social media, which can enhance functional health literacy (Gupta, Tyagi & Sharma 2013: 299). This is confirmed by the evidence of increasing numbers of people consulting social media networks for advice and information (Giustini, Ali, Fraser & Boulos 2018:14). As such, national and provincial health departments seeking to reach specific communities with pro-vaccination messages should consider the role and opportunities of social media for health communication.

Social media have positioned themselves as an indispensable part of healthcare industry promotion therefore, researchers argue that social media may play an essential part in disseminating and enabling engagement of science-based healthcare information (George, Rovniak & Kraschnewskiv 2013:6).

In addition, Boon-itt (2019:1) states that people can access almost all health information from the comfort of their homes by pressing a button, individuals are looking for ways to gain information about their well-being by searching for information online that will help them determine whether to visit a doctor or not. Today, owing in part to the instantly accessible social media reviews, patients are well informed about the services provided by different health-related organisations (Pellisé & Sell 2009:396). In addition, numerous social media platforms allow patients to interact with other patients and with health care providers, thereby making social media a vital information system with the ability to potentially improve patient health outcomes (McCarroll, Armbruster, Chung, Kim et al 2013:948).

Countries are making more significant attempts to create healthcare systems centred on patients. – "Patient-centred healthcare is a component of a change in focus that has attracted growing interest in recent years, emphasizing the significance of integrating patient requirements and perspectives into care delivery" (Rozenblum &

Bates 2013:183). This is accomplished by promoting patients to participate actively in health services growth (Crawford, Rutter, Manley, Weaver et al 2002:5). Social media have become appropriate and important platforms to increase patient participation in the healthcare industry by enabling interaction.

Furthermore, the literature demonstrates that social media is a suitable platform for public health promotion communication. Using social media platforms for campaigns to show the dangers of vaccine hesitation, for instance, can shed light on the advantages of taking vaccines for public health. Therefore, more individuals will be provided with important health-related data using social media for public health campaigns.

In addition to patient participation, social media offer the healthcare industry real-time data, which can shape business objectives and the way healthcare is provided going forward. This data can be discovered through monitoring social networking sites instead of acquiring data about health or medicine by visiting the doctor or pharmacy. For example, physicians can upload videos on YouTube on particular medical subjects, and healthcare practitioners could use blogs to share medical data and education (Subramoniam & Sadi 2010:46). In addition, healthcare quality may improve as organisations actively use social media to boost communication and provide patients and their families with information (Van de Belt, Engelen, Berben, Teerenstra et al 2013:8). In brief, the healthcare industry can benefit from using social media as it allows the interaction between the healthcare professional and the patient.

Social media can impact vaccine perceptions as it is the fastest increasing source of data about consumer health. Recent surveys, for instance, show that South Africa had a general Internet penetration rate of 54% in January 2019, which represents just over 31 million individuals in the nation online. The country's development in social media activity was particularly noteworthy, with approximately 5 million more South Africans entering the ranks of active social media consumers, where the level of social media penetration is 40% of the population (Digital 2019).

3.8   Summary

Considering the background provided in the chapter, it can be concluded that social media is a powerful information platform, because "we are all connected" through social media (Hanna, Rohm & Crittenden 2011:272). As such, health authorities seeking to reach a specific audience should understand social media and the needs of social media users (Gu, Badger, Su, Zhang et al 2017:8).

This chapter presented an overview of aspects related to social media, and Twitter as platform on which users share their opinions about COVID-19. To this end, this chapter presented and described social media, social media characteristics, Twitter, the online audience, social media and implications for health communication, as well as highlighted the importance of e-WOM.

CHAPTER 4: THEORETICAL BACKGROUND

4.1 Introduction

The previous chapters presented the literature on health communication and social media. This chapter reviews the literature on theories and concepts that frame and support the exploration of vaccine sentiments on social media by relating each to the context of the study. Adom, Hussein and Agyem (2018:438) suggest that conceptual frameworks are a fundamental part of a research enquiry to form a foundation upon which research is constructed. Therefore, this chapter aims at understanding the theories that may assist in solving the research problem and ultimately explore and describe the vaccination sentiments on social media. The discussion of theories will include the social impact theory, social cognitive theory, theory of reasoned action and resource mobilisation theory.

4.2 Social impact theory

After running a series of trials to test a hypothesis about how power functions, Latané (1981:343) developed the social impact theory to explain social contact opportunities. *Social impact theory* is, therefore, defined as " … any of the great variety of changes in physiological states and subjective thoughts, motivations and emotions, cognitions and attitudes, principles and behaviour that arise in a person, human or animal, as a consequence of the actual, implied, or imagined presence or behaviour of other individuals" (Latané 1981:343).

Given the fact that social media allow people to connect without boundaries (Fueller, Schroll, Denhardt & Hutter 2012:3218; Sawyer & Chen 2012:154; Amedie 2015:3; Appel, Grewal, Hadi, & Stephen 2020:79), it is reasonable to assume that, in an online setting, such that of social media, people are free to interact and to be in the presence of one another virtually (Cobb 2009:242; Oztok, Zingaro, Makos, Brett & Hewitt 2015:20; Bayer, Triệu & Ellison 2020:483). This means that being in the apparent presence of others may have a significant impact on people's opinions on COVID-19 vaccinations according to Twitter tweets.

Similarly, Moeller and Bushman (2007) observe that the social impact theory proposes that the amount of influence a person experiences in group settings depends on (i) strength (power or social status) of the group; (ii) immediacy (physical or psychological distance) of the group; and (iii) the number of people in the group exerting the social influence (i.e. number of sources). Therefore, a group with numerous members (rather than a few members), high power (rather than low power), and proximity (rather than distant proximity) should exert the most influence on an individual.

To build on the definition of the theory of social impact, Perez-Vega, Waite and O'Gorman (2016:300) put forth the social influence theory, and define *social influence* as "… the direct and indirect influence processes that can operate at the interpersonal, group or socio-cultural level, and that involve effects that may be subconscious or conscious, and can impact on thoughts, judgements and observable behaviours".

The social impact theory suggests that online interaction with other users may influence social media users' actions offline (Snijders & Helmes 2014; Perez-Vega et al 2016:310). The theory of social impact may reveal insights into how online conversations about the COVID-19 vaccination roll-out could have influenced online opinions and allow organisations such as the NDoH to formulate guidelines for the proactive use of social media to detect, respond to and prevent misinformation about vaccines during disease outbreaks (Wallack 2002:27; Perez-Vega et al. 2016:2).

The social impact theory is a suitable approach for understanding communication on social media between the consumers of vaccine-related information and how it influences the mentions on Twitter specifically (Mir & Zaheer 2012:3; Pulido, Redondo-Sama, SordeÂ-MartõÂ & Flecha 2018:1). Organisations are increasingly seeking methods to create an efficient social media presence to boost awareness and engagement (Perez-Vega et al 2016:300). Therefore, the NDoH may strive to improve the approach followed during the COVID-19 roll-out strategy. The social impact theory is considered relevant to reaching the research objectives of this study, which include exploring sentiments and describing key themes behind vaccination sentiments, based on the data on Twitter during the vaccine roll-out. For these reasons, the features of the social impact theory are critical in guiding this inquiry and informing the

social media discourse around vaccinations. To this end, the following section briefly explores the key features of social impact theory.

Under this theory, the following three key variables constitute social effect: power, immediacy and number.

4.2.1   Power (Social status)

Latané (1981:344) defines *power* as a given source's salience, influence, significance, or intensity to the target, usually characterised by items such as the status of the source, age, socioeconomic status and prior relationship with the target or potential power over it. Perez-Vega et al (2016:304) suggest that, as power increases, so does the degree of social impact, thereby making power in the context of the social impact theory trans-situational. The concept of power in this theory has become much more applicable to the setting of social media, as social media offer power in the form of followers, friends and colleagues who are interested in your published opinion (Appel, Grewal, Hadi & Stephen 2020:82). Besides the number of fans or followers on social media, some of the key contributors to power are the source's status, age, socio-economic status and future or prior relationship with power (Latané 1981:344).

4.2.2   Immediacy

Immediacy, as described by (Latané 1981:344), is a central characteristic of the social impacts theory. *Immediacy* refers to the closeness in space or time and the lack of intervening boundaries or filters. According to Perez-Vega et al (2016:305), the degree of social influence rises as immediacy increases. In social psychology, the impact of interpersonal communication on attitude, values and behaviour was researched (Perez-Vega et al 2016:303); different types of immediacy – i.e. physical, temporal and social immediacy – are theorised as influencing individual behaviour (Bourgeois 2001:2).

Social media provide both temporal and virtual immediacy and the people engaging on social media are no more than a mobile device apart (Suvojit 2016:25). The removal of physical boundaries in social media means that communication occurs immediately, regardless of geographical location.

Consequently, Perez-Vega et al (2016:306) suggest that immediacy influences attitude, thereby producing implications for organisations who share information on vaccines on social media.

4.2.3 Number

The last core feature of the social impact theory is the number of people in society who exercise social influence (Moeller & Bushman 2007:2). Perez-Vega et al (2016) opine that social media are a significant motivation for the number of users in the influencing community, such as the number of participants in an online forum. Social media influencers are new types of independent, third-party endorsers who shape audience attitudes through blogs, Twitter and other social media (Kim, Duffy & Thorson 2021:3). However, these scholars maintain that, based on the number of followers and other considerations, influencers may have different degrees of influence on their followers.

Similarly, Mir and Zaheer (2012:4) argue that "… when other people are the source of impact and the person is the target, impact should be a multiplicative feature of the strength, immediacy, and number of other people." It also means that, as the number of social network users grows, so does the effect on the target person. Furthermore, Mir and Zaheer (2012:3) claim that, as the number of people sharing their experiences and knowledge of the same product, brand or event increases, the impact on target users looking for information and feedback on social media grows. As a result, the aforementioned ability of social media could drive social media interactions with implications for vaccine sentiments, making the application of the social impact theory in understanding social media sentiments highly significant.

Although the social impact theory accounts for a viewpoint on social effect, it does not address the importance of perception in one's ability to comprehend their feelings and establish attitudes (Bourgeois 2018:4). The social cognitive theory, which will be explored in the following section, has been used to guide studies in both health and media use habits.

4.3   Social cognitive theory

The social cognitive theory originated as the social learning theory in 1977 and later developed to the social cognitive theory (Luszczynska & Schwarzer 2005:127). The social cognitive theory, which was founded by Albert Bandura in 1986, focuses on the notion that learning is influenced by cognitive, behavioural and environmental influences (iSALT Team 2014; Lin & Chang 2018:772). As indicated by Bandura (2014:144), the social cognitive theory "… defines a central collection of determinants, the process by which they function, and the optimal means of transforming this information into successful health practices".

The social cognitive theory has served as the foundation for a variety of studies, including efforts to encourage pre-diabetic people in rural areas to exercise. The study conducted by (Marmo 2013) found that implementing a social cognitive theory-based physical activity intervention for a rural community at risk of diabetes has potential benefits, such as the reduction in fasting blood sugar among rural individuals with pre-diabetes. Another study, conducted by Lin and Chang (2018) used the social cognitive theory to explore what motivates people to share health information on social media and discovered a connection between social media interactive features, outcome expectations and personal behaviour (Lin & Chang 2018:771). This study is particularly relevant to this study and the main findings revealed that people are motivated to share information, because communications through social media may increase social media users' expectations about the enhancement of health self-management competence.

When well designed, health awareness campaigns have the ability to affect one's behaviour, personal influences, or the environment positively (Bandura, 2004:148; Seymour 2018:34). The social cognitive theory makes forecasts and promotes change by teaching, influencing and motivating people to follow healthier lifestyles and behaviours, while several other models and hypotheses of communication focus on forecasting health behaviours (Bandura 2004:144).

The social cognitive theory, which is regarded as a leading scientific theory in the field of health communication, is believed to be valuable to achieve all the research objectives and to make recommendations that the NDoH could follow in detecting and reacting to vaccine misinformation on social media (Marmo 2015:16).

The following six determinants are involved in the social cognitive theory: awareness of the health consequences; advantages of different health behaviours; presumed self-efficacy that one should exert control over one's health habits; outcome assumptions regarding the potential costs, benefits for various health habits; and health targets people set for themselves (Marmo 2015:446). Based on the views of Wang, Shen, Bartsch and Zuo (2021:106555), public acceptance of public health interventions is influenced by self-efficacy, social environment, cognised goals and outcome expectations. The following sections will focus on these four components.

4.3.1   Self-efficacy

In the social cognitive theory, self-efficacy is the most researched and well-established subject. Self-efficacy is described as "people's assumptions about their capacities to attain established standards of success that exert influence over events that affect their lives" (Bandura 1994:2). However, perceived self-efficacy refers to a person's anticipation of the consequences of his/her behaviours in a challenging situation (Bandura 1994:2; Raeder, Karbach, Struwe, Margraf et al 2019:1)

According to the social cognitive theory, self-efficacy means that providing a depth of information required to intervene, such as vaccination information on social media, will not be enough if people lack the self-efficacy to use the information or skills gained (Krieger, Serrano & Neighbours 2017:2). Past performances, indirect learning, peer persuasion, and physical and emotional states will contribute to self-efficacy (Wood & Bandura 1989b:365; Marmo, 2015:446). Literature has shown that self-efficacy may have an impact on health attitudes and, as such, this study needs to explore the literature concerning self-efficacy (Phoosuwan & Lundberg 2020:2).

Although Yoon and Tourassi (2014:2) assert that self-efficacy is the most effective element in improving behaviour, Myhre, Xiong, Vogel and Teoh (2020:5) discovered that non-vaccinators have a greater understanding of their ability to prevent HPV infection without vaccination. Another study on the willingness to get the COVID-19 vaccine found that those with more positive attitudes and stronger subjective norms favouring vaccine behaviour have more intentions to get vaccinated and that those who feel vulnerable about the health threat have the self-efficacy to overcome barriers are more likely to be willing to get the vaccine (Guidry, Laestadius, Vraga, Miller et al 2021).

4.3.2   Cognised

The social cognitive theory further emphasises the potential for self-direction and self-motivation (Bandura 1994:2). As opined by Marmo (2013:446), goals serve as self-motivators and may encourage healthier behaviours. Set goals may serve as a compass for action and as encouragement for perseverance and progress (Bandura 1986:239). People may be dissatisfied with unsatisfactory results and achieve self-satisfaction by achieving important goals (Wang, Li, Sun, Cheng & Zhang 2017:2). Consequently, inconsistencies in actions and personal expectations create self-reactive influences that function as motivators and directions for action directed at achieving desired outcomes (Wood & Bandura 1989b:366). Not only has goal-setting been a significant aspect of the care of patients with two or more long-term illnesses (Vermunt, Elwyn, Westert, Harmsen et al 2019:2), but it also has consequences for vaccine attitudes (Korn, Betsch, Bohm & Meier 2018:3) and forms an essential part of this research exploring vaccine sentiments on Twitter.

4.3.3   Outcome expectation

As part of the social cognitive theory triad, behaviour requires consequence expectations (LaRose & Eastin 2004:360). Outcome expectations are personal assumptions on the impact of an action producing a certain outcome (Plotnikoff, Lippke, Courneya, Birkett et al 2018:630). This means that, when an individual performs a particular action, the desired outcome is expressed in the outcome assumption, which may be positive or negative.

For example, if an individual expects vaccinations to prevent a certain disease, this can affect the decision to vaccinate or not to vaccinate. As a result, positive outcomes can be inspiring, while negative results may be demoralising (Marmo 2015:446). Good outcomes may encourage a greater sense of self-efficacy, linking behaviour to personal factors. Incentives can specifically be linked to the cognised expectations one set for themselves, and positive outcomes can promote a greater sense of self-efficacy, thereby linking behaviour to personal factors. Outcome expectations have implications for vaccine attitudes, as can be seen in a study on social cognitive theory predictors of Human Papillomavirus vaccination intentions of college men at a South-Eastern University, which found that health interventions should be informative about the potential benefits of vaccines and should individualise the value of those benefits (Priest, Knowle & Sharma 2015:379).

Lin and Chang (2018:772) remark that a person's expected outcomes from online group knowledge sharing can be divided into two categories: personal expectations and community-related expectations. Receiving more attention and making more friends or followers are some of the positive outcome expectations associated with sharing vaccine knowledge.

4.3.4   Environmental factors

Environmental factors include a variety of social, physical and cultural aspects that play a part in affecting behaviour choices (Marmo 2015:447). In terms of COVID-19, government restrictions and lockdowns could be considered as an environmental factor. In certain instances, the amount of stress individuals experience in managing strenuous environmental demands, and the belief these individuals hold about their capabilities affect their decision-making and behaviour (Bandura 1998:3).

Concerning vaccine attitudes, the social cognitive theory helps to understand why people adopt and maintain certain behaviours (Marmo 2015:447; Lin &Chang 2018:772). Although the social cognitive theory is a useful tool for understanding how human behaviour is shaped (Marmo 2015:447), it does not provide the explanations for people organising themselves to seek collective, societal, or political change, such as the anti-vaccine agenda. The theory of reasoned action may be able to close this

gap and answer the research question about the key themes that were raised on Twitter during the COVID-19 vaccine roll-out in South Africa. The following section explores the theory of reasoned action.

4.5 Theory of reasoned action

Icek Ajzen and Martin Fishbein founded the theory of reasoned action in 1975. The theory involves a model of behavioural intention prediction that covers attitude and behaviour predictions (Hagger 2019:1). According to the theory of reasoned action, an individual's conduct is dictated by their intention to perform it, which, in turn, is a function of their attitude toward that behaviour and their subjective norm (Baker, Morrison, Carter & Verdon 1996:529; Fishbein 2008:1).

According to the theory of reasoned action, the intention to undertake a particular action is the best predictor of behaviour (Roberto, Krieger, Katz, Goei & Jain 2011:3; Norman, Wilding & Conner 2020:1008). Additionally, the theory suggests that intention is a cognitive representation of an individual's readiness to demonstrate a specific behaviour and that the following two factors determine the intention to perform a specific behaviour: attitude towards a particular behaviour; and subjective norms (Hahn & Popan 2020:1).

The idea of planning or being prepared to receive vaccinations can be linked to vaccine hesitancy, in that it reflects someone's intention at a particular time (Chapter 2: Section 2). The theory further assumes that people reflect on the positive and negatives of a certain issue before acting on them (Jeffres, Carroll, Rubenking & Amschlinger 2008:257). As the second research objective (RO2) specifically aims at investigating the nature of the sentiments during the specified time frame, this theory stresses the importance of understanding the types of sentiments that were raised, as this may influence the action taken by others.

Several researchers have found the theory of reasoned action to be useful in predicting behaviour, particularly in the health domain (Jeffres, Carroll, Rubenking & Amschlinger 2008:257).

In a study investigating the decision to use condoms in a sexually transmitted disease (STD) clinic community, the theory of reasoned action was found to be effective in the development of health education interventions (Baker et al 1996:528).

In line with the research purpose of the of recommending guidelines for future vaccine roll-out strategies, another study on predicting paediatricians' communication with parents about the Human Papillomavirus (HPV) vaccine, determined that communication interventions aimed at paediatricians would be successful, if they were developed in conjunction with the constructs of the theory of reasoned action (Roberto, Krieger, Katz, Goei & Jain 2011:10).The important elements as highlighted in this section underlines the relevance of this theory.

The following section will explore the resource mobilisation theory.

4.4 Resource mobilisation theory

In the1960s, collective action studies resulted in the development of the theory of resource mobilisation (Eltantawy & Wiest 2011:1212), which emphasises both social support and the constraint of phenomenon of a social movement (McCarthy & Zald 1977:1213). Resource mobilisation fundamentally explains the way in which individuals and groups overcome disparities of resources by organising themselves to pursue collective, cultural or political transformation through social media (Reda, Sinanoglu & Abdalla 2021:6).

The resource mobilisation theory claims that the mechanism formed through contact, by the behaviour of multiple network players in relationships and networks, is the central factor influencing the growth and emergence of a social movement (Drummond, McGrath & O'Toole 2018:70). This theory is based on the core principles that social protest actors are rational and that they are taking social action in response to power imbalances (McCarthy & Zald 1977:1235). Understanding the contexts and conditions under which social movements arise, particularly on social media, is critical to the study, since social movements on social media, such as anti-vaccination, affect vaccine sentiments that are relevant to this research.

According to Lopes (2014:4), the study of the use of social media to stimulate social movements emerged in the 1960s. In the advent of social media, However, movements' use of social media to mobilise has been criticised for trivialising the need for elite support (Lopes 2014:13), which may undermine the public's trust in health authorities' achieving vaccine uptake. Supporters and non-supporters can form groups and mobilise by using social media (Garcia-Ruano, Pacheco & Suazo 2013:1884). Similarly, mutual benefits, such as anti-vaccine feelings, can be operationalised by using social media (Garcia-Ruano et al 2013:1884). According to Melnychenko (2020:25), social media provide opportunities to movements seeking to effect social change, in that they lower the cost of enlisting marginalised constituents to support social movements, such as movements aimed at disseminating pro or anti-vaccine messages, thereby giving them an advantage (Eltantawy & Wiest 2011:1212; Ortiz & Triphathi 2018:3050).

Since the Arab revolts, Twitter, Facebook, Instagram and Google have been, among others, the key components of social movements in Iceland, Spain and globally (Reda, Sinanoglu & Abdalla 2021:7). According to the resource mobilisation theory, movement supporters, such as anti-vaccine activists, will operate on internalised ideals and sentiments of individuals (Jenkins 1983:538), which means that negative experiences on vaccines (e.g. side effects) shared on social media may appeal and facilitate the forming of solidarity and moral obligations to a bigger number of people, possibly triggering a formation of a social movement (Melnychenko 2020:13). It should be expected that, as the tweets are in the public domain, anti-vaccine activists and similar movements have access to the opinions that are raised on Twitter and may take advantage of it.

Germani & Biller-Andorno (2021:2) support the foregoing argument – i.e. that anti-vaccination activists find fertile ground, particularly on Facebook and Twitter, because these sites provide a public space for people to post every type of content, even science-related or medically controversial content, with the potential of reaching a large audience.

Furthermore, through its ability to provide platforms with the capacity to mobilise instantaneously, social media enable ordinary citizens to share unsubstantiated vaccine information on social media platforms and enable users to lobby and organise support for their vaccination sentiments (Lopes 2014:2; Germani & Biller-Andorno 2020:2).

4.6   Summary

This chapter provided a theoretical background for the current study by summarising theories that are deemed particularly appropriate and that serve as foundation for the study. All the theories explored in this chapter may be used to investigate and explain vaccination sentiments on social media. The social impact theory proposes that social media users' offline conduct may be influenced by their online interactions with other users, whereas the social cognitive theory explains why individuals acquire and sustain specific behaviours. The theory of reasoned action may be used to predict behaviour, particularly in the health area, while the resource mobilisation theory purports that movement supporters, such as anti-vaccine activists, will operate on internalised ideals and sentiments of individuals, triggering the formation of a social movement.

Elements from selected health communication theories were explained and linked to the research objectives of the study. The next chapter outlines the research methodology that guided the empirical section of the study.

CHAPTER 5: RESEARCH METHODOLOGY

5.1 Introduction

The preceding chapters primarily covered a review on the literature on health communication, social media and relevant theories involved in the study. This chapter discusses the research methodology that was applied to analyse COVID-19 vaccination sentiments posted on Twitter during the first months of the vaccine deployment in South Africa.

The chapter is structured as follows: firstly, the research purpose and general research problem will be described. Secondly, the research methodology is described, after which the research design, the sample strategy and the data collection procedures will be discussed. Finally, the ethical considerations are highlighted.

5.2 Purpose and broad research problem

This study was motivated by the need to obtain a deeper understanding of COVID-19 vaccination sentiments expressed on social media – particularly on Twitter. As such, the primary purpose of the study was to explore and describe COVID-19 vaccination sentiments expressed on Twitter in South Africa, from January 2021 to May 2021 (RO2 and RO3). The aim is to use the research results and findings to suggest guidelines to the NDoH for the proactive use of social media platforms, such as Twitter, in conducting vaccine roll-out strategies in future (RO4).

5.3 Methodological orientation

Methodological orientation is a term used intuitively and most often to designate a theoretical approach or a theoretical trend, a research strategy or a paradigmatic inclination (Pasikowski 2019:111). As such, this section of the chapter explores the overall research methodology followed to empirically investigate vaccine sentiments during the COVID-19 vaccine roll-out in South Africa.

This study uses both quantitative and qualitative methodologies, as these two forms of research collect different types of data which are designed to answer different questions and produce different types of insights (Kinn & Curzio 2005:318).

5.4   Research paradigms

A research paradigm is an intellectual prism by which the researcher explores the analytical implications of a research project, in order to decide on the research techniques to be used to collect and analyse data (Kivunja & Kuyini 2017:26). Similarly, Park, Konge and Artino (2020:690) are of the opinion that research paradigms guide scientific developments by their assumptions and principles.

This study applied both the positivist and interpretivist research paradigms towards the exploration of COVID-19 vaccine sentiments on social media. Both these paradigms contain certain beliefs about the collection, analysis and use of data – i.e. ontology, epistemology and methodology (Alharahsheh & Pius 2020:41). These beliefs will be defined and explained in the following sections, along with the key characteristics of the respective research paradigms.

5.4.1   Positivism

The positivist paradigm, which was first introduced by the French philosopher, Auguste Comte (1798–1857), describes a worldview of science that is based on what is perceived in research methodology, as the empirical method of investigation (Kivunja & Kuyini 2017:30; Alakwe 2017:42). Positivism assumes that real events can be empirically observed and focuses on social evidence, scientific methods and quantitative data (Leong 2008:343; Ryan 2018:4).

The overarching objective of the positivist research paradigm is to define, forecast, and, therefore, learn the relevant and qualifying conditions for a particular natural phenomenon (Alakwe 2017:42). Furthermore, in the field of media and communication studies, positivism has long been associated with attempts to create a methodical science of communication (Bergman 2016:1). This research approach is relevant for this study, because it seeks to explore COVID-19 vaccine sentiments on social media (Bergman 2016:1).

As an objectivist research perspective, positivism underpins most human and social science research throughout the 19th and 20th centuries, and it is believed to have an impact in the 21st century as well (Hiller 2016:102).

In the research methodology of this study, positivist techniques were used alongside interpretivist techniques in a complementary manner.

The positivist paradigm was employed to investigate the COVID-19 vaccination sentiments during the roll-out in South Africa. It relies on the collection and interpretation of data to guide and essentially support the findings of the study in a descriptive manner.

5.4.1.1 Ontological assumptions

Regardless of the researcher's position or belief, a positivist ontology maintains that the world is external and that any researched occurrence or scenario has a single objective reality (Dean 2018:3). By adopting a methodical and scientific approach to study, "truth" can be seen and assessed objectively (Swart 2020:141). As such, the positivist researcher maintains a distance from the research subjects, which is critical for maintaining the researcher's neutrality (Darby, Fugate & Murray 2019:398).

The adoption of the positivist paradigm, which views reality as objectively provided and measured by using qualities that are independent of the researcher, is an effective approach for reaffirming the validity of the data obtained in this study that sought to explore COVID-19 sentiments. Fuchs and Sandoval (2017) suggest that research based on the positivist paradigm implies an objective truth and a quantifiable reality, as it depends on data and statistical, quantitative methodologies and approaches.

5.4.1.2 Epistemological assumptions

According to Wagner, Kawulich and Garner (2012:55), the nature of knowledge is inherent in the natural science paradigm, and positivists see knowledge as those declarations of conviction for a truth that can be experimentally evaluated. The basic epistemological assumptions of positivism are that by using deductive reasoning and other secure kinds of logical inference, individuals seeking knowledge may obtain more comprehensive conclusions about the external world (Little 2019:2).

Furthermore, the epistemological assumption of positivism maintains that knowledge is formed and confirmed by the use of human senses, implying that a researcher who has an undistorted touch with reality can gain accurate knowledge (Majeed 2019:122).

The positivist epistemology essentially maintains the premise that explanation necessitates the finding of law-like generalisations about the phenomena that the scientific discipline encompasses (Little 2019:3).

The notion by Terre Blanche et al (2006:7) that a positivist epistemological approach provides a framework that defines and informs a study, is particularly relevant to the present study, in that it enabled the researcher to follow a structured approach to obtain a description of COVD-19 sentiments on Twitter during the specified study period.

5.4.1.3 Methodological assumptions

Park et al (2019:691) maintain that information can and must be established independently – without the researchers or participants' beliefs affecting its development. Similarly, Alakwe (2017:43) is of the opinion that, if an inquiry were conducted in positivism, with the least amount of interrelationship between the researcher and the subject under review, the results would be solely impartial.

Positivists often make generalisability arguments by using quantitative methodologies, such as statistical and mathematical approaches, which may reveal a single, objective reality (Dean 2018:3). According to Majeed (2019:123), there is a number of research approaches that are frequently used in positivism research to understand the natural world better, including survey research technique, quasi-experimental methodology, experimental methodology, correlational methodology, causal-comparative methodology and randomised controlled trials, among others.

The positivist research paradigm entails the systematic processes, general plan and reasoning through an approach that emphasises experimental control, structured and replicable observation and measurement, quantification, generalisation and objectivity (Babbie & Mouton 2001:27). This enables a researcher adopting such an approach to consider a range of methodologies before deciding on a technique that best meets the research objectives of a study, such as to investigate COVID-19 sentiments.

In accordance with the foregoing views, this study employed quantitative sentiment analysis to gain an understanding of the topic at hand (Bryman 2012:27).

5.4.2 Interpretivism

As mentioned previously, this study also adopted an interpretivist research paradigm, which entailed exploring the key themes that were raised on Twitter during the COVID-19 vaccine roll-out in South Africa. In this way, the study aimed at characterising the subjective intentions behind communicating the sentiments shared about the pandemic (Terre Blanche et al 2006:6; Dean 2018:3; Darby, Fugate & Murray 2019:398). As supported by Dean (2018:3), the concept of interpretivism refers to philosophies or hypotheses about how people acquire worldly knowledge and focuses on interpreting or deciphering the meanings that humans attach to their actions.

The interpretivist paradigm is concerned with understanding the meaning behind people's behaviour, as they respond to specific circumstances, and, therefore, it attempts to bring about an understanding of people's actions and relationships (Swart 2020:110). Interpretivist research approaches are particularly useful for revealing contextual knowledge; interpreting silences in narratives and the reasons behind them; and discovering tacit information that supports cooperation, conflict; and other connections, in order to obtain a subjective understanding of persons' social activity and valid facts (Schwartz-Shea & Yanow 2012).

Contrary to the positivist school of thought, which believes that scientific investigation cannot objectively capture external reality, interpretivist research helps to "… understand the complicated world of lived experience from the perspective of humans who live it" (McChesney & Aldridge 2019:3). This perspective is believed to uncover and explain the reasons behind the social action and the point of view of those who voiced their vaccination opinions on Twitter (Terre Blanche et al 2006:6; Alharahsheh & Pius 2020:41).

The interpretivist research paradigm allows research to be contextual, implying a large number of research in which a single outcome can have multiple interpretations, as opposed to a truth that can be discovered by means of a measuring procedure (Dean 2018:3; Pham 2018:3).

Furthermore, Terre Blanche et al (2006:346) maintain that the interpretivist paradigm in qualitative research is "… less immediately concerned with identifying universal, law-like patterns of human behaviour and is more concerned with making meaning of human experience".

According to Chowdhury (2014:436), interpretivism helps researchers to comprehend the social world through meaningful interpretations of the inhabitant's environment, which they have already interpreted by the meanings they make and replicate as a vital part of their collective daily actions. Similarly, an interpretivist approach supports the aims stated in the research objectives, namely to explore the reasons surrounding COVID-19 vaccination sentiments on Twitter, from January 2021 to May 2021, in South Africa.

5.4.2.1   Ontological assumptions

According to Darby et al (2018:397), the interpretivist ontological assumptions dispute the concept of an objective, fragmentable reality. Instead, the interpretivist ontological approach assumes that individuals experience reality as a comprehensive framework that is always evolving as they make sense of the world (Darby et al 2018:397), As a result, the type of vaccine opinions expressed on Twitter during the first few months of the COVID-19 vaccine deployment in South Africa would be determined by each individual's experience.

Therefore, the ontological assumptions collected from personal experiences from the subjects during the social study is of great significance and contributes towards the notion of the subjects having varied frames of reference with regards to the COVID-19 sentiments held and shared on Twitter during the period of study.

5.4.2.2   Epistemological assumptions

According to Hiller (2016:103), an interpretivist researcher aims at obtaining access to the created meanings that participants bring to encounters, as well as the wider cultural and experiential worlds from which those individuals' viewpoints and beliefs are formed. Furthermore, the interpretivist method is based on the concept that the researcher is a participant in the study and interprets data and, therefore, he/she can never be completely impartial and detached from the study (Brown & Duenas 20).

Interpretivists are concerned with specific, contextualised contexts, and they recognise that reality and knowledge are not objective and that each human has his/her interpretation of a situation or occurrence and will act on that understanding (Swart 2020:110). The philosophy of phenomenology is commonly associated with interpretivism (Bahari 2010:22). Phenomenology is a branch of philosophy that deals with the way in which humans make sense of the world around them, and how the scientist, in particular, should establish assumptions in his/her understanding of that reality (Bryman 2004:30).

The tweets that were collected are believed to represent unique world opinions from people about the COVID-19 vaccines. Users share different opinions, beliefs or convictions. This reality affects the way people experience life in general and, in the context of this study, reality could influence people's insights and formation of opinions around COVID-19 vaccines.

5.4.2.3 Methodological assumptions

According to Du Plooy (2002:20) and Terre Blanche et al (2006:6), the methodological assumption tries to explain methodologies and procedures for studying what can be found about communication. Since methodological assumptions involve organising principles that provide the procedure for guiding the research process, research design methods are frequently divided into data collection methods, such as interviews and observation, and data analysis methods, such as thematic analysis and narrative analysis (Eriksson & Kovalainend 2008:16).

The methodological assumptions of interpretivism include using a range of techniques, tools and strategies to obtain full knowledge of the issue under research (Dean 2018:3). In order to obtain a better grasp of the research field and objectives, qualitative thematic analysis (TA) was used in this study. TA is a technique for methodically discovering, organising and interpreting patterns of meaning (themes) in a particular set of data (Braun & Clarke 2012:57).

5.5 Research design

A research design is essentially a structure that outlines how, when and where research data can be collected and analysed (Parahoo (1997:142). Consequently,

research designs are types of inquiry within a qualitative, quantitative, or mixed-methods approach that provide specific direction for procedures in a study (Creswell 2013:297). The research design is one of the most important components of any research methodology, as it is the blueprint that guides the researcher on how to address research questions (DeForge 2012:2).

5.5.1 Quantitative and qualitative research approaches

According to Apuke (2017:41), quantitative research methods focus on quantifying and analysing variables to get results. In this study, quantitative research was used to identify and express the data from the sentiment classification numerically, in order to identify and describe COVID-19 vaccine tweets.

The essential goal of quantitative data analysis is to identify common patterns in the collected data. Therefore, quantitative data analysis was employed in this study to classify tweets about vaccines. "Qualitative research is a form of social action that stresses on the way people interpret and make sense of their experiences to understand the social reality of individuals" (Haradhan 2018:2). This type of research approach was moreover used in this study to understand the possible opinions underlying vaccine views expressed on social media. In this study, qualitative research was also conducted to identify specific themes in the tweets.

The quantitative and qualitative research techniques differ in terms of their epistemological, theoretical and methodological bases, as was explained in previous sections. In addition, specific differences between qualitative and quantitative approaches are revealed in the literature, as summarised by Du Plessis (2020:59) in Table 5.1. The distinctions in the table also illustrate the reasons for selecting the two approaches for the study at hand.

Table 5.1: Qualitative vs quantitative research approach (Du Plessis & Satar 2021:59)

Qualitative research	Quantitative research
No single reality exists but is subjective and exists only concerning the observer. The researcher is not separated from the data.	The study has objectivity without bias while the researcher is separated from the data.
The study's design often evolves during the research and can be adjusted or even changed as the study advances.	The study's research design is considered before the study and guides the implementation of the study.
Exploratory objectives (although in some instances a qualitative study might also have descriptive objectives).	Descriptive, predictive, or explanatory objectives.
Smaller sample size.	Larger sample size.
Data cannot be counted.	Data is numerical.
Uses methodologies to develop a deep (information-rich) understanding of the phenomenon under investigation.	Uses methodologies to measure the phenomenon quantitatively.
Creative and interpretive data analysis.	Uses statistics to summarise data, describing patterns and relationships and can be descriptive and inferential.
Conventional standards of reliability and validity cannot be applied.	Others can replicate studies
Findings cannot be generalised to the larger population.	Findings can be generalised to the larger population.

A mixed-method research design was selected for this study, as it enabled the researcher to investigate the sentiments around COVID-19 vaccines among South Africans between January 2021 and May 2021 by using both qualitative and quantitative research methods.

5.5.2   Mixed methods research design

The mixed methods research design involved in the study is summarised in Table 5.2, as well as the way in which the mixed methods design aligns with other research components, including the research focus, purpose, philosophy, method, data analysis and research findings.

Table 5.2: Mixed methods research approach (Author's own interpretation)

	Quantitative research approach	Qualitative research approach
Focus	Quantitative research was employed to quantify attitudes and opinions about COVID-19 vaccines.	Qualitative research was used to investigate themes of sentiments shared on social media during the study period.
Research philosophy	Positivism	Interpretivism
Research method	Sentiment analysis	Thematic analysis
Goal	The quantitative research approach was used to explore and describe the nature of COVID-19 vaccine sentiments.	The qualitative research approach was used to identify possible reasons behind vaccination sentiments.
Sample	Topic-based sampling	Purposive sampling
Data analysis	Deductive through machine learning	Inductive through thematic analysis
Research findings	Numerical	Narrative

Integrating methodologies in research creates the possibility of addressing the difficulties of using the qualitative or quantitative research approach. Because this study involved both an exploratory and descriptive component, a mixed-method research design was employed. Qualitative and quantitative methodologies were used to acquire a deeper understanding of COVID-19 vaccine sentiments in South Africa. By doing so, the research design was strengthened through methodological triangulation (Thurmond 2001:253; Yousefi Nooraie, Sale, Marin & Ross 2020:111).

A mixed methods research design, according to Creswell (2013:43), combines or integrates qualitative and quantitative research and data in a study endeavour. Creswell (2013:44) distinguishes three methods to mixed methodology: convergent parallel mixed methods, explanatory sequential mixed methods, and exploratory sequential mixed methods.

In this study, explanatory sequential mixed methods were utilised, in which quantitative research was conducted first, followed by qualitative research to elaborate on the findings (Snelson 2016:9).

It is not uncommon for a social media study to employ this sequential mixed methods research design. In a study that examined qualitative and mixed methods techniques for social media research, Snelson (2016:9) found that the explanatory sequential mixed method was used in nine social media studies. Similarly, the study conducted by Deltell, Congosto, Claes and Osteso (2013:703), which was solely based on Twitter content, utilised the explanatory sequential mixed method, which began with a large-scale investigation of tweets with particular tags connected to Hugo Chavez. Dominant opinion leaders were discovered, based on the spread of their tweets and the profiles of top opinion leaders were then analysed as part of the qualitative research process to explore the features of these prominent tweeters.

For the present study, a collection of tweets was selected to explore the range of sentiments expressed about the COVID-19 vaccine roll-out on Twitter as part of the quantitative research. Thereafter, the qualitative part of the research was used to uncover insights into the key themes that were raised on Twitter during the COVID-19 vaccine roll-out in South Africa.

Because the study employed research methods from both the quantitative and qualitative research approaches, it is necessary to provide a brief overview of social media research in the section below.

5.6   Social media research

According to Sloan and Quaan-Haase (2017:8), social media research enables scientists to investigate new types of problems and provide insight into current research issues from different angles. Twitter, in particular, has been identified as useful for social media research in terms of generating insight into numerous issues from social media users (*cf.* De Villiers 2020:27; Du Plessis 2020:45).

Furthermore, Pak and Paroubek (2010:1320) observe that data from Twitter can be efficiently used in social studies, as more and more users use the platform to express their sentiments on different issues. The advantages and disadvantages relevant to social media research and the present study are discussed below.

In the literature, the ability to reach larger numbers of participants than might otherwise have been possible is described as one of the potential benefits of using social media in research (Moorhead, Hazlett, Harrison, Carroll et al. 2013). By using social media research, the researcher was able to obtain data from a wide range of people on Twitter, including spontaneous and more deliberate tweets to a subject, which included comments on COVID-19 vaccines (Du Plessis 2020:47).

Since the study was centred in South Africa, the researcher had access to data from a wide sample of people, regardless of the geographical location in the country from where they were tweeting. Furthermore, the researcher had access to tweets containing different opinions and, because this study investigated COVID-19 vaccine sentiments on Twitter, social media research was advantageous, in that it provided access to the different opinions and conversations on a variety of topics, including health issues (*cf.* Du Plessis 2020:47).

Despite the benefits discussed here, there are several disadvantages involved in the use of social media research. The disadvantages mentioned in the literature (Taylor & Pagliari 2018:3) include: inequalities in access to social media platforms are probably the most pressing disadvantage, as the study only managed to investigate the views of those who did have access to social media platforms. In other words, the opinions of individuals without access to Twitter could not be obtained.

Furthermore, the need to pay for expensive social media subscriptions for data analysis, which are utilised to deal with a big sample of data efficiently, is regarded as a disadvantage (Du Plessis 2020:49). Aside from the vastness and unstructured nature of social media, researchers must invest substantial effort in data analysis, in order to achieve deep and rich results (Du Plessis 2020:48).

Another disadvantage of social media research, which was particularly relevant to this study, could be that samples might have been subject to criticism, due to researcher bias– i.e. only testing the opinions of those individuals interested in the topic and who used the hashtags were used in the study (Du Plessis 202:49). As a result, those who were less interested in the topic and those who did not use the identified hashtags could unintentionally be excluded from the study. In an attempt to minimise researcher bias, the researcher deliberately decided to select both negative and positive tweets for the qualitative research.

The following section discusses the data collection strategy that was adopted for this study.

5.7   Data collection strategy and procedure

Data collection essentially involves the systematic collection and measurement of primary, in order to answer research questions, test hypotheses and meet research objectives. However, there are defined points to guide data collection for social media research (Mayr & Weller 2017). This can be attributed to differing perspectives on what constitutes social media research, as well as the several fields that are interested in this type of study (Kapoor, Tamilmani, Rana, Patil et al 2018:532). Subsequently, the present state of affairs presents researchers flexibility to consider different ways and approaches to reach ROs and answer RQs (Mayr & Weller 2016:5; Du Plessis 2020:41).

Nevertheless, the researcher acknowledges that decisions with regards to the data collection for social media research are vital and should be taken with caution, because it may affect the types of analyses and the expected research results (Mayr & Weller 2016:3; *cf.* Bosch 2020:146).

Based on the foregoing information, both qualitative and quantitative research methods were used in this study. The Meltwater Media Intelligence tool was utilised to collect data for the study, since both approaches were applied. Falck-Jensen and Larsen (2016:2) describe the Meltwater Media Intelligence tool as a real-time media intelligence tool and data supplier in the field of external data. From January 2021 to

May 2021, the Meltwater Media Intelligence technology was programmed to track and identify tweets about COVID-19 vaccinations in South Africa. It crawled and indexed tweets by using machine-learning methods and an online Boolean search to collect relevant tweets. Ahmed and Du Plessis (2020:235), describe the corpus as the "raw data" collected from social media platforms.

Firstly, the corpus of this study was collected by using a topic-based method by means of the Meltwater Intelligence tool on the subject COVID-19. Mayr and Weller (2021:7) opine that a topic-based method to collect data on Twitter is suitable for tracking social media data, since relevant topics are frequently labelled through unique hashtags. Furthermore, several studies have utilised Twitter and hashtags to assess topic-based sentiments of the general public about a certain environmental or public health concern (Reyes-Menendez, Saura & Alvarez-Alonso 2018:4).

Secondly, a widget in the Meltwater Media Intelligence tool identified the most popular Twitter hashtags within the COVID-19 topic-based corpus. Through the widget, tweets were extracted by using the following prominent hashtags that resulted in a research string being created, namely:

> #AstraZenecavaccine OR #CoronaVaccine OR #COVID-19Vaccination OR #COVIDVaccination OR #CovidVaccine OR #getyourjab OR #johnsonandjohnsonvaccine OR #LargestVaccineDrive OR #modernavaccine OR #PeoplesVaccine OR #PfizerVaccine OR #vaccinated OR #vaccination OR #vaccine OR #VaccinesForSA OR #VaccineforSouthAfrica OR #VaccineReadySA OR #VaccineRoll-outSA OR #Sisonketrial OR #VaccinateToSaveSouthAfrica OR #VaccinesWork OR #IChooseVacciNation OR #VaccinesSaveLives) AND country: ZA

The search yielded 76,265 tweets, including original tweets, emojis, retweets, replies and quoted tweets, which were saved in an Excel file to allow the researcher to continue the trend of hashtag studies. According to Bosch (2020:148), the use of such a file is popular, due to the ease with which researchers with limited technical skills can track and gather sizeable datasets of all tweets containing specific hashtags.

The search string allowed the Meltwater tool to recognise different kinds of tweets, whether an original tweet, a reply, retweet or quote-tweet, as composed by the Twitter user. The act of retweeting (RT) someone else's tweet involves a process of resharing a tweet, previously posted by someone else, but referred to as "retweeting". When a user quotes a tweet (quoted-tweet), they retweet someone else's tweet and includes a comment to the original tweet (Cheplygina, Hermans, Albers, Bielczyk & Smeets 2020:1).

Following the Twitter search, a search results page was generated that contained specific tweet information, including the Uniform Research Locator (URL) of the tweet, the creation date of the tweet, the tweet text, the username of the user who tweeted, the number of likes, retweets, replies and geographic location. Figure 6.1 illustrates the data collection process adopted for this study.
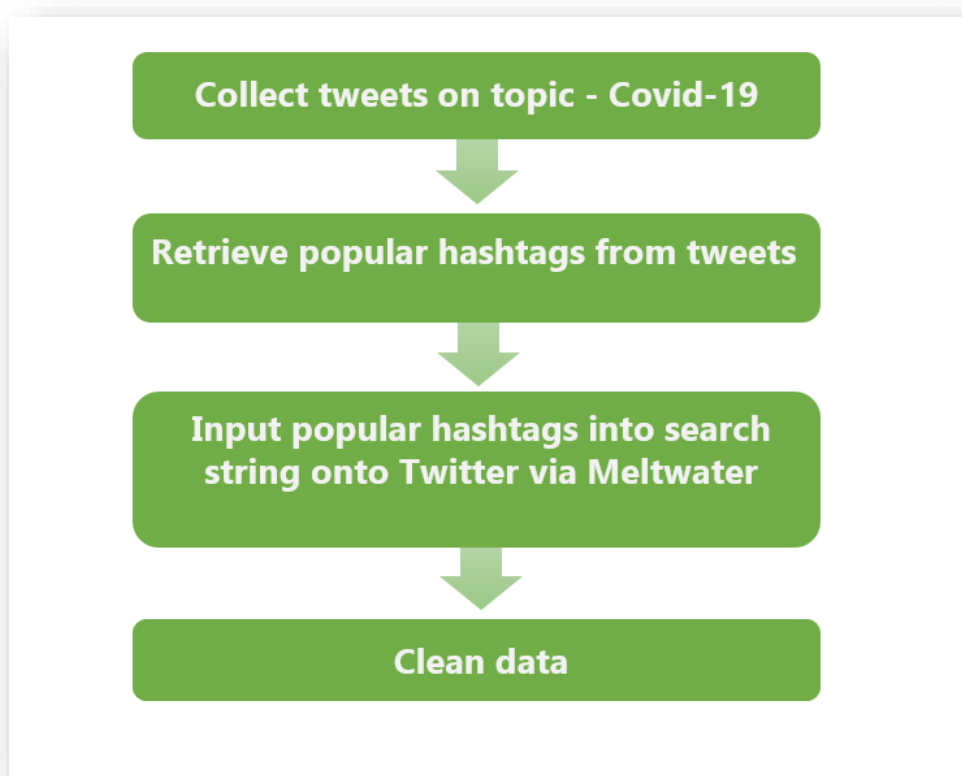

Figure 5.1: Flowchart of the data collection procedure (Author's own conceptualisation)

The entire corpus was used for the quantitative part of the empirical research and a sample of it was selected for the qualitative investigation (Acharya, Prakash, Saxena & Nigam 2013:330).

It would not be possible to research the entire population and, consequently, this study considered an appropriate sample, as explained in the following section.

5.8   Sampling design

The following sections discuss the unit of analysis and time dimension, population and sampling frame, and sampling methods and procedures that were applied in the study.

5.8.1   Unit of analysis and time dimension

According to Bhattacharjee (2012:66), the unit of analysis refers to the individual, group, or object that is the target of the investigation. For the quantitative and qualitative parts of the empirical investigation, the unit of analysis consisted of the tweets of Twitter users in South Africa, who commented on vaccination during the study period by using the hashtags mentioned in the preceding section. Therefore, the unit of analysis is social artefacts (Du Plessis 2020:66).

5.8.2   Population and sampling frame

In the research context, *population* refers to all the research subjects (i.e. people or objects) that the researcher intends to study. According to Du Plessis (2020:66), a research population in a social media study focuses on many persons or objects. The population of this study included all tweets about COVID-19.

Bryman (2012:187) defines a *sampling frame* as a list that contains "… all units in the population from which a sample will be selected". Due to the volume of tweets about the pandemic, it was impractical to include and analyse all tweets in this study and, therefore, a sampling frame was selected. Tweets related to the specified time frame of the study (January 2021 to May 2021) and data cleaning served as the sampling frame for the quantitative and qualitative analyses.

5.8.3   Sampling methods and procedures

A sample refers to a group of subjects selected from a broader population, who may be studied as well (Maree 2012:69). *Non-probability sampling* is any sampling method in which inclusion in the sample is not determined randomly.

Probability sampling, on the other hand, refers to "… obtaining a representative sample from a target finite population" (Kim & Wang, 2019:177) in which all units in the population have known and positive probabilities of inclusion (Vehovar, Toepoel & Steinmetz 2016:327). Both sampling methods are widely used in research (Maree 2012:69; Vehovar et al 2016).

5.8.4   Quantitative sampling

As mentioned earlier, the corpus of this study was collected through a topic-based method. No sampling was done for the quantitative part of the research, as all the collected data – following data cleaning – was investigated.

5.8.5   Qualitative sampling

The same corpus was used in the quantitative and qualitative parts of the empirical research. Due to the size of this collection (a total of 20,841 tweets), an analysis of the entire dataset was not practical, and a subset was chosen for in-depth qualitative analysis via purposive sampling. Purposive sampling, also known as *judgmental* or *expert sampling*, is a type of nonprobability sampling and its primary goal is to provide a sample that can be logically considered to be representative of the population (Battaglia 2011:2). However, due to the qualitative research approach and the sample type and size, it could not be claimed that the findings are representative of the population.

Fifty (50) tweets from each month were chosen, from January to May 2021, for in-depth thematic analysis. A total of 150 tweets were selected, which resulted in 1.199% of the entire corpus.

As this part of the study is qualitative, the intention was not to compare the findings over the specified period, but exclusively to gain an understanding of key themes behind the vaccination sentiments raised on Twitter during the specified period.

5.9 Data cleaning

Raw social media data is unstructured, scattered and 'noisy' posing some challenges for social media researchers wanting to prepare data for analysis according to Ahmed and Du Plessis (2020:256). Following data collection, data cleaning is an essential step before the analysis of data can be done. Ahmed and Du Plessis (2020:257) state that data cleaning is the "process of preparing data for analysis by removing all irrelevant and incorrect parts and identifying incomplete areas that would need more data".

Before the quantitative and qualitative analysis, the 76,265 tweets discovered for the assessment of COVID-19 vaccination sentiment in South Africa, were cleaned by completing multiple pre-processing activities.

The following steps were taken to prepare the data for analysis:

- In the first step, RTs were removed from the data set, since they were taken from another user's tweet. RTs (Chong, Ch'ng, Liu & Boying 2017:1808), are a way to disseminate long, intriguing discoveries and news, but they are redundant for training the sentiment model because they contain the same texts as the originals.
- The second step involved removing duplicate and irrelevant tweets from the data to ensure a more accurate analysis of the topic and audience.
- Mayr and Weller (2018:12) anticipate that traditional media may use Twitter as well, making certain journalists and editors gatekeepers. As a result, in the third step, journalists, editors and news organisations were identified and excluded from the data.
- The fourth step was to eliminate usernames beginning with the letter "@" because they refer to the author of the tweet, thereby ensuring that the Twitter user's identity was safeguarded.

After the data had been cleaned, the remaining collection of tweets on which the quantitative analysis was conducted contained 20,841 original tweets from individual users and quoted tweets was generated between January 2021 and May 2021.

A total of 150 tweets from this collection was sampled for the qualitative analysis (see Section 5.10.5).

5.10   Analysis of Twitter data

As already indicated, this study followed a mixed-method research approach by using a quantitative method – sentiment analysis – and a qualitative method – thematic analysis. These are explained in the sections below.

5.10.1   Quantitative sentiment analysis

There are numerous different definitions of sentiment analysis. Thelwall (2017:2) describes *sentiment analysis* as "the process of computer learning to identify, extract, and describe the sentiment content of a text unit", while Feldman (2013:82) describes it as the challenge of finding the opinions of authors about certain subjects. According to He and Zheng (2019:1208), sentiment analysis is equivalent to opinion mining and is concerned with describing emotions from the text. Taken together, sentiment analysis is the analysis of opinions, feelings, assessments, attitudes and emotions of individuals towards a plethora of aspects, including products, services, organisations, individuals, issues, events, topics and their attributes (Liu & Zhang 2012:415; Thelwall 2017:2). Accordingly, sentiment analysis aims at extracting the text of written reviews by classifying them into positive or negative opinions, according to the polarity of the sentiment (Cambria, Schuller, Xia & Havasi 2013:15).

Machine learning technologies. such as sentiment analysis can aid in the understanding of health discussions on Twitter (Ola & Sedig 2020:16). Furthermore, Gohil, Vuik, and Darzi (2018:2) argue that data may be collected and analysed in real-time from social media platforms such as Twitter, with the capacity to gauge public opinion (sentiment) toward a subject.

According to Okazaki, Dìaz-Martìn, Rozano and Menéndez-Benito (2014), an opinion is a subjective expression of sentiment by an author about something or an aspect of something that could be negative or positive and that describes what a person thinks or believes to be true about something (Agrawal & Gupta 2019:2).

The purpose of sentiment analysis is to determine the attitude or inclination of a communicator through the contextual polarity of their speaking or writing (He & Zheng 2019:1208).

Opinions can be based on personal interpretations of information but do not necessarily carry a sentiment, or emotive opinions can be based on personal interpretations of information but do not necessarily carry a sentiment or an emotion. The assessment of sentiment was done through Meltwater Media Intelligence by considering direct opinions.

Sentiment analysis via Meltwater Media Intelligence was used to conduct sentiment analysis by using two widgets to understand the overall tonality of a group of posts – i.e. Sentiment Classification Widget and Sentiment Score Widget.

5.10.1.1 Sentiment Classification Widget

Within the sentiment widget, natural language processing (NLP) algorithms on the platform were used to generate sentiments. Sentiment analysis largely rely on NLP techniques that allow a computer to interpret genuine human language and transform it to a format that the machine understands, so as to extract subjective information from data (Rajput 2020).

The *sentiment classification* of the collected data involved categorising personal expressions – including opinions – into one of the following three sentiment polarities or sentiment words, to determine vaccine sentiments: negative, neutral and positive. Based on the NLP sentiments, allocated by sentiment classification within the media-monitoring tool that would allude to a user being negative, neutral or positive.

Sentiment refers to the overall tonality of any given tweet and, according to Stets (2006:309), sentiments are "… socially constructed patterns of sensations, expressive gestures and cultural meanings organised around a relationship to a social object".

This provides a look at each tweet and classifies the tone of the tweet according to negative, neutral *or* positive, as derived from the NLP algorithms.

5.10.1.2 Sentiment Score Widget

The Sentiment Score Widget was implemented once the sentiment classification process had been concluded. The Sentiment Score Widget allowed for a more detailed analysis by revealing how the general tonality of a topic evolved. This broadened the range of sentiments to include *very negative* and *very positive*.

In this study, the Sentiment Score Widget was used to calculate the percentage of positive tweets against negative tweets on a given day, while excluding "neutral" tweets. Each day was scored as either very positive, positive, neutral negative or very negative, based on a percentage of positive posts compared to negative posts on a given day.

The Sentiment Classification Widget calculated the percentage of tweets that were positive, neutral, or negative. This means that, if half the tweets on a given day were classified as positive and the other half as negative, a neutral score of 0% will be given. However, if the tweets on a given day were either all positive or all negative, the tweets would be classified as 100% (very positive) or -100% (very negative) respectively. The following table outlines the sentiment classification of tweets:

Table 5.3: Sentiment score ranging from very negative to very positive

Sentiment score	
Very positive	51 to 100%
Positive	1 to 50%
Neutral	0%
Negative	-1 to -50%
Very negative	-51 to -100%

The use of the two widgets – Sentiment Classification and Sentiment Score – made it possible to understand the overall tonality of a group of tweets.

Following the process of sentiment classification and sentiment scoring respectively, the corpus was retrieved by using the Meltwater Media Intelligence tool. The process

consisted of data on the (i) sentiment spectrum; and (ii) daily and monthly count of tweets and sentiments per province, between January 2021 and May 2021.

The literature revealed that no single classification of sentiments exists, but that texts are generally classified into positive, neutral and negative categories (*cf.* Sing et al (2018:30). Consequently, in this study, sentiment classification was undertaken that involved classifying beliefs and opinions into negative, neutral and positive sentiments.

Other research, such that of as Sing et al (2018), employs a larger range of categories in addition to the three spectrum classification. Similarly, the current study subdivided the broad classification of feelings into extremely positive and very negative sub-categories. The argument was that, rather than identifying the extreme viewpoints stated on Twitter, it would be more useful to get an indicator of the extreme opinions, e.g. positive or negative.

5.10.2 Qualitative thematic analysis

According to Mustafa et al (2020:350), thematic analysis is a way of analysing qualitative data that is used to identify, analyse, and understand the patterns and deeply hidden themes of the data (*cf.* Nowell, Norris, White & Moules 2017:2). Similarly, Ahmed and Du Plessis (2020:272) assert that, when a study focuses on uncovering patterns of meaning in qualitative data, qualitative researchers doing social media research often use thematic analysis. In this study, investigating hashtags narratives assisted the researcher in uncovering a richer set of themes relevant to the research topic and purpose of this study.

Following the steps proposed by Braun and Clarke (2012:60), the following steps were taken to conduct the thematic analysis of tweets:

- In the first step, the sampled tweets were studied in order to gain familiarity with the main thought that was raised. According to Braun and Clarke (2012:6), this phase involves immersing oneself in the data by reading and rereading textual data.
- The second step comprised the construction of codes to represent the meaning of each tweet. A code, according to Ahmed and Du Plessis (2021:274), is a single

notion about a section of data that the researcher collects with several labels that correspond to the research topic of a study.

- The third step was to identify possible themes. A theme is a coherent and meaningful pattern in the data that is pertinent to the research question (Braun & Clarke 2012:63).

- In the fourth step, the basic concepts were reviewed to see how different codes could be combined and if any themes could be subdivided. In addition, themes were reviewed to ensure that they actually answered the research questions involved in the study.

- Step 5 was concerned with defining and naming the themes. This step included a clear statement of what made each theme distinctive. "A good thematic analysis will have themes that (a) do not try to do too much, as themes should ideally have a singular focus; (b) are related but do not overlap, so they are not repetitive, although they may build on previous themes; and (c) directly address your research question," according to Braun and Clarke (2012:66).

- In the sixth step, the researcher tells the story of the data by writing the report narratively and reporting on each theme. In this study, this is done in Chapter 6. According to Ahmed and Du Plessis (2021:274), it is critical for the narrative to be consistent and that the discussion is convincingly grounded in the literature.

5.11   Reliability and validity

As this study used both quantitative and qualitative research methods, it is critical to assess the efficacy of these efforts. These techniques employ various criteria to assess their quality, which will be explained in the following sections. Rigour in quantitative research, according to Heale and Twycross (2015:67), is established by examining the validity and reliability of the techniques or instruments employed in the inquiry.

To gain a deeper understanding of COVID-19 vaccination sentiments on Twitter in South Africa, the researcher used methodological triangulation, which combined qualitative and quantitative techniques. In this way, a purposeful effort was made to improve the overall validity of the study (Burton & Bartlett 2009:8).

The following section explains the measures taken towards strengthening the reliability and validity of the research findings of this study.

5.11.1 Reliability and validity of the findings of the sentiment analysis

In research, reliability essentially involves the ability to replicate research and to provide consistent results. Furthermore, Durrheim and Painter (2016:152) define *reliability* as the dependability of measuring equipment, or the degree to which the data collection instrument consistently produces consistent data over time. The use of sentiment analysis made it possible to improve the dependability of the study. As pointed out by Atteveldt, Van der Velden and Boukes (2021:124), machine learning techniques outperform dictionary-based methods in sentiment analysis.

Validity is concerned with the significance of the research components and refers to whether the study measures what it claims to measure to draw fair conclusions (Drost 2011:114). Various types of validity can be used in quantitative social media research (Cresswell 2013:252). This study considered face validity, which refers to the extent to which a study measures what it claims to measure (Mohajan 2017), which, per RO1, is to investigate COVID-19 vaccination sentiments on Twitter during the specified period. In this way, the study did indeed measure what it intended to measure. According to Creswell (2013:223), internal validity refers to the extent to which evidence supports the researcher's claims in the research findings. In order to ensure internal validity, the research process applied in this study is thought to be the best way of addressing the research questions (outlined in Section 5.6) and to ensure internal validity.

5.11.2 Credibility, transferability and reliability (dependability) of the findings of the thematic analysis

The criteria employed in quantitative research and outlined in the preceding section are not adequate for judging the quality of qualitative research (Korstjens & Moser (2018:121). Some of the ways that may be used to assess the trustworthiness of qualitative research, in general, include credibility, transferability and dependability (Elo, Kääriäinen, Kanste, Pölkki et al 2014:2; Korstjens & Moser 2018:121).

Credible research produces credible research findings and, in qualitative research, credibility is developed throughout the entire research process. Furthermore, Korstjens and Moser (2018:121) opine that credibility determines whether research findings are credible and represent an accurate interpretation of perspectives. To this end, the codes and themes were only finalised after the researcher had emerged herself in the data and all the tweets that were sampled had been thoroughly studied (Nowell, Norris, White & Moules 2017:10). In addition, the detailed description of the steps that were used for the thematic analysis enabled the researcher to apply the data analysis process in a structured way.

Transferability, according to Nowell et al (2017:3), refers to the efforts to generalise research findings. However, qualitative research does not particularly seek to achieve generalisation, because it is oriented to the contextual uniqueness and significance of the aspect of the social world being studied (Bryman 2012:392). Because qualitative research strongly relates to a particular context, there may be substantial constraints in terms of generalising the research findings.

The extent to which the findings can be reproduced is referred to as *reliability* (Van der Riet & Durrheim 2016:92). According to Du Plessis (2020:71), interrater reliability, intracoder reliability and dependability, among other factors, can enhance the trustworthiness of a qualitative social media study. For this study, the thematic analysis and interpretation were conducted by the researcher only and, therefore, did not present the challenge of ensuring consistent data interpretation, which may be the case if more than one coder is involved in the process.

This study sought to assure the consistency of its findings by meticulously documenting the entire research process, including data collection and cleaning, sampling and data analysis.

In order to acquire meaningful information, research results must be trustworthy, based on the richness of the data (Braun & Clarke 2012:61). As original tweets and quoted tweets from actual users were obtained for the study, the data reflected accurate and authentic opinions.

Furthermore, the research methodologies discussed in the preceding sections must be appropriate for answering the research questions presented in Chapter 1, to ensure trustworthiness of the qualitative component of the study. According to Mills and Birks (2014:221), trustworthiness involves the research processes and findings, as well as the overall quality of the social media study. As a result, theme analysis was viewed as a viable option for the qualitative part, as it is recognised as an effective qualitative approach for working and analysing big qualitative data sets.

5.12   Limitations

As observed by Taylor and Pagliari (2018:3), access to social media platforms aredivided, which means that the study managed to investigate the perspectives of people with access to these platforms only. In other words, without access to Twitter, it would have been impossible to learn what people thought about the vaccination roll-out.

Furthermore, Lorentzen and Nolin (2015:284) claim that the hashtag-based collection favours hashtag users and those who initiate a conversation. Therefore, only tweets from people who had access to Twitter and used the hashtags were included in the research and examined, although these tweets may not be representative of the general population. Similarly, Mayr and Weller (2018:8) point out that geo-coded tweets only include tweets from those who have intentionally chosen to share their location – a sample that may not be representative of all Twitter users. Because machines may not understand the subtleties of language, the machine listening tool could not recognise sarcastic tones.

Mayr and Weller (2016:3) also observe that topic-based approaches may have a limitation, in that they can systematically exclude specific user types from the corpus. Examples include users who are unfamiliar with hashtag conversations, or who use a different set of hashtags or hashtags in different languages – or entire strains of follow-up conversations because users may no longer use the hashtag within a constricted context.

Concerning thematic analysis as applied in this study, the researcher did not consider the full Twitter corpus for analysis but instead drew a purposive sample for deep analysis, which may have implications of selection bias (Du Plessis 2020:52).

5.13   Ethical considerations

Ethical clearance was obtained from the University of South Africa on 30 April 2021, with reference 42154413_CREC_CHS_2021. However, due to the use of publicly available data and the lack of direct human involvement, considerations regarding ethical principles – such as informed consent, privacy, anonymity and confidentiality – were not required.

Apart from geographic location, this study was not interested in personal attributes or information about social media users; hence the tweets in the corpus were not linked to people who tweeted during that time. The statistics did not reveal any personal information or characteristics about the users and, therefore, their privacy was protected. All efforts were made to meet the ethical requirements set out in the Policy on Research Ethics of UNISA (University of South Africa 2016).

5.14   Summary

The study approach utilised to investigate COVID-19 vaccination sentiments on Twitter during the South African vaccine deployment from January to May 2021 was detailed in this chapter. The research paradigm, qualitative research, quantitative research, population, sampling, units of analysis, data collecting methodologies, data analysis, validity and reliability, as well as ethical issues, have all been described.

In Chapter 6, the empirical results of the study are reviewed, analysed and interpreted, in order to report on the quantitative and qualitative research findings.

CHAPTER 6: DISCUSSION AND INTERPRETATION OF RESEARCH RESULTS AND FINDINGS

6.1   Introduction

In this study, the empirical research methodology, as discussed in Chapter 5, involved a quantitative and a qualitative component. This chapter presents and interprets the quantitative and qualitative research results and findings, following the sentiment and thematic analysis of the collected data.

The aim of this chapter involves addressing the following two research objectives:

RO2:   *To investigate the nature of COVID-19 vaccination sentiments raised on Twitter during the vaccine roll-out in South Africa.*

RO3:   *To explore the key themes behind COVID-19 vaccination sentiments, based on the data on Twitter during the vaccine roll-out in South Africa.*

The chapter consists of two major sections: the interpretation and discussion of the results and findings of the quantitative data analysis (Sections 6.2–6.4) and the qualitative data analysis (Sections 6.5–6.6.7).

6.2   Interpretation and discussion of the quantitative data analysis

The goal of this study was to investigate the sentiment of tweets about COVID-19 vaccines on Twitter in the early stages of the COVID-19 vaccine roll-out in South Africa, between January and May 2021. Because Twitter enables data access via an Application Programming Interface (API), there are numerous pre-built software applications for the analysis of social media data obtained from Twitter.

This study used the Meltwater Media Intelligence tool to collect data on the trajectory of sentiment of the South African public following the roll-out of the COVID-19 vaccination. The collected data was used for both the quantitative and qualitative analyses.

For the quantitative part of the empirical research, sentiment analysis was applied by using two Meltwater Media Intelligence widgets, namely the Sentiment Classification Widget and the Sentiment Score Widget, which were discussed in Chapter 5 (Section 5.10).

As illustrated in Figure 6.1, a total of 20 841 original and quoted tweets from individual users, between January and May 2021, were collected and quantitatively analysed. The following section provides an overview of the data that was collected.

In order to explore COVID-19 vaccination sentiments on Twitter within the specified timeframe, the quantitative analysis was performed for each month. As shown in Figure 6.1, the corpus of 20 841 tweets comprised 5 278 tweets in January; 10 283 tweets in February; 1 875 tweets in March; 1 093 in April; and 2 312 tweets in May 2021.
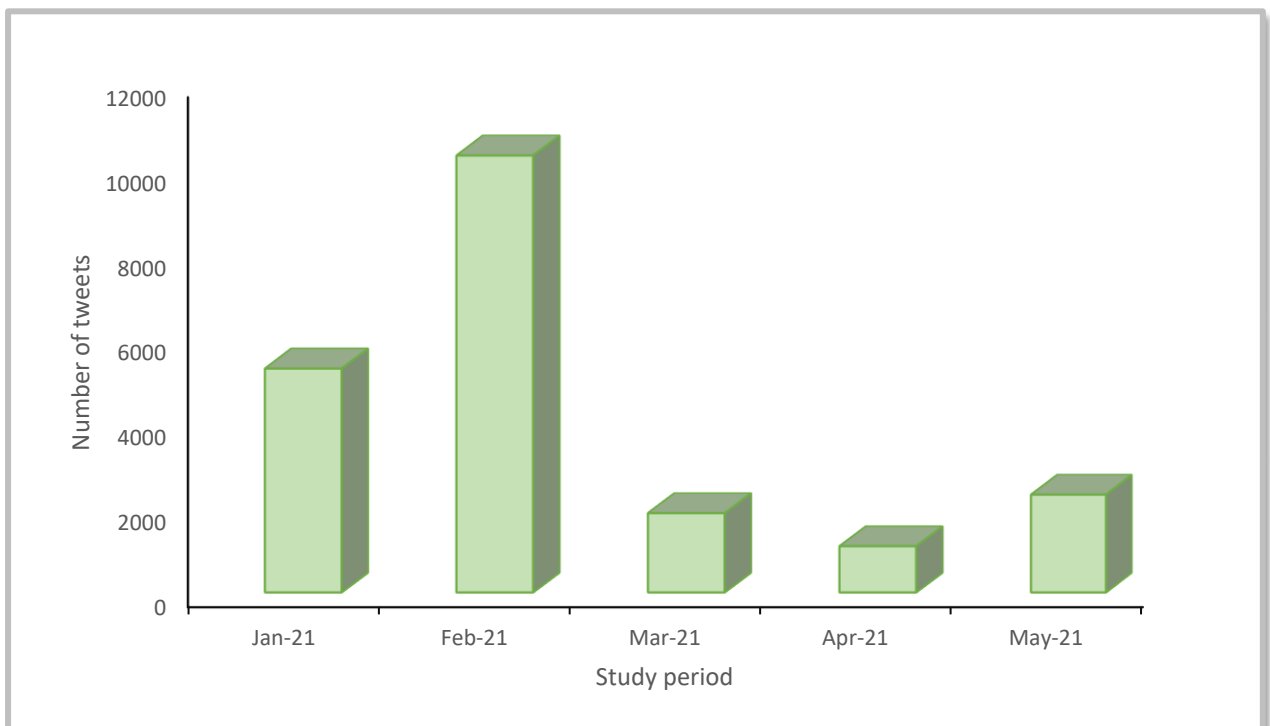

Figure 6.1: Number of COVID-19 vaccination tweets, South Africa, January–May 2021 (Authors own conceptualisation)

Figure 6.1 indicates a high number of tweets in January and February 2021. Although the COVID-19 vaccine roll-out was a prominent topic of discussion during the first two months of 2021, the roll-out actually started on 17 February, through the Sisonke Trial (see Chapter 2: Section 2.4.3.1.2). In March and April 2021, a reduced number of COVID-19 vaccine-related tweets occurred, compared to the number of tweets during the first two months under study. The reduced number of tweets might be attributed to a decrease in COVID-19 cases during that period, implying a decreased urgency for COVID-19 vaccination. A factor that might have contributed to the rather low numbers of COVID-19 vaccine-related tweets in April could be the deal between the South African Government and the African Union (AU) in which South Africa sold 1 million doses of the AstraZeneca vaccine to African Union member states – although vaccines were still in short supply in South Africa (Naidoo 2021). This transaction occurred after research rendered the AstraZeneca vaccine ineffective against the circulating Beta 501Y.V2 variant in South Africa (Madhi et al 2021:1885).

In order to enhance the credibility of the data and to acquire meaningful information, original tweets and quoted tweets from actual users were obtained for the study. The data is reflected in Figure 6.2.
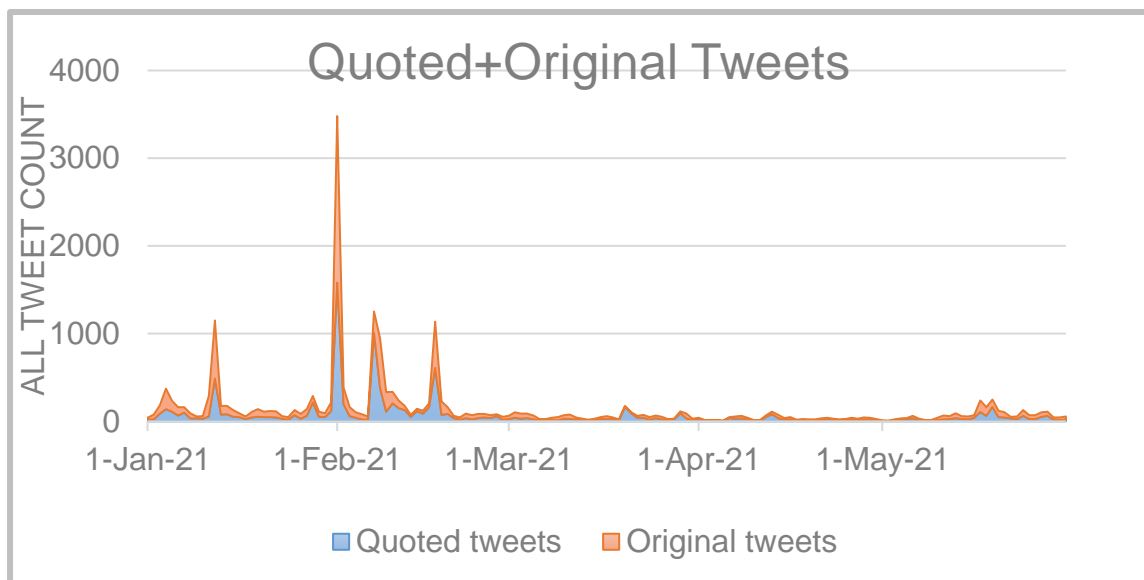

Figure 6.2: Breakdown of tweets by type, South Africa, January–May 2021 (Author's own conceptualisation)

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Given the fact that Phase 1 of the South African vaccine roll-out started on 17 February 2021, it is possible to conclude that the surges in original and quoted tweets in February were prompted by anticipation regarding the first day of vaccination. According to the data, both quoted tweets and retweets increased at the same time in February.

The next section presents the results and findings of the data collected by means of the Sentiment Classification Widget and the Sentiment Score Widget respectively.

6.2.1 Findings from the Sentiment Classification Widget

The Sentiment Classification Widget was used to categorise the collected data into specific sentiments according to their tones (see Chapter 5: Section 5.10.1.1).

Tweets from January 2021 to May 2021 were explored and sentiment classification was undertaken by means of the Sentiment Classification Widget, with the aim of obtaining a better understanding of COVID-19 vaccination sentiments. The Sentiment Classification Widget was mainly used to provide insights into the tonality of the tweets and, in this way, to identify changes in sentiments and link them to the roll-out plan that could allow organisations, such as the NDoH in the present context, to redesign and adapt their communication strategies. Sentiment classification involves classifying personal expressions, including opinions, into one of the following *three* sentiment polarities or sentiment words: negative, neutral and positive.

In the following sections, findings are interpreted and visually presented in graphs and tables.

6.2.2. COVID-19 vaccination sentiments on Twitter, January–May of 2021

In line with the purpose of this study, which was to investigate social media users' opinions of the COVID-19 vaccine roll-out in South Africa, a month-by-month analysis was undertaken to investigate COVID-19 vaccination sentiments on Twitter over the designated period (see Table 6.1 on p. 95).

According to the analysis, the majority (≥ 85%) of tweets for each month, from January 2021 to May 2021, demonstrated neutral sentiments regarding COVID-19 vaccines, as outlined in Figure 6.3.

SENTIMENT BY MONTH

Negative — Neutral — Positive

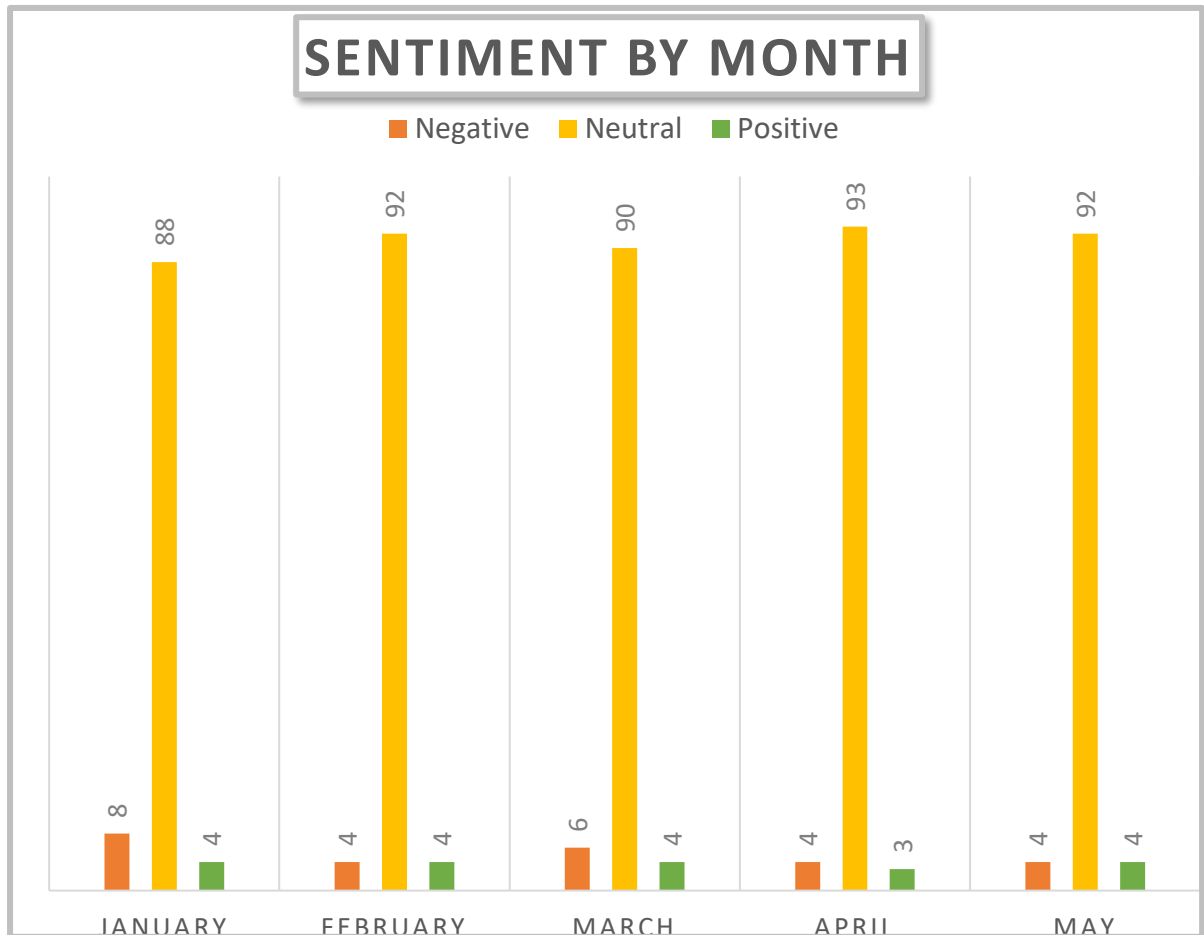|	January	February	March	April	May
Negative	8	4	6	4	4
Neutral	88	92	90	93	92
Positive	4	4	4	3	4

Figure 6.3: Percentage of vaccination sentiments by month, South Africa, January–May 2021 (Author's own conceptualisation)

According to Liu (2012:37), positive and negative sentiments are people's subjective opinions, whereas neutral sentiments involve the lack of sentiment. In other words, Twitter users may express a range of positive and negative feelings about the COVID-19 vaccination, including disappointment, satisfaction, surprise, etc. On the other hand, users may ask questions, offer factual information, or make generic remarks, all of which are generally devoid of emotion and, hence, categorised as neutral (Jansen, Zhang, Sobel & Chowdury 2009:2178).

Given the novel nature of COVID-19, the fact that the majority of tweets were neutral throughout all months showed that there could be unique aspects that urged individuals to form positive or negative opinions about the COVID-19 vaccination roll-out.

Figure 6.3 also demonstrates more negative than positive tweets in January and March 2021. This could be attributed to the poor start to the COVID-19 vaccine roll-out, which included challenges with delayed vaccine purchases and mass vaccinations only commencing in mid-May (see Chapter 2: Section 2.4.3.1). During the entire period, the percentage of negative tweets – i.e. negative sentiments towards COVID-19 vaccines – showed little variation (see Figure 6.3). Overall, all tweets showed little variation when the Sentiment Classification Widget was applied.

Following the broad classification of the tweets into positive, neutral and negative tweets and seeing that the findings indicated an overall high neutral sentiment for the entire period, it was deemed necessary to explore month-to-month changes in the sentiments. Table 6.1 in outlines the column percentages.

Table 6.1: Trends in COVID-19 vaccine tweets, January to May 2021

	BREAKDOWN OF VACCINE TWEETS, JANUARY–MAY 2021, WITH COLUMN PERCENTAGES										
	MONTH	JAN		FEB		MARCH		APRIL		MAY		TOTAL
		n	%	N	%	N	%	N	%	N	%	n
SENTIMENT	POSITIVE	208	3,94	432	4,20	82	4,37	44	4,03	98	4,24	864
	NEGATIVE	431	8,17	454	4,42	149	7,95	61	5,58	96	4,15	1,191
	NEUTRAL	4,639	87,89	9,397	91,38	1,644	87,68	988	90,4	2,118	91,61	18,786
	DENOMINATOR	5,278	100%	10,283	100%	1,875	100%	1,093	100%	2312	100%	20,841

The percentage of positive tweets in January 2021 was 3.94%, followed by a minor increase to 4.20% in February and 4.37% in March 2021. The percentage declined to 4.03% in April and showed a slight increase to 4.24% in May 2021. The highest volume of positive tweets occurred in March.

At 8.17% and 7.95% respectively, January and March 2021 demonstrated the highest percentage of negative sentiments. In February, 9,397 out of 10,283 tweets were neutral, which constituted 91.38% of all the tweets during that month. 454 out of 10,283 tweets were negative, which constituted 4.42% of all tweets for February.

Having obtained insights into the way in which the sentiments changed from month to month during the study period (Table 6.1), the researcher sought to determine the share of each classification in relation to the total sentiment during the study period.

Table 6.2 presents row percentages, which allowed the researcher to explore the proportion contributed in each month to the overall sentiments for the period. For example, out of the total number of positive sentiments in the five month research period (i.e. 864 tweets), 208 tweets occurred in January.

Table 6.2: Sentiment trends observed in the tweets, January to May 2021

BREAKDOWN OF VACCINE TWEETS FROM JAN - MAY 2021 BY ROW PERCENTAGES						
MONTH	JAN	FEB	MARCH	APRIL	MAY	TOTAL
POSITIVE	24,07%	50%	9,5%	5,09%	11,34%	100%
NEGATIVE	36,19%	38,12%	12,51%	5,12%	8,06%	100%
NEUTRAL	24,7%	50,02%	8,75%	5,26%	11,27%	100%

The proportion of vaccine sentiments expressed in tweets varied from month-to-month. According to Table 6.2, of the total of 864 tweets that showed positive sentiments in the research period, the month of February 2021 contributed the highest percentage (50%), followed by January (24.07%) and May (11.34%).

Of the 18,786 tweets that showed neutral sentiments, the research period March and April 2021 contributed less than 10% each to the overall neutral sentiment. In February 2021, a similar trend as the positive sentiments was observed under neutral sentiments, with the highest percentage of 50, 02%. Of the 1,191 tweets that showed negative sentiments, the highest percentage occurred in February 2021 (38: 12%), followed by January 2021 (36: 19%).

Noteworthy is the relatively high proportion of tweets for all three sentiments that were expressed during the initial stages of the vaccine roll-out. Considering the overview of the roll-out, it can be assumed that the information that was shared by the NDoH during this time encouraged conversations and Twitter users to express their sentiments on Twitter. Compared to the positive and negative categories and as illustrated earlier, the overall number of tweets expressing neutral sentiments was significant higher.

6.2.3 COVID-19 vaccination sentiments on Twitter by province

The purpose of this study was to investigate COVID-19 vaccine sentiments on Twitter in South Africa within the given period. South Africa has nine provinces and, therefore, it was necessary to investigate the sentiments by province, in order to establish whether significant differences had occurred on provincial levels.
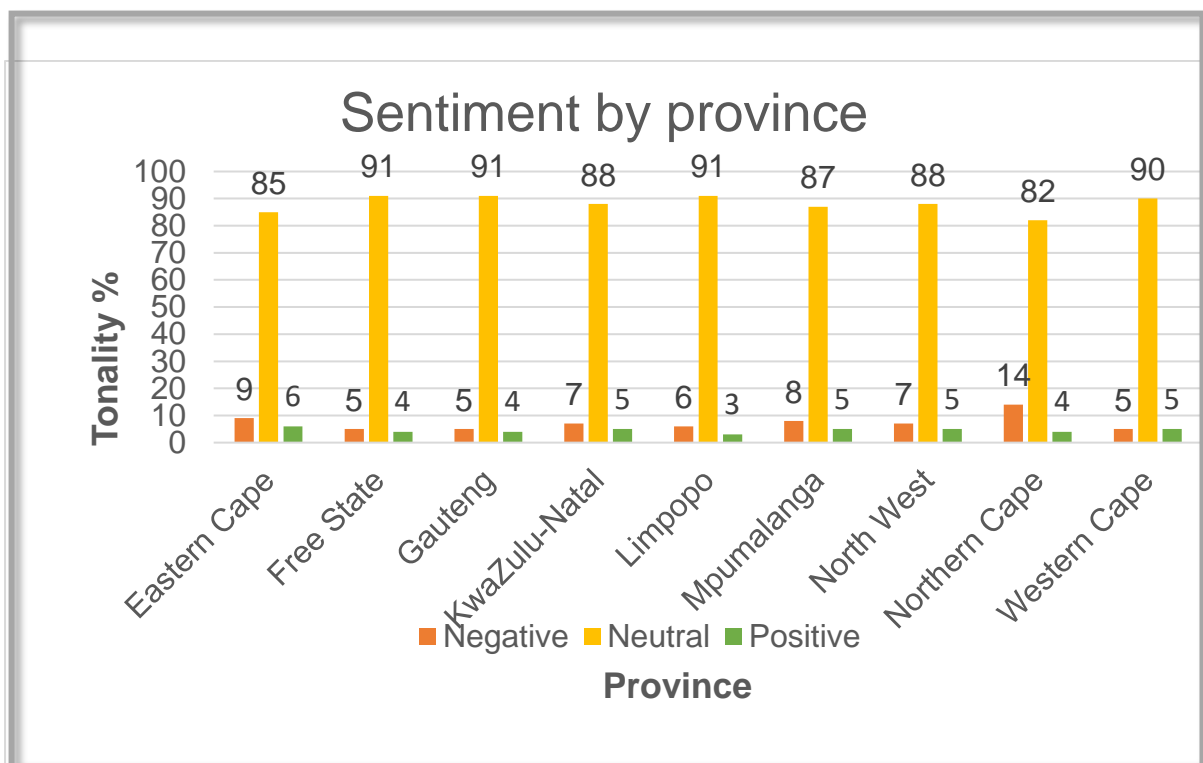

Figure 6.4: Vaccination sentiments by province, January–May 2021 (Author's own conceptualisation)

The COVID-10 vaccination tweets in all nine provinces were generally neutral, mirroring the findings of the overall sentiment analysis. Users' overall neutral sentiment indicated that they were not openly negative. The data showed that negative sentiments exceeded positive sentiments in all nine provinces, with the exception of

98

the Western Cape, where there occurred no difference in negative and positive sentiments. In the Northern Cape, tweets during this time indicated a significantly higher percentage of negative (14%) to positive (9%) sentiments.

6.2.4 Findings from the Sentiment Score Widget

The findings of the sentiment classification of tweets from January to May 2021 resulted in the need to analyse the data further by employing the Sentiment Score Widget to determine how the tonality of the sentiments evolved and to gain a deeper understanding of the more moderate tweets. The use of the Sentiment Score Widget also broadened the sentiment classification to include *very positive* and *very negative* categories.

As explained in Chapter 5 (Section 5.10.1.2), the Sentiment Score Widget was particularly helpful in uncovering the development of general tonality of a topic. In this way – and by considering the relatively high number of neutral tweets over the entire research period – it was regarded as useful to obtain an indication of the tweets that were not fully negative nor positive.

Figure 6.5 demonstrates that tweets during January expressed a *very negative* sentiment. This could be because of the delay in the South Africa's COVID-19 vaccination roll-out (Fihlani 2021). However, in February, the *very positive* scores were substantially higher, most likely due to increased awareness of the COVID-19 vaccine roll-out strategy and vaccinations in general, as well as progress in the South African vaccine roll-out. In February, a *positive* sentiment score was also seen, with the notable absence of a very negative sentiment score. By using the Sentiment Score Widget to broaden the sentiment classification, notable lower *neutral* scores and overall higher *positive* and *very positive* scores were revealed since the actual roll-out in February.
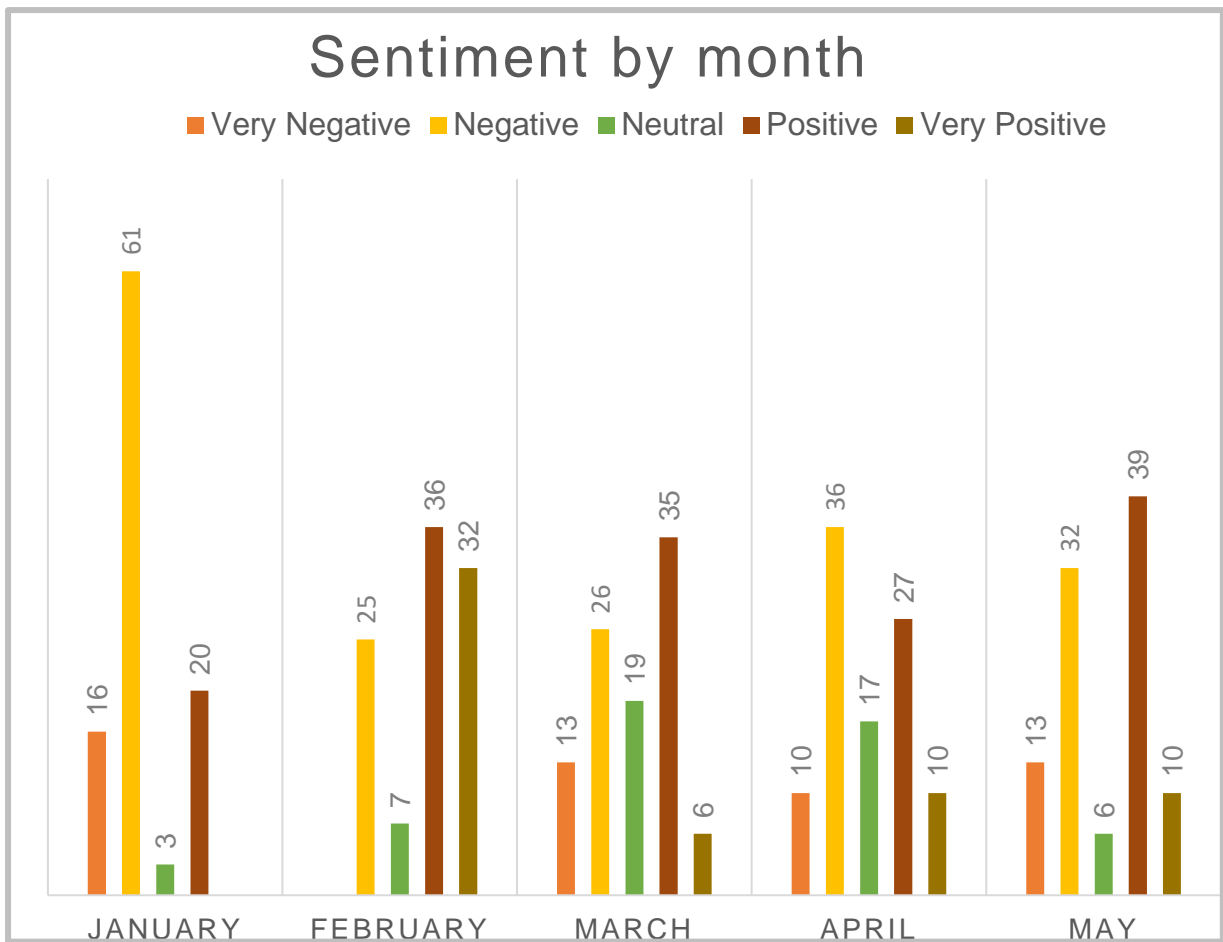
Figure 6.5: Sentiment spectrum by month, South Africa, January–May 2021 (Author's own conceptualisation)

6.2.5 Sentiment score by month

Towards the exploration of COVID-19 sentiments, this section presents sentiments by month to identify specific changes in the COVID-19 vaccine sentiments on Twitter.

6.2.5.1 January 2021

For most days in January 2021 (see Figure 6.6), the sentiment score occurred in the negative to very negative range (i.e. below the neutral/average line), which was congruent with the month's events – particularly the South African COVID-19 vaccine roll-out being hampered by procurement delays and regulatory concerns (refer to Section 2.4.3.1).
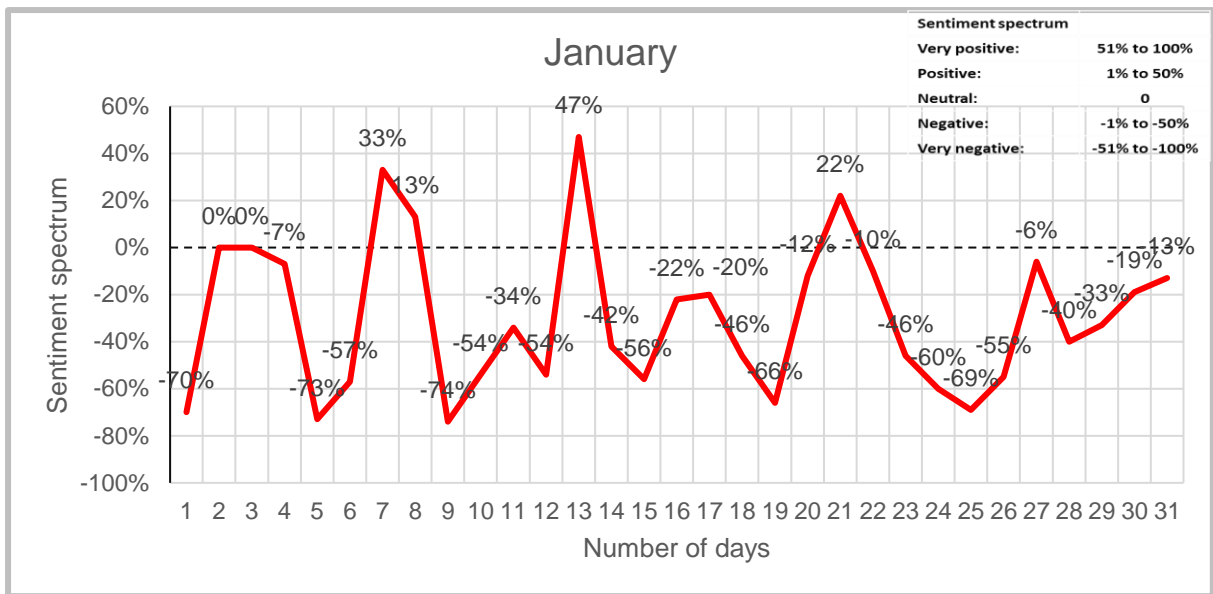
Figure 6.6: Daily sentiment score, South Africa, January 2021 (Author's own conceptuatlisation)

On 1 January, the sentiment score was very negative, despite the Minister of Health's announcement on that day that the NDoH and the South African Health Products Regulatory Authority (SAHPRA) were fine-tuning and aligning all regulatory processes to ensure that there were no unnecessary delays or regulatory impediments to activating the COVID-19 vaccine roll-out (Mkhize 2021). Surges in positive scores were seen on 7, 13 and 20 January respectively. These sharp increases can possibly be linked to the announcement on 7 January that Aspen Pharmacare was to start production of Johnson & Johnson COVID-19 vaccines in South Africa by late March or early April, if all approvals were in place (Mukherjee 2021). On 20 January, Burger, Buttenheim, English, Maughan-Brown et al (2021) reported that the COVID-19 vaccine developed by Pfizer and BioNTech was likely to protect against a more infectious variant of the virus discovered in Britain, which had spread around the world, according to results of further laboratory tests.

6.2.5.2   February 2021

On 1 February, a negative sentiment score was observed. However, when the South African Government received 1 million doses of the Oxford AstraZeneca vaccine from India (Stoltz 2021), the sentiment score moved to positive (see Figure 6.7).
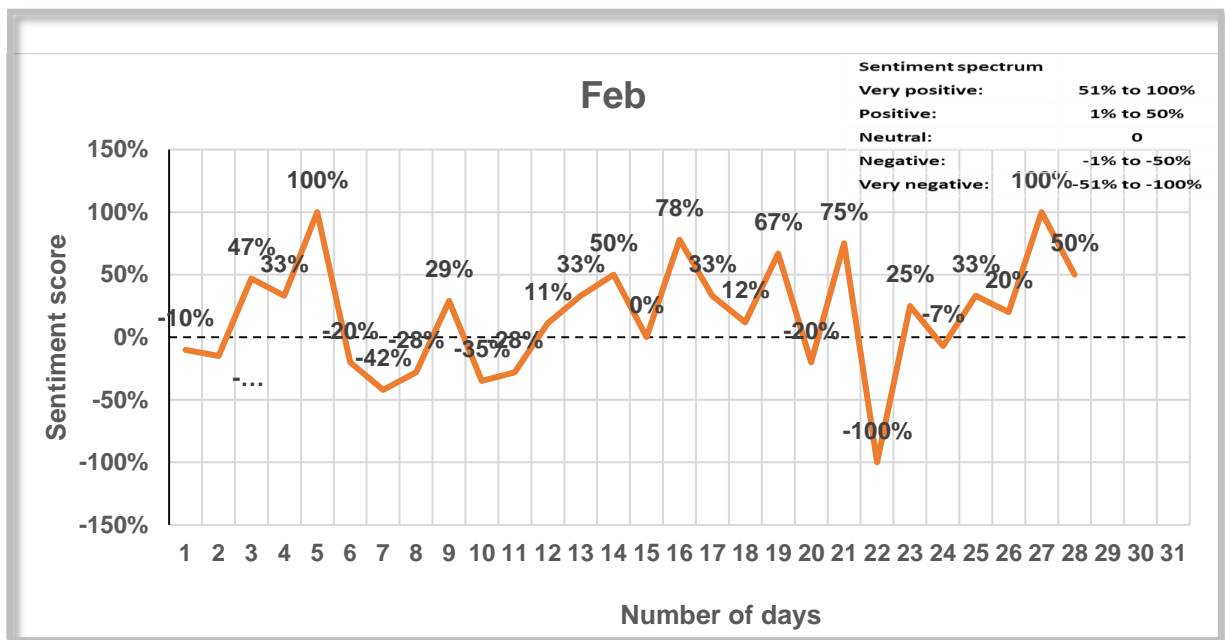
Figure 6.7: Daily sentiment score, South Africa, February 2021 (Author's own conceptualisation)

The data demonstrated a very positive sentiment score reaching its highest spikes on 5 February and 27 February. On 7 February, the NDoH suspended the distribution of the AstraZeneca vaccine, owing to concerns about the clinical efficiency of the vaccine, in light of the discovery of Beta variants (Herper 2021), which noticeably influenced the sentiment towards negative. Thereafter, on 9 February, the sentiment shifted to positive again.

On 16 February 2021, South Africa received and cleared the first shipment of 80,000 doses of the Janssen vaccine and, under the Sisonke Trial, it was allocated for all the health professionals (Browdie 2021). The sentiment for this day increased, which suggested that the arrival of the Janssen vaccine was well received. South Africa commenced its countrywide COVID-19 vaccination programme the next day (17 February), commencing with healthcare personnel (Republic of South Africa. Department of Health 2021c). However, the sentiment did not move to positive to reflect this milestone. Although a positive sentiment score occurred from 5–19 February, a highly negative sentiment score was noted on 22 February, which may be linked to talk about alleged dishonesty by the Minister of the NDoH.

These talks were supported in a news article on 23 February in which the Minister was linked to corruption in the awarding of a contract to Digital Vibes (Myburgh 2021).

From 25 to 28 February, the sentiment score rose from positive to very positive, which might have been the result of the news about the second supply of the Janssen vaccine and the subsequent fact that South Africa acquired 80,000 doses of this vaccine on 27 February 2021 (Mahlati 2021). A very positive sentiment was recorded on that day (27 February).

6.2.5.3 March 2021

March started with a negative sentiment score that increased to a positive score on 2 March (see Figure 6.8).
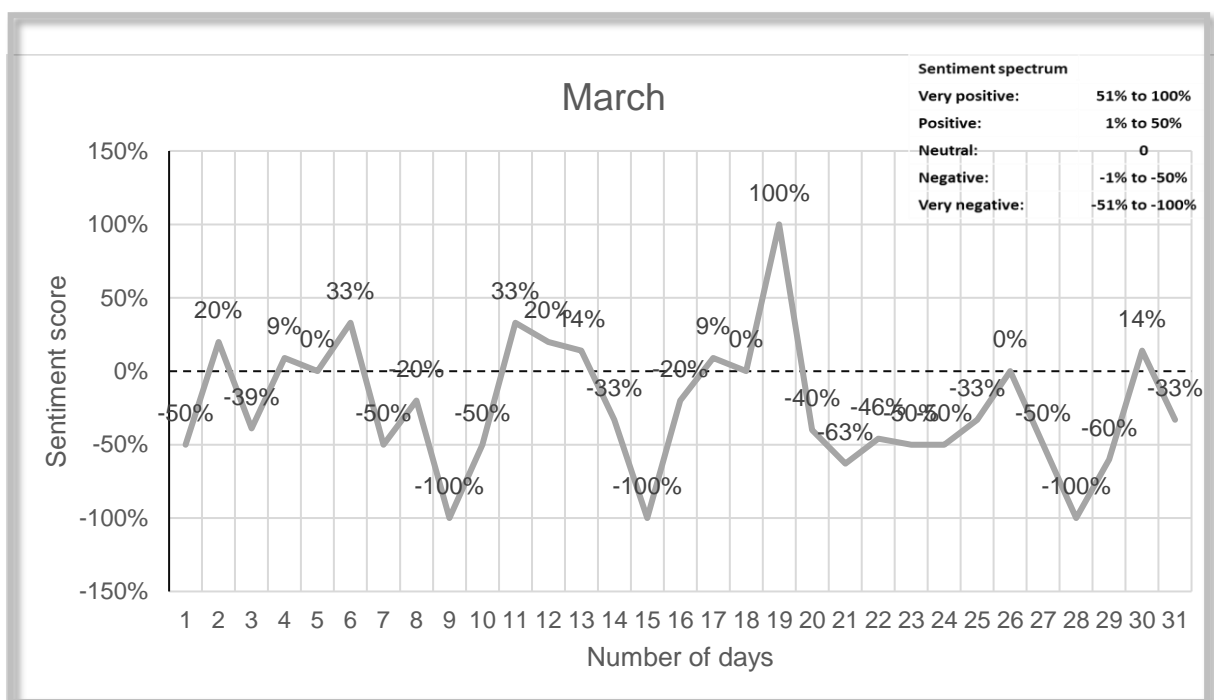

Figure 6.8: Daily sentiment score, South Africa, March 2021 (Author's own conceptualisation)

According to Steinacker (2021), the number of dosages administered exceeded 100,000 on 4 March 2021, although it was followed by a very negative sentiment on 9 March. From 11 to 13 March, there occurred a positive sentiment, which could be ascribed to South Africa receiving Part 1 of its third consignment of 40,000 Janssen COVID-19 vaccines.

While there was a significant negative sentiment on 15 March, there was a minor increase in the positive score on 17 March, when the South African Health Products Regulatory Authority (SAHPRA) approved the Pfizer vaccine for usage in the country.

South Africa received Part 2 of its third consignment of 66,000 Janssen vaccines on 18 March 2021, which might have resulted in the significant spike in positive sentiment on 19 March 2021 (Mahlati 2021). From 20 to 25 March, a negative sentiment was noted, with 21 March being particularly negative, which might be ascribed to South Africa starting to transfer 1 million doses of Oxford-AstraZeneca vaccine to other African Union members (Mkhize 2021).

Overall, the sentiment score reached its lowest point on 9, 15 and 28 March and remained below average, with the exception of the eight days indicated in Figure 6.8, when it was mostly slightly above average.

6.2.5.4   April 2021

On 1 April 2021, a very positive sentiment score was recorded, which might have resulted from the Janssen vaccine receiving Section 21 Approval, allowing usage outside the Phase III Trial of the Sisonke Protocol (South African Health Products Authority 2021). The sentiment scores for April 2021 are illustrated in Figure 6.9.
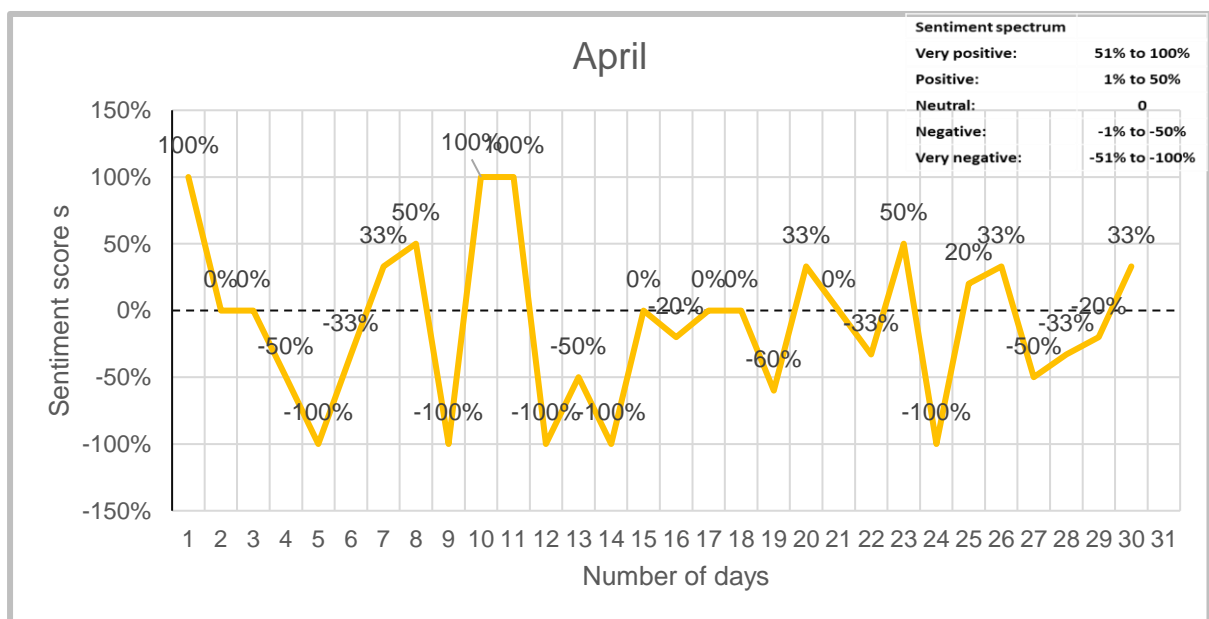

Figure 6.9: Daily sentiment score in April 2021 (Author's own conceptualisation)

The high positive sentiment on 1 April was followed by a decline on 2 and 3 April, when a neutral sentiment score was recorded. Negative to very negative sentiment scores were reported on 4, 5 and 6 April, with a positive sentiment score from 7 to 8 April,

which could have resulted from Government formally signing a contract with Pfizer on 6 April for 20 million vaccines, which were expected to arrive by the end of April (Winning, Mukherjee, Elgood & Williams 2021).

On 9 and 11 April, the sentiment score switched from very negative to very positive. The days of 12, 13 and 14 April demonstrated very negative scores, possibly owing to health concerns over the Jansen COVID-19 vaccine, which was suspended in South Africa on13 April (Ellis 2021).

Despite the Minister of Health launching the EVDS registration for COVID-19 vaccination of citizens aged 60 and above on 16 April 2021, the sentiment score fluctuated between neutral and negative from 15 to 18 April, before reaching a new low on 19 April (Mkhize 2021).

Positive sentiment scores were recorded on 25 and 26 April, which could be attributed to the news of the restart of the use of the Janssen vaccine (Republic of South Africa. South African Government 2021). From 24 to 31 April, sentiment levels ranged from negative to very negative. Despite a strong start to the month, the sentiment index remained generally negative to very negative throughout April. According to Mzekandaba (2021), this might be owing to teething difficulties with the EVDS system, as several older citizens turned to social media to vent their dissatisfaction with the government's online registration portal for the COVID-19 vaccination.

6.2.5.5 May 2021

The very positive sentiment score was highest during mid-May. This coincided with the roll-out of the Sisonke Trial to the general public during this time. Overall, the sentiment score remained low (below average) for most days of May, except for days 1, 6, 10, 14, 17, 19, 22, 26 and 30 (see Figure 6.10).
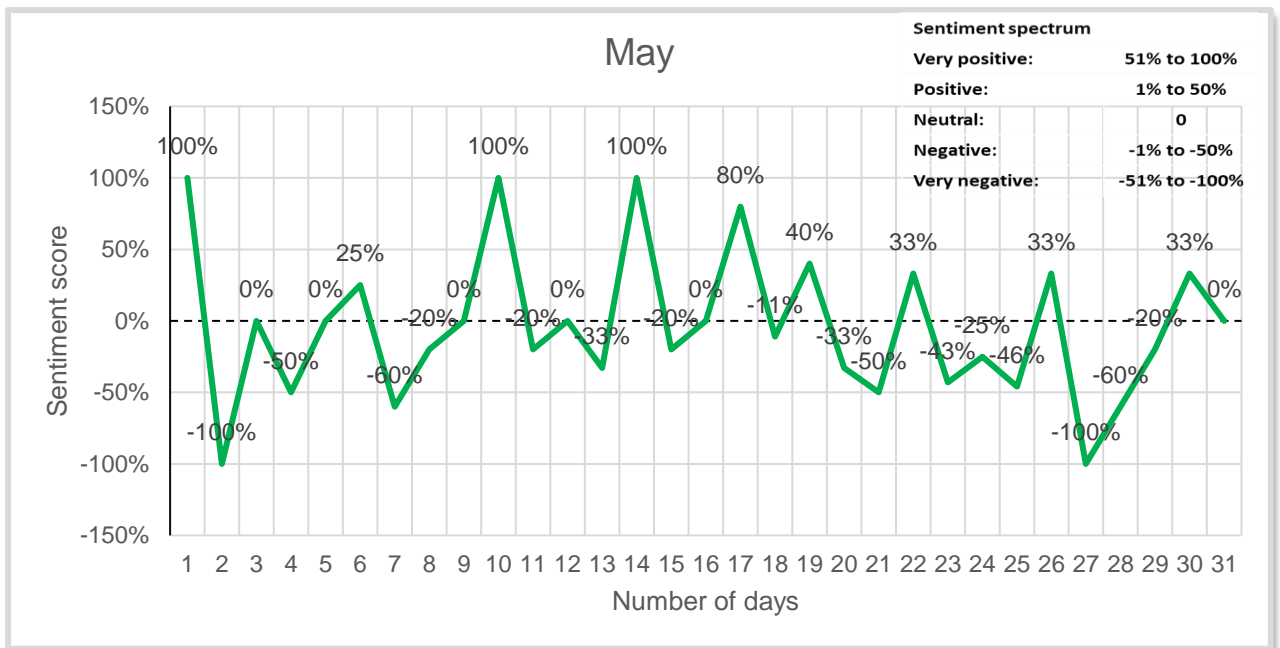
Figure 6.10: Daily sentiment score, South Africa, May 2021 (Author's own conceptualisation)

On average for this month, the sentiment score increased to above neutral every three (3) to four (4) days, but thereafter declined to lower than -20%. Figure 6.9 illustrates an overall low sentiment score for the month, regardless of significant spikes of positive sentiments on some days.

Due to enough capacity and dosages, the Sisonke study was expanded to include non-patient-facing health care workers, including administrative and supportive staff, on 10 May (South African Medical Research Council 2021). On 17 May 2021, a highly positive sentiment score was recorded, following the announcement on 16 May of the start of Phase 2 of the COVID-19 vaccination deployment to people over 60 (Republic of South Africa. Department of Health 2021b 2021).

Despite the expansion of the Sisonke Study, several events occurred in May, which might have contributed to the low neutral sentiment score readings, including the unfolding corruption at the NDoH, which implicated the Minister on 23 May (Myburgh 2021) and the circulating Delta variant, which influenced attitudes about vaccines and other related topics, such as the efficacy of vaccines on the Delta variant.

6.3 Interpretation and discussion of the qualitative data analysis

The data that was collected by means of the Meltwater Media Intelligence tool was used for the qualitative analyses of the study. The data analysis was conducted by means of the thematic analysis and the findings the thematic analysis, which were purposively collected from January to May 2021, are presented and interpreted in the next sections. Tweets that expressed neutral, negative and positive sentiments were sampled.

Sections 6.5 to 6.6 present the results and findings of the qualitative data analysis. The objective of the thematic analysis was to answer RQ3:

RQ3:   What are the key themes that were raised on Twitter during the COVID-19 vaccine roll-out in South Africa?

6.3.1 Results of the thematic analysis

Thematic analysis was performed on tweets that were purposely sampled, in order to discover potential themes that might give insight into the COVID-19 vaccine sentiments underlying the tweets posted on Twitter. The aim was to obtain insights into the prominent sentiments that were mentioned in tweets by Twitter users during the COVID-19 roll-out. The expectation was to identify topics that could provide insight into the reasons for the sentiments being during the specific period, and that could be of significance to the NDoH and interested stakeholders for future disease outbreaks.

A total of 150 tweets, comprising negative, neutral and positive sentiments were collected and analysed. The purpose of the sample was not to compare sentiments, but rather to identify themes and topics related to COVID-19 vaccinations in South Africa on Twitter. Table 6.1 represents the breakdown of tweets per month and by sentiment.

Table 6.3: Breakdown of COVID-19 vaccine tweets per month and by sentiment

VACCINE TWEETS SENTIMENT BREAKDOWN				
Month (2021)	**Positive**	**Neutral**	**Negative**	**Total**
January	10	10	10	30
February	10	10	10	30
March	10	10	10	30
April	10	10	10	30
May	10	10	10	30
TOTAL	**50**	**50**	**50**	**150**

A bottom-up approach was used, and seven (7) main themes and 25 topics were discovered. The key themes, which are shown in Table 6.2, are: (i) vaccine roll-out and administration; (ii) vaccine acceptance; (iii) government trust; (iv) vaccine knowledge and vaccination information; (v) vaccine hesitancy; (vi) vaccine efficacy and safety; and (vii) economic impact. The analysis uncovered that there were negative, neutral and positive tweets for each theme, as presented in Table 6.3.

Table 6.4: COVID-19 vaccine themes per sentiment as uncovered in the collected data

THEME	Number of tweets	Negative	Neutral	Positive		Total %
1. Vaccine roll-out and administration	37	13	12	12		24.66%
2. Vaccine acceptance	30	1	6	23		20%
3. Government trust	29	15	3	11		19.33%
4. Vaccine knowledge and vaccination information	19	11	6	2		12.66%
5. Vaccine hesitancy	15	4	11	–		10%
6. Vaccine efficacy and safety	12	4	6	2		8%
7. Economic impact	8	3	3	2		5.33%
TOTAL	150	50	50	50		100%

Table 6.5: Overview of fundamental themes and the relevant topics of each theme

No.	THEME	Topics		Tweets	%	Total tweets	%
1	Vaccine administration and roll-out	1.1	Appreciation of medical professionals	1	0.67%	37	24.67%
		1.2	Vaccine accessibility and distribution	21	14.00%		
		1.3	Vaccination experience	13	8.67%		
		1.4	Proper storage and transportation of vaccines	2	1.33%		
2	Vaccine acceptance	2.1	Open to taking the vaccine	5	3.33%	30	20.00%
		2.2	Sharing vaccine experience	6	4.00%		
		2.3	Saving lives	6	4.00%		
		2.4	Vaccination is a choice	13	8.67%		
3	Government trust	3.1	Government is doing a good job	10	6.67%	29	19.33%
		3.2	Government mismanaged the vaccine roll-out	6	4.00%		
		3.3	Doubting the real intention of government	5	3.33%		
		3.4	Government should account	8	5.33%		
4	Knowledge of vaccines and vaccination information	4.1.	Misinformation and fake news	9	6.00%	19	12.67%
		4.2.	Information on vaccine roll-out	4	2.67%		
		4.3.	Communication advocacy	6	4.00%		

No.	THEME	Topics	Tweets	%	Total tweets	%
5	Vaccine hesitancy	5.1. Alternatives to vaccines	7	4.67%	15	10.00%
		5.2. Vaccine side effects	1	0.67%		
		5.3. Vaccines developed abroad	7	4.67%		
6	Vaccine efficacy and safety	6.1. Post-vaccine side effects	2	1.33%	12	8.00%
		6.2. Vaccines and variants	3	2.00%		
		6.3. Vaccine safety	5	3.33%		
		6.4. Vaccine quality and production	2	1.33%		
7	Economic impact	7.1. The negative economic impact of travel restrictions	3	2.00%	8	5.33%
		7.2. Employment	2	1.33%		
		7.3. Vaccines are key to kick-starting the economy	3	2.00%		
TOTAL			150	100%	150	100%

6.3.2   Major themes identified in the thematic analysis (tweets)

The analyses of the themes that were identified from the negative, neutral and positive tweets are discussed in the following sections.

6.3.2.1   Theme 1: Vaccine administration and roll-out

Tweets in this category discussed the vaccination roll-out plan in general, the COVID-19 vaccine registration process, the administration approach, and vaccine availability. According to Schaffer Deroo, Pudalov and Fu (2020:2459), a plan for the COVID-19 mass vaccination campaign should proactively address known potential barriers to vaccine acceptance through the use of linguistically and culturally competent messaging. The majority of the tweets that were collected particularly indicated

opinions about the vaccine delivery and roll-out. A total of 37 tweets were discovered under this theme, accounting for 24.7% of the total number of tweets in the qualitative sample. Neutral and positive tweets each accounted for 32.43% respectively, whereas negative tweets accounted for 35.16% of the sample. Furthermore, four topics steered the sentiment under this theme, namely: (i) an appreciation of medical professionals who risk their lives; (ii) vaccine experience; (iii) vaccine accessibility and distribution; and (iv) proper storage and transportation of vaccines (see Figure 6.1).
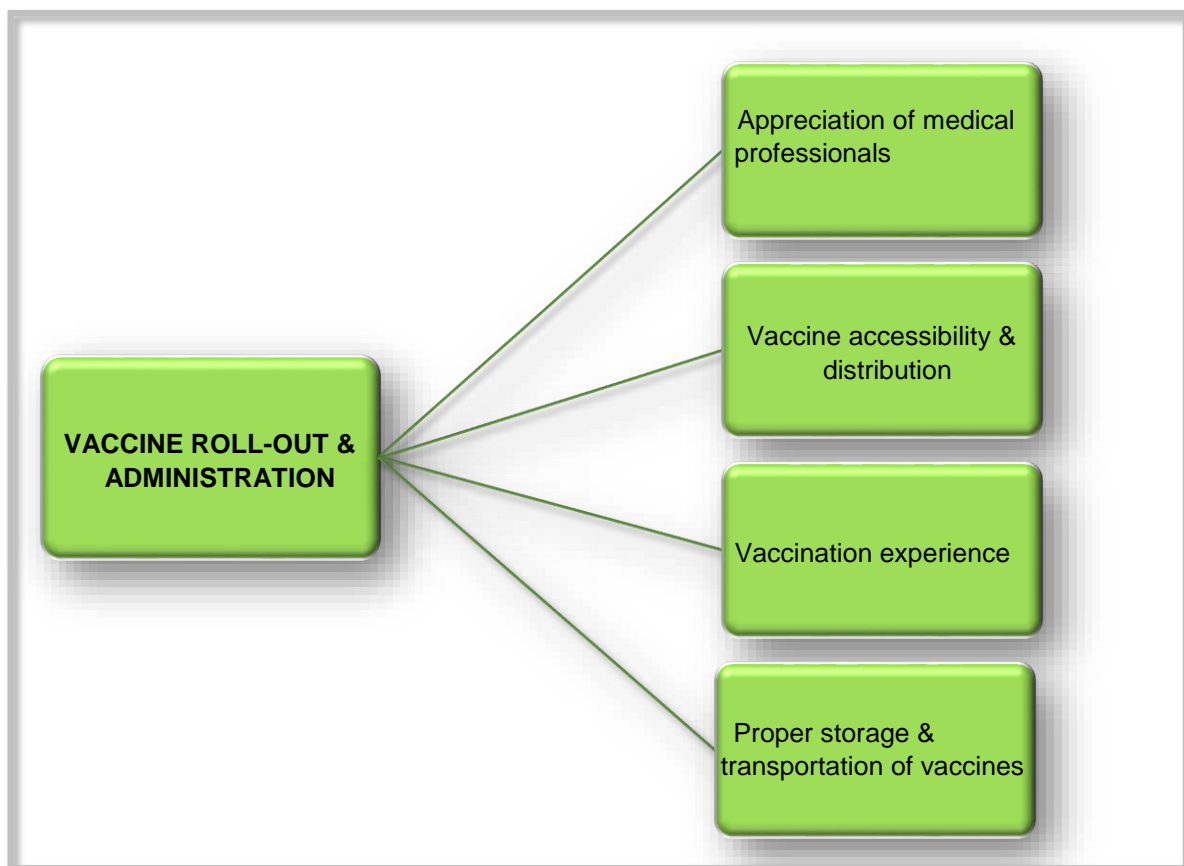

Figure 6.11: Topics of vaccine roll-out and administration (Author's own conceptualisation)

Noteworthy are the tweets that described specific aspects of vaccine delivery and distribution and that were categorised under the topic vaccine accessibility and distribution. This was regarded as significant, because a small number of African studies on the vaccine and vaccination-specific issues that influence vaccine acceptance, have recognised vaccine accessibility, the timing of vaccine delivery and availability of vaccinations as the strongest factors of vaccine hesitancy (Cooper et al. 2018:2355).

Twelve (12) positive tweets were collected under this theme, with the majority of users expressing their gratitude to medical workers under the topic of appreciation of medical professionals. As demonstrated in the following examples, most of the positive tweets under this theme focused on the appreciation of medical experts and associated professionals for aiding with the vaccine roll-out. Some of the tweets were:

Received my JJ #vaccine today, thanks to @HealthZA for such a systematically, safe and time efficient implementation of the program, #Sisonke trial. Thanks to @DG_HealthRSA @UNinSouthAfrica @WHOSouthAfrica @nardosbthomas [10 May 2021]

Received the jab at the FF Ribeiro Clinic at Sammy Marks Square in Tshwane. The process included screening, before being ushered for verification and vaccination. Thank you to the nursing staff for a smooth and efficient process @DBE_SA @HealthZA #vaccination #VaccineRoll-outSA [25 May 2021]

6.3.2.1.2 Neutral tweets

Neutral tweets under the theme vaccine administration and roll-out largely commented on the vaccine roll-out process and experiences at vaccination sites. These tweets commented on the queue at a vaccination site, comparing it to queues one would see during times of election. For example:

The line for vaccines starts at the entrance of the university (the hospital is next door), there is another line from the opposite side as well, never seen anything like this except during national elections #sisonketrial #Covid19SA [13 May 2021]

Vaccines are here, now we hope and pray that they will be sent to our health workers and all frontline workers #CovidVaccine #FamilyMeeting [1 Feb 2021]

Another topic that featured neutral tweets was vaccination experience. Users were sharing their experiences with other Twitter users, which was consistent with emerging research on electronic word-of-mouth (e-WOM) discussed in Section 3.6 of this study, suggesting that many acknowledge that Internet users are more likely to believe other

users' opinions of their health experiences and side effects than those of medical authorities (Erkan & Evans 2014:03).

There's a new video up on my channel all about my COVID19 Vaccine experience, as well as some information about the vaccine that will help you when you need to make the choice to get yours. #COVID19SouthAfrica #CovidVaccine [28-Feb-2021 04:53PM]

This what a senior citizen from Mdantsane had to say about his experience after being vaccinated for COVID-19 at the Bhisho Hospital today. #IChooseVaccination #VaccineRoll-outSA #VaccineRegistration #covid19SA [19 May 2021]

Something a little different for today's vlog ... Talking about my experience getting the Covid vaccine, from stab to side effects! Hope you enjoy! [24 March 2021]

6.3.2.1.3   Negative tweets

There were also negative tweets on vaccine experiences detected under the theme of vaccine roll-out and administration. The two tweets below are two of several that expressed dissatisfaction with the long waiting period and bad infrastructure of a vaccination facility. The first tweet involved one owned by a private pharmaceutical retailer:

Tempers frayed after 2 hours waiting for a COVID-19 vaccination. Not enough ventilation, not enough chairs, over 60s sitting on the floor. Not good enough Dischem Mall of the South. #Dischem #COVID19 #vaccination [25 May 2021]

South Africa's vaccination roll out process is a disgrace at the rate it's going at, simply reflects the caliber of governance. At this point we're left with no option but to commence with our lives #PeoplesVaccine #SouthAfrica #covid19SA [23 March 2021]

Furthermore, the topic of proper storage and transportation of vaccines came up in the negative tweets under this theme. The tweets below, for example, highlight the poor state of roads and raises the question of how many vaccine vials will remain intact once transported to informal settlements:

Because that same marketing genius leads a government that has screwed up vaccine supplies from the get-go. They decided against giving us a choice because a choice cannot be made for non-existent supplies. #COVID19Vaccination [21 May 2021]

Now they are spending thousands of money to observe and celebrate the arrival of #VaccineforSouthAfrica but clinics and hospitals don't have the capacity to store the vaccines at -70 degrees Celsius [1 February 2021]

Finally, some Twitter users mentioned the topic of vaccine accessibility and distribution. According to Cooper et al (2021:921), supply-related problems, vaccine nationalism, and associated unequal vaccination availability both within and between countries are causing greater concern. Examples included:

This #vaccine roll-out is more concentrated on urban areas, just like any other thing in this country. I wonder if it will ever reach our parents in rural areas #VaccineShortage [26 May 2021]

Unequal #CovidVaccine distribution a "catastrophic moral failure" and a bitter reminder of the more than 9 million people who died needlessly during the Aids epidemic because they didn't have lifesaving drugs – "Don't let it happen again" [12 April 2021]

6.3.2.2   Theme 2: Vaccine acceptance

This theme included tweets about the factors influencing people's willingness to get vaccinated. As previously indicated, ensuring vaccine acceptance is viewed as equally important as ensuring effective and fair distribution of COVID-19 vaccines (Solís Arce, Warren, Meriggi, Scacco et al. 2021:1385).

Of the sample that was analysed during this period, a total of 30 tweets expressed opinions about vaccine acceptance. This accounted for 20% of all tweets collected between January and May 2021. The sample comprised 3.33% negative, 20% neutral and 76.67% positive tweets under this theme. Four (4) prominent topics were identified under the vaccine acceptance theme, namely: (i) open to taking the vaccine; (ii) sharing vaccine experience; (iii) saving lives; and (iv) vaccination is a choice (see Figure 6.12).
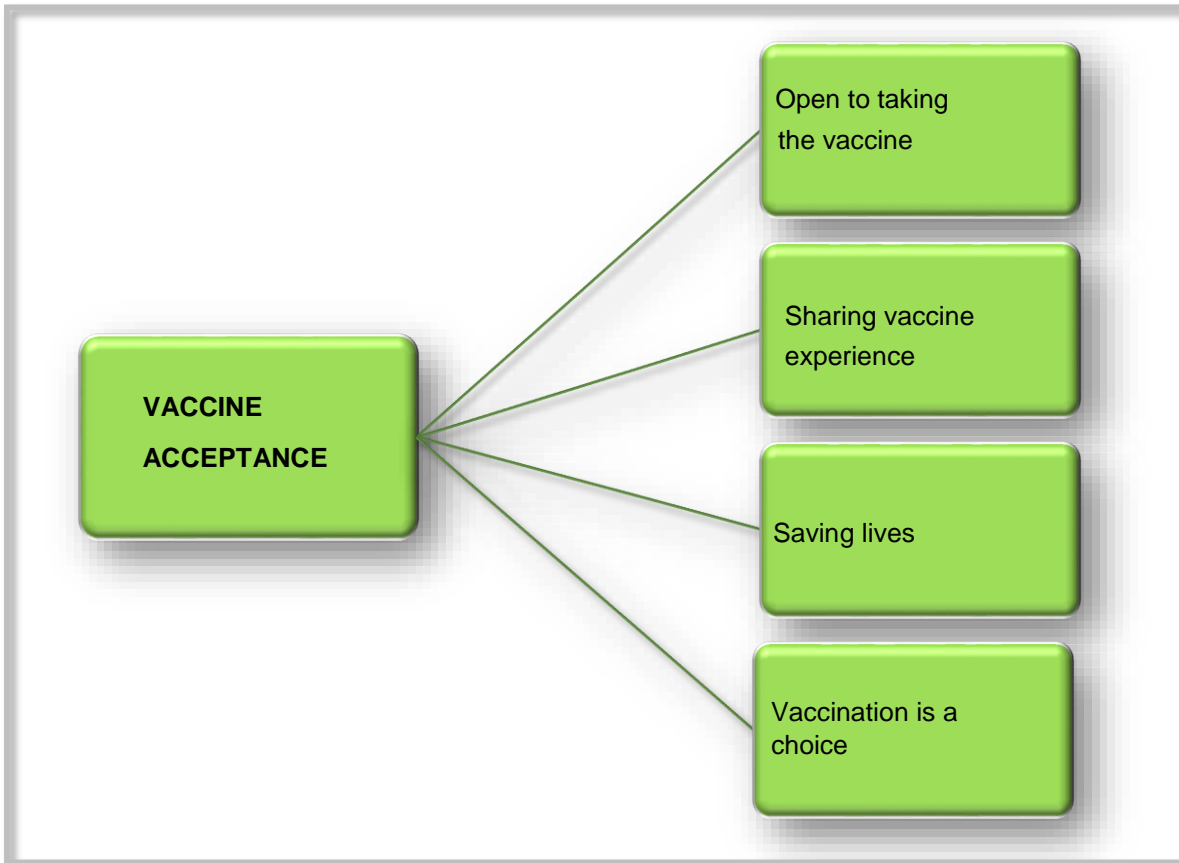
Figure 6.12: Vaccine acceptance topics (Author's own conceptualisation)

6.3.2.2.1 Positive tweets

This theme resulted in the identification of 23 positive tweets. The topic of being willing to take the COVID-19 vaccine was evident under this theme, with Twitter users sharing their experiences like the tweets below:

I now hope and pray that my fellow Africans and people all over the globe can be vaccinated so that we can slay this monster that are ruining lives, jobs, freedom, happiness, and many other things that we have so often taken for granted. #VaccineForSA #VaccineRoll-outSA [31-May-2021]

It's been a week since I have had my JJ Vaccine @JNJNews. I feel great and thankful ... by the grace of God ⛪ #VaccineRoll-outSA [23-Mar-2021]

Under neutral tweets, the topic of vaccination being a choice was observed, supported by tweets in which the users felt particularly strong about exercising their democratic rights and freedom. Examples included:

It is possible to eliminate COVID-19 by ensuring that we vaccinate enough people to achieve population immunity, but we all have to choose vaccination. #COVID19Vaccination [11 February 2021]

Have the vaccination or don't, but don't criticise those who think differently. Has mine today, totally painless then and still fine now, just like when I receive my annual flu jab. 1 day closer to end of lockdowns. #COVID19Vaccination #vaccinated [9 March 2021]

6.3.2.2.3 Negative tweets

As presented below, the single negative tweet related to the topic of vaccine acceptance and demonstrated no interest in taking the COVID-19.

Really not interested in any vaccine, I'll take my chances #CovidVaccine [14 January 2021]

6.3.2.3 Theme 3: Government trust

Vaccine confidence is important since vaccinated populations experience fewer COVID-19 illnesses, hospitalisation and fatalities. This theme dealt with the aspect of trust in the government (see also Chapter 7: Section 7.2.1). Trust in the organisation supplying the vaccines is considered to be a key component in the efficiency of any vaccination campaign (Solís Arce et al 2021:1385). The NDoH, which is part of the South African government, was in charge of providing the COVID-19 vaccination in South Africa. Tweets about different elements related to government trust in the administration and roll-out of the COVID-19 vaccination are included in this theme.

Under this theme, 29 tweets were analysed, accounting for 19.33 % of all tweets sampled. This theme generated the most negative tweets out of all those selected. This is significant because government trust can be thought to influence opinions on

COVID-19 vaccination, as evidenced by a study by Cooper et al (2021:927) found that South African respondents who thought the President of the Republic and the national government were doing a bad job were less likely to want vaccination than those who thought the President and national government were doing a good job (36% versus 42%) The sample included 72% negative 10.34% neutral and 37.93% positive tweets under this theme. Four prominent topics were identified, namely: (i) government doing a good job; (ii) government mismanaged the vaccine roll-out; (iii), doubting the intentions of government; and (iv) government should take accountability.
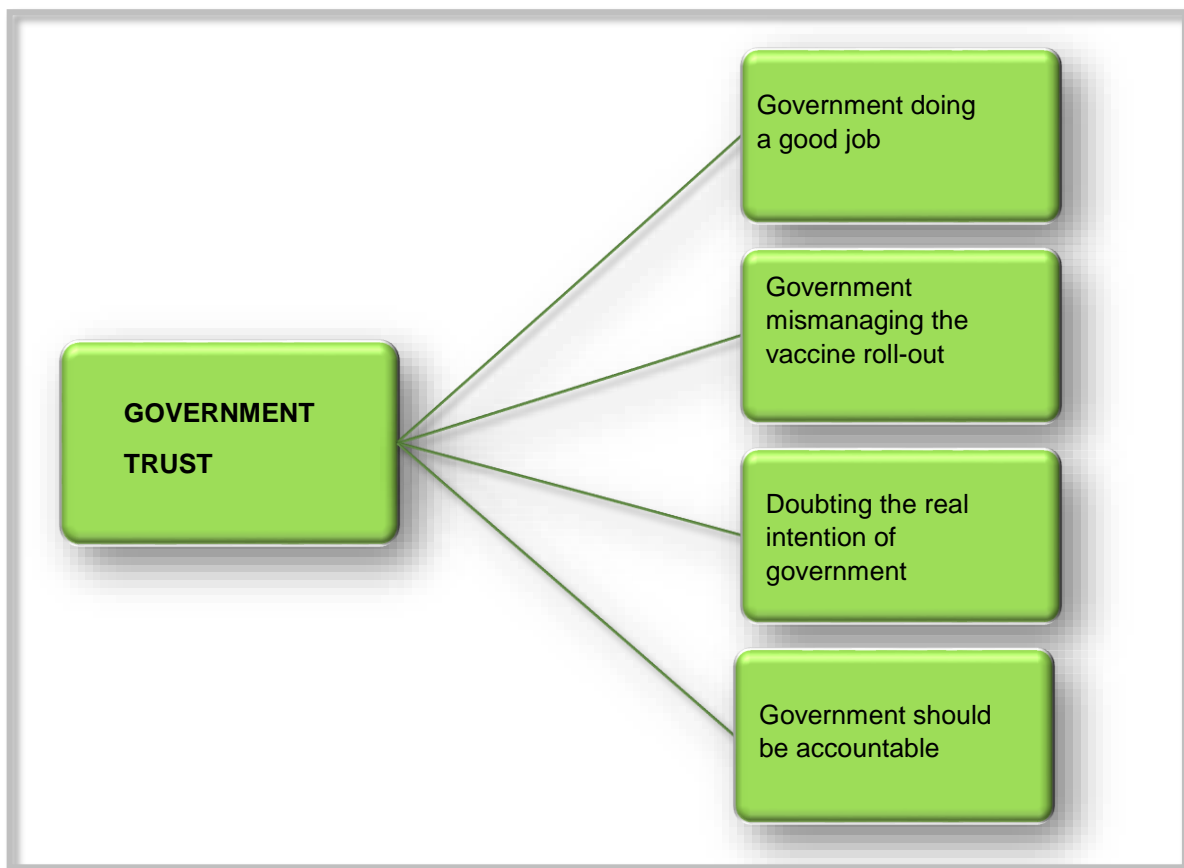

Figure 6.13: Topics under the theme of government trust (Author's own conceptualisation)

6.3.2.3.1 Positive tweets

The topic under which authorities were commended for doing a good job was observed under the theme of government trust. For example, below the former Minister of Health, Dr. Zwelini Mkhize, was complemented for doing a good job with the vaccine roll-out:

Health minister Mkhize is doing such a great job. He inspires confidence in government's ability to see us through this crisis. #COVID19 #VaccineforSouthAfrica [5 February 2021]

Furthermore, as reflected in the following tweets, confidence in the government and the South African President was expressed as follows:

You can congratulate government for doing one good thing! Even if you are in the opposition party. You don't need to be unnecessarily negative all the time. #vaccine [17 February 2021]

Cyril Ramaphosa has done a great job of being an ambassador for that vaccine, ninja be doing everything in his power to promote it. #VaccineforSouthAfrica [17 February 2021]

Both of the foregoing tweets were posted on the first day of the COVID-19 vaccination roll-out in South Africa.

6.3.2.3.2 Neutral tweets

The three neutral tweets discovered under this theme centred on the topic of doubting the true intentions of government. In some tweets concerns about the government's actual intentions regarding the COVID-19 vaccination roll-out were expressed, with the example below requesting evidence that the President, as a representative of government, is being administered the same vaccine as the citizens.

What proof will we get that the vaccine that the president and other high official will use is the same as the one every single South African will use? #VaccineforSouthAfrica @PresidencyZA @DrZweliMkhize [1 February 2021]

Vaccinations shouldn't be compulsory; no rights should be stripped if the people don't want to be vaccinated. Authorities from different standings have made us question them nd now they want us to trust them when they are dodgy #COVID19 #CovidVaccine #IDontTrustYou #COVID19inSA [28 January 2021]

6.3.2.3.3 Negative tweets

According to Wasserman and Madrid-Morales (2021), the declining level of trust in the South African government may be connected to the country's faltering vaccine deployment, which has been experiencing several failures and the government was heavily chastised for failing to reach its objectives. Consequently, negative tweets under this theme focused on how the pandemic and the vaccine roll-out were considered by some Twitter users to have been mismanaged by the government. Some of the examples were:

QT @DiePlaasPatriot: How long until the Covid 19 Vaccine Injury program becomes the next Road accident fund?? Do South Africans truly believe when the government tells them everything will be fine? I refuse to be a lab rat. #VaccineRoll-outSA #VoetsekANC ; What the government is actually trying to say is that you must ensure that your medical aid, life insurance and funeral plan is up to date before going for the #CovidVaccine [22-Apr-2021]

I'm tired of the lies. Coronavirus pandemic: South Africa's shots shortage slows vaccination drive #COVID19 #VaccineRoll-outSA #vaccines [6 March 2021]

Given that these issues were high on the news agenda at the time of the study, it was not surprising that the topic of government trust primarily related to government's perceived inability to manage the vaccine roll-out adequately, with questions about government's true intent being raised. Furthermore, under the topic calling for government to take accountability, tweets shared opinions on how vaccine procurement funds were squandered, for example:

As citizens of this country we have rights to hold our government accountable we need to start with the Covid19 scam and the money they looted buying killer J&J vaccine, expired vaccine and also collapsing the economy with stupid lockdown restrictions. #vaccine [14 April 2021]

Assuming this is true and these aren't more fake or expired vaccines, then we can move on to distribution, which the government will bungle up for the next few

years. #VaccineRoll-outSA is a pipe-dream so long as government is in charge. [6 April 2021]

In addition, there were tweets that suggested that the private sector should take control of the vaccine administration were observed:

#Covid19 #VaccineRoll-outSA needs to be managed by the private sector, otherwise nothing will happen. Or worse, we'll end up with toxic vaccines. The government is great at ruining things. Don't let them ruin this so they can continue #lockdown! [15 April 2021]

People disputing the fact that the Government fools are real fools. They ordered the vaccine but yet failed to inform the suppliers about the new variant of the virus discovered in RSA and major countries had rejected the vaccine but ey ANC administration. #COVIDVaccine [7 February 2021]

According to Wasserman and Madrid-Morales (2021), public dissatisfaction with Government's handling of the epidemic should serve as a wake-up call to government communicators that producing compelling pro-vaccine messaging was insufficient. The lack of confidence in the messenger also has a detrimental influence on people's trust in the message itself, as well as their willingness to propagate such messages. This was evident in the tweets below:

I'm not against #vaccine for COVID, anyone who thinks it can help them May go for it, I really don't care however I'm terrified by the obsession of the powers that be, propelled & controlled by those pushing vaccine agenda, to have us ALL vaccinated even against our will. [7 January 2021]

Today is a good day to ask our government, which seems to have spent a lot of money on useless PPE tenders, empty field hospitals, ineffective fumigation materials and so on, when South Africans can expect to be vaccinated. #vaccine #myanc #ramaphosa #COVID19AB [21 March 2021]

6.3.2.4   Theme 4: Knowledge of vaccines and vaccination

This theme addressed information sources of vaccines as well as efforts by authorities to inform the public on vaccines and the vaccine roll-out. Sources of health and vaccination-related information play a vital role in the choices that people make about vaccination (Dzinamarira et al 2021:3). This theme accounted for 12.66% of the overall sample which included tweets concerned with improving awareness of COVID-19 vaccinations and vaccines.

Under this theme, 57.89% tweets were negative; 31.58% were neutral and 10.53 % was positive. Three key topics were identified – i.e. misinformation and fake news, information on vaccine roll-out, and communication advocacy.

Three topics were identified under the theme of knowledge of vaccines and vaccination as illustrated in Figure 6.14.
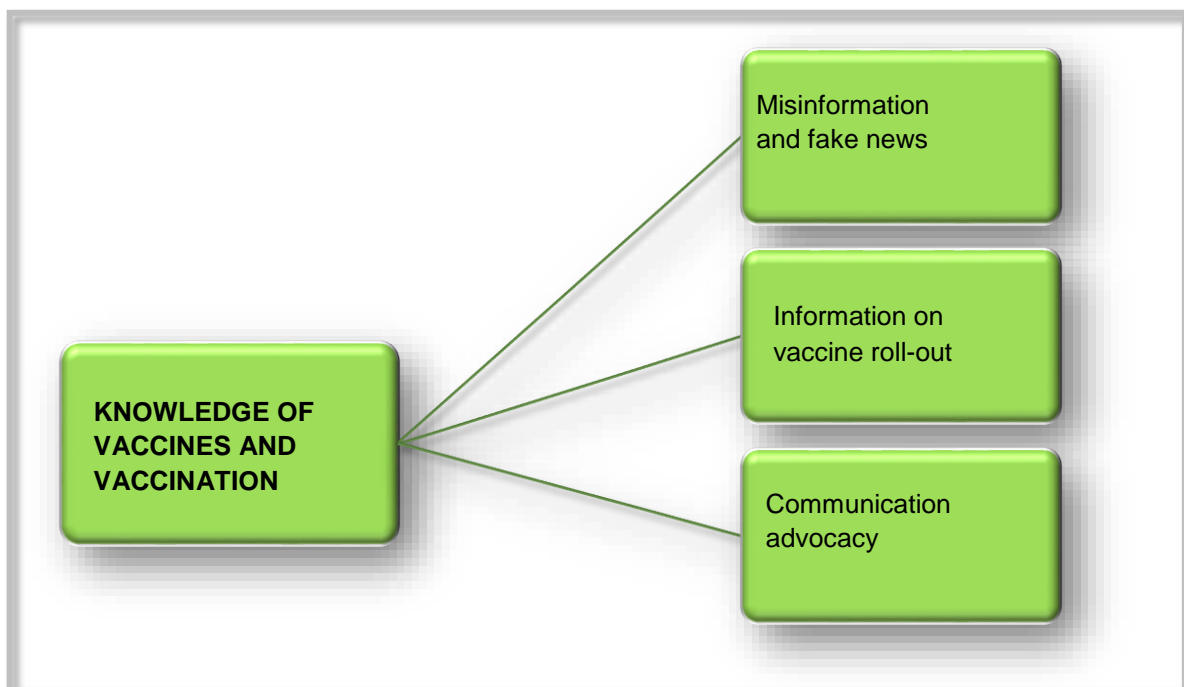

Figure 6.14: Topics under the theme of knowledge of vaccines and vaccination information (Author's own conceptualisation)

6.3.2.4.1   *Positive tweets*

In the sample, there were just two positive tweets under this theme, both of which were about vaccines and vaccine roll-out. The following Twitter users demonstrated trust in

vaccine information and the manner in which the President addressed issues around fake news relative to COVID-19 vaccines and their roll-out:

#VaccineRoll-outSA information shows that Vaccination 💉 is the best defence against serious infections #VaccinesWork @GautengHealth @WHO @HealtheNews @nioh_sa @nicd_sa [6 March 2021]

I'm happy @PresidencyZA @CyrilRamaphosa addressed the conspiracy theories around #COVID19 and #vaccination. I hope you too will think twice before sharing such information. [11 January 2021]

6.3.2.4.2 Neutral tweets

As discussed in Chapter 2: Section 2, increasing community knowledge and awareness through social mobilisation may have a positive impact on the vaccine uptake (Larson 2014:2156; Dubé et al 2015:100).

This suggested that vaccine roll-outs should consider and harness effective methods to engage diverse communities (Schaffer Deroo 2020:2459). As seen in the following tweets, the topic of communication advocacy centred on community education, with a substantial number of tweets encouraging authorities and other Twitter users to provide important information about COVID-19 vaccines:

We need public education re vaccinations, please Mr President. #COVID19inSA #CovidVaccine #AstraZeneca #eNCA [1 February 2021]

Let us maintain social distancing, whether we in the line to get a vaccine, shopping line or visiting the bank etc. Let's beat #covid #staysafe #socialdistancing #VaccineRoll-outSA [18 February 2021]

Cooper et al (2021:930) observe that communication campaigns and other types of civic engagements that are sensitive to the information requirements of communities may assist in intensifying people's trust in the COVID-19 vaccines. The Twitter user in the following tweet was seeking information on how long the immunity provided by the vaccine lasted.

#COVIDSecondWave #COVID19 #COVID19SK #COVID19AB #CovidVaccine #coronavirus Can anyone tell me how long the vaccine lasts? Can I get Covid if I have the vaccine? What are the side effects? [3 April 2021]

According to Kricorian, Civen and Equils (2021:6), misinformation may lead to vaccination hesitancy and influencing willingness to get vaccinated. Some Twitter users voiced the topic of misinformation, as reflected in the following tweet:

QT @Abramjee: There is a lot of misinformation around Covid19 vaccines. Let's not spread false information and cause fear. Let's follow the scientists and doctors! @DrZweliMkhize @ProfAbdoolKarim @GautengHealth #IChooseVaccination Johnson & Johnson phase 3 #Covid19Vaccine Trial in SA. Explanation: WATCH @IsmailMitha786 [30 January 2021]

#VaccineforSouthAfrica all these hypocrasy and misinformation about vaccines must be a thing of the past,there should be punishment for such people. [12 January 2021]

6.3.2.4.3 *Negative tweets*

According to Klimiuk, Czoska, Biernacka and Balwick (2021:2026), a growing number of people are currently relying on the Internet only for health-related information and information on vaccines. However, there were a number of tweets related to the impact of the Internet with regard to misinformation and fake news that are classified as negative. This conclusion is consistent with existing research, which identifies information overload, disinformation and falsehoods on the Internet and social media platforms as possible barriers to vaccination uptake (Dzinamarira et al 2021:3). Examples:

Fake news is hurting SA vaccination roll-out: Nzimande: #COVID19Vaccine #VaccineforSouthAfrica #VaccineRoll-outSA [25 February 2021]

QT @A_C_D_P: deliberately disseminating false information about Covid?; Deaths from #CovidVaccine are particularly egregious. While most understand that deaths occur among people WITH Covid and even fewer die OF Covid, NOBODY expects to die from the vaccine. Yet vax messaging continues undeterred, while vax uncertainty even scepticism, is rubbished. [5 May 2021]

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Under the theme of knowledge of vaccines and vaccination, the topic of information on the vaccines and the vaccine roll-out was observed. A number of Twitter users felt that they did not have sufficient information as can be seen in the tweets below:

@TheAgenda_SABC @DesireeChauke I don't wanna lie I don't feel sufficiently informed about the vaccines and I'm scared that I might cause more trouble than the corona virus itself, I can't wait to see how the health workers will take the vaccines. #VaccineS [1 February 2021]

> *I foresee a very confused vaccinated country ... So many different vaccine companies ... haaaai anyways let me tool #vaccine #vaccines #FamilyMeeting* [1 February 2021]

6.3.2.5   Theme 5: Vaccine hesitancy

As conceptualised in Chapter 2 (Section 2.5.1) and for the purposes of this analysis, *hesitancy* should be understood as being indecisive about receiving the COVID-19 vaccine, rather than refusing to take it (Dube et al 2021).

The theme of vaccine hesitancy accounted for 10.10% of the total number of tweets in the sample. The sample revealed 26.67% negative and 73.33% neutral tweets in this theme. Naturally no positive sentiments were expressed. The tweets under this theme mostly highlighted Twitter users' opinions related to three topics, namely vaccine alternatives, vaccine side effects, and vaccines produced abroad.

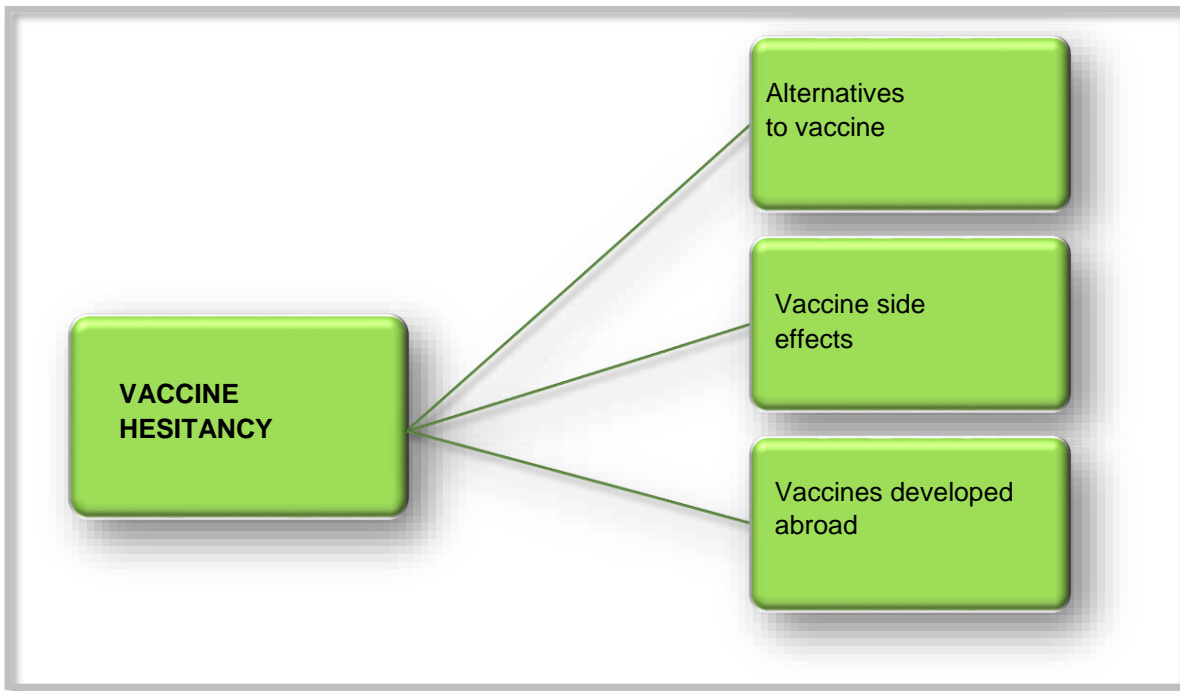The topics under the vaccine hesitancy theme are illustrated in Figure 6.15.

Figure 6.15: Topics under the vaccine hesitancy theme (Author's own conceptualisation)

6.3.2.5.1   Neutral tweets

Some neutral tweets within this theme focused on the topic of alternatives to vaccines to combat COVID-19. There were tweets that enquired about the use of the ivermectin drug for COVID-19:

@Newzroom405 Can you ask him about #Ivermectin please? When will Government implement its use for people while they wait for the #vaccine It's cheap, easy to get and effective against #COVID19 [4 March 2021]

@WHOAFRO @WHO @UNICEF @gavi @CEPIvaccines #Ivermectin should be given to those waiting for #vaccine [7 March 2021]

Another topic emanating from this theme was that of the side effects and long-term effects of the COVID-19 vaccine. For example, the users in the following tweets were concerned about the side effects of the COVID-19 vaccine and the fact that it might potentially cause infertility, questioning the fact that this was not being addressed:

What about the vaccine and the unknown about whether it could cause fertility issues in young women & men? Why is no one talking about this? #vaccine #fertility [13 April 2021]

I have a feeling that this #Plandemic #vaccination, among the foreseeable catastrophes, it will cause infertility (and even birth defects or recurring miscarriages). Unfortunately the #MainstreamMedia won't cover this! Only time will tell. #VaccineforSouthAfrica #COVID19 Woe! [29 Jan 2021]

6.3.2.5.2 Negative tweets

Cooper et al (2021:922) claim that national and global organisations providing COVID-19 vaccines and overall solutions to the pandemic, have a significant influence on public trust and acceptance of the COVID-19 vaccination. Given the diversity of the South African population, some variables must be addressed, so as to build public faith in a vaccine that is already cloaked in ambiguity and mistrust.

Furthermore, as reflected in the following tweet, there were Twitter users, who believed that the vaccine was a weapon designed by Western countries to wipe out the African population:

Trusting vaccines that are manufactured by the countries who are obsessed about cutting down the African population is like suicide mission #level5 #VaccineforSouthAfrica #cyril [4 January 2021]

@Lungah ___ People think the vaccine that is distributed in Europe and America is the same to what's going to be administered here in Africa. Well, it's not.#VaccineforSouthAfrica [12 January 2021]

6.3.2.6   Theme 6: Vaccine safety and efficacy

According to Kaplan and Milstein (2021:3), a safe and effective vaccine against the SARS-CoV-2 virus that causes COVID-19 has a high potential of preventing a COVID19 pandemic. The importance of a person's belief about his/her ability to execute a certain behaviour, such as being vaccinated, was discussed in Chapter 2: Section 2.2.2 and Chapter 4: Section 4.3.1. The thematic analysis revealed that users raised the issue of vaccination safety and efficacy in their tweets, most of which were neutral and negative.

The number of tweets related to this theme accounted for 8% of the total sample. The sample included 33.33% negative, 50% neutral and 16.67% positive tweets. As shown

in Figure 6.6, the following topics were discovered under this theme: (i) post-vaccine side effects; (ii) vaccines and variants; (iii) adverse events; and (iv) vaccination quality and production.
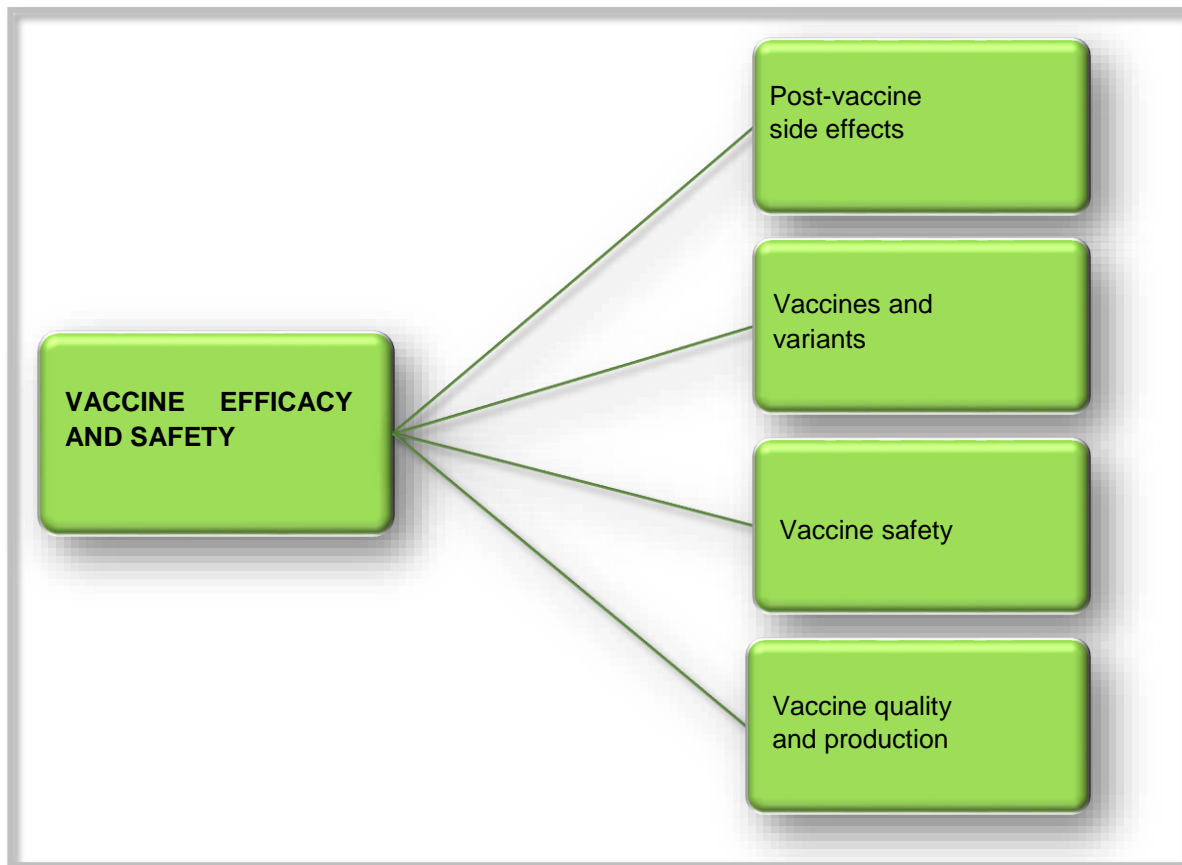

Figure 6.16: Topics under the theme of vaccine safety and efficacy (Author's own conceptualisation)

6.3.2.6.1 Positive tweets

In the sample, there were two positive tweets that expressed excitement over the vaccine roll-out under this theme:

QT @_HassanF: The Sisonke Program is approved! Thank you SAHPRA - now just ethical review, and we can start vaccinating!!! #VaccineforSouthAfrica #VaccinesSaveLives; Also, @SAHPRA1 - please share status now of all requested approvals. [12 February 2021]

Just had my AstraZeneca #vaccine. Thank you, science. [23 April 2021]

6.3.2.6.2   Neutral tweets

Most of the neutral tweets under this theme focused on the topic of adverse effects. Some users expressed anxiety in terms of what the side effects would be following vaccination.

> *A plea to those that have taken the vaccine, please do share the adverse effects you experienced. #VaccineRoll-outSA* [24 February 2021]

> *Reporting adverse events is a critical part of monitoring #vaccine safety once a vaccine has been rolled out to the broader population. @MRCza @PHMSA1 @adelebaleta @LindaGailBekker @nicd_sa @GautengHealth @WestCapeHealth @NorthWestDOH @kznhealth @nc_doh @echealthdept @ec_health2* [27 May 2021]

> *Officially in the row to get my covid vaccine. Nervous, to see how bad the side effects will be. Anyway, only one way to find out. Let's see how this pans out. #vaccinated #frontlineworkers #JohnsonAndJohnsonVaccine* [25 March 2021]

6.3.2.6.3   Negative tweets

Under the topic of vaccine quality and production, Twitter users shared opinions on whether the proper procedures were followed during vaccine production, whereas others implied that the procured vaccines were presumably of substandard quality and that the expedited vaccines were indicative of health authorities bypassing procedures. Examples are:

> *It cannot be denied that this vaccine is rushed. It was not tested if suitable for pregnant women and nor for children under the age of 6. #VaccineforSouthAfrica* [1 February 2021]

> *I rest my case with your government first they chow all the PPE money R500 billion and now they bring low quality vaccine.* [8 February 2021]

According to Trent, Seale, Chughtai, Salmon and MacIntyre (2021:7), one major hurdle to COVID-19 vaccination appears to be safety concerns, due to the fast development timeframe. Tweets under this topic also questioned whether the vaccine trial procedure followed the specified safety regulations. In a survey conducted by Boyon (2020:4), it was established that the most common reasons given by South

Africans for not taking the vaccine were concerns about its side effects (53%). The tweet below was one of many that comments on the feelings and expectations relating to vaccine safety and potential side effects.

Honestly speaking, I don't sit nice with this #VaccineforSouthAfrica #vaccine, something is off here. We need a cure, why take something but u still can get affected/spread #COVID19, we go to Dr to be cured, #vaccine for what?! [1 February 2021]

QT @DiePlaasPatriot: Thousands of reports of menstrual irregularities, reproductive dysfunctions, swollen testes etc following Covid vaccines I am more worried about the vaccine than I am about Covid; What the government is actually trying to say is that you must ensure that your medical aid, life insurance and funeral plan is up to date before going for the #CovidVaccine [26 Apr 2021]

As can be seen in the following tweet, this theme included tweets which included topics of vaccine production and quality, as well as uncertainty about whether the vaccinations would be successful in treating the variants in South Africa.

Tweet @SAfmnews: That vaccination that was once bought, which wasn't effective for South Africans from India, now if the country can manufacture and distribute to other countries, surely, they can conquer this new variant #COVID19 #CovidVaccine [5 May 2021]

Saze sathenga iFlaming Lamborghini of vaccines. Wena variant-effective, wena Not so much. Yhuuu South Africa. ☹ #FamilyMeeting #vaccineroll-outsa [30 March 2021]

6.3.2.7 Theme 7: Economic impact

This theme addressed the economic impact of the COVID-19 pandemic on South Africa, as well as the impact of government restrictions imposed to curb the virus's spread (Chapter 4, Section 4.3.4). According to (Dzinamarira et al 2021:5), effectively placing the COVID-19 vaccination's immediate economic advantages to the individual will likely impact their adoption of the vaccine. Under this theme, the total of Tweets accounted for 8.33% of the sample. Negative and neutral tweets each accounted for

37.50% respectively, whereas positive tweets accounted for 25.00%. In addition, three topics steered the sentiment under this theme, namely (i) the negative economic impact of restrictions; (ii) employment; and (iv) vaccines being key to kick-starting the economy.
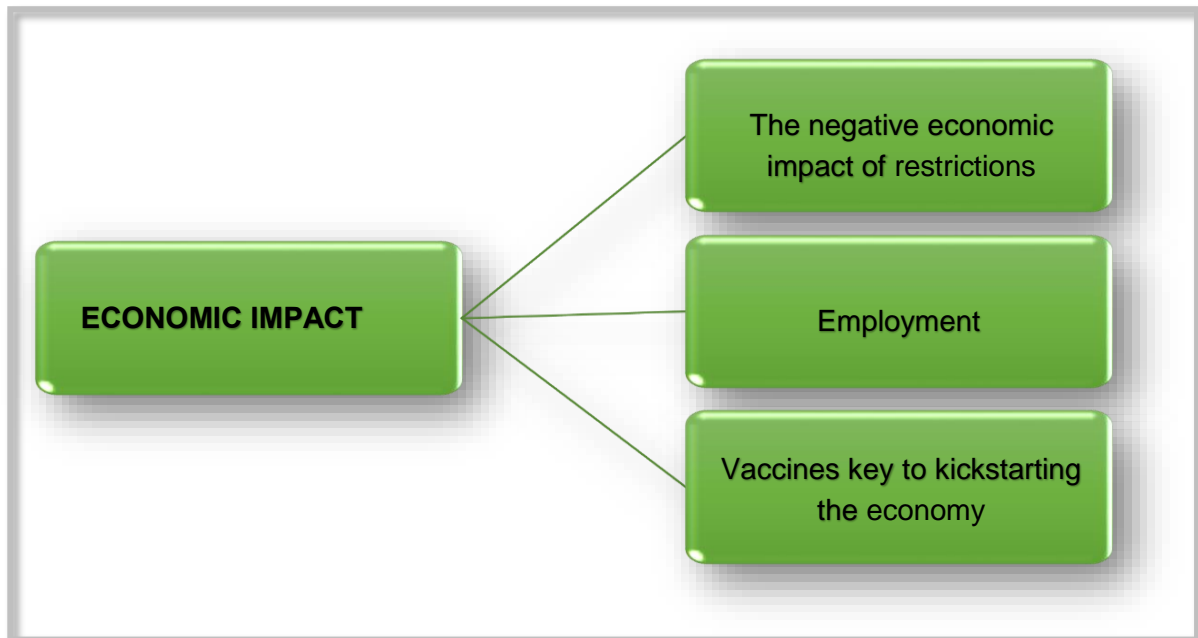

Figure 6.17: Topics under the theme of economic impact (Author's own conceptualisation)

6.3.2.7.1   *Positive tweets*

A small number of tweets were positive about vaccination and its economic impact, expressing delight, optimism, relief, and other positive feelings. According to Rodrigues and Plotkin (2020:12), a growing awareness for the economic impact of vaccinations is being included in the planning and evaluation of vaccine programs, possibly realising a higher value to society. Examples:

I have a mixed feeling(s) about it, it's a good thing but at the same time, our country is getting into more debt. Unless the process is not corrupted and we see it through seamlessly, then I will pat them on the back and say great job #COVIDVaccine [9 April 2021]

Our triumph over #COVID19 through the #vaccination programme could unleash an economic recovery greater than we might imagine @SiyabuyaSA's @MeleneRossouw [22 May 2021]

6.3.2.7.2 Neutral tweets

A number of users expressed a neutral opinion on the topic of revitalising the economy by persuading communities to be vaccinated against the virus that causes COVID-19.

We need to reach herd immunity, open our economy and kick-start our economic recovery. @DrZweliMkhize @ParliamentofRSA #VaccineforSouthAfrica [14 April 2021]

#Ramaphosa says Phase 2 of the #vaccination programme will start in the middle of May over 6 months. Registration will start in April. It aims at reducing the need for #lockdowns that impact the #economy and #education #COVID19 #FamilyMeeting [30 March 2021]

The impact of COVID-19 on the #cultural sector is being felt around the world. This impact is social, economic, and political – it affects the fundamental right of access to culture, Happy #WorldDayofCulturalDiversity. #StayatHome #ShareOurHeritage #ShareCulture #COVID19 #vaccine [21 May 2021]

6.3.2.7.3 Negative tweets

According to Chitiga-mabugu, Henseler, Mabugu and Maisonnave (2021:83), the COVID-19 pandemic devastated the South African economy – at a time when it was already under significant duress. Aside from the human tragedy of COVID-19, the tweets expressed concerns about the economic consequences of the pandemic. The majority of tweets were related to the negative impact on the economy.

QT @abelmike: Event and exhibition industry decimated; Re #VaccineRoll-outSA Tens of millions stayed home. Millions lost their jobs Tens of thousands lost their businesses. Tourism industry is on its knees Hospitality industry brutalised. Crippling unemployment levels 3rd wave coming @GovernmentZA STOP DITHERING #DoYourJob [18 March 2021]

We now don't have money for #COVID19 #CovidVaccine. Do you ever learn? Remember that billions we lost because of this stupid ban? @JacksonMthembu_ the listening gov. We can't afford to ban it again whether you like it or not. Like you would say #SAA is too big to fail. [5 January 2021]

6.4   Summary

The purpose of this chapter was to present and discuss the quantitative and qualitative research results and findings. The findings were specifically related to the insights obtained from the literature overview in Chapters 2, 3 and 4. The following chapter offers concluding remarks to the study, with recommendations for future purposes, based on the research findings.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1   Introduction

The primary objective of this study was to investigate COVID-19 sentiments on Twitter from January 2021 to May 2021, while the vaccine was being rolled out in South Africa. This chapter focuses on the conclusions of the study and includes suggestions for improving future roll-out strategies based on the research objectives and questions outlined in chapter 1 and the key findings presented in Chapter 6. Additionally, this chapter attends to the final RO of the study, namely:

RO4: To recommend guidelines for future vaccine roll-out strategies.

The chapter concludes by exploring the strengths and limitations of the study and suggesting recommendations for future research.

7.2   Research questions and research findings

Chapters 2, 3, and 4 explored RQ1: *Of which aspects does the theoretical foundation of this study consist?* Chapter 2 provided an overview of health communication and related issues, such as health communication campaigns and principles of health communication campaigns, among other topics, and revealed that health communication is a critical component of an effective public health system because it is thought to increase understanding of elements of individual and collective health, as well as the importance of long-term public health.This was followed by an investigation of social media, social media networks, and other essential concepts in Chapter 3 and found that social media is a powerful information platform which can be used by health authorities seeking to reach a specific audience with health information.

A review of the literature on theories that framed and supported the exploration of vaccine sentiments on social media was conducted in Chapter 4. The theories investigated in the review were the social impact theory, social cognitive theory, theory of reasoned action, and resource mobilization theory. It was discovered that the social impact theory proposes that social media users' offline behavior may be influenced by their online interactions with other users, whereas the social cognitive theory explains

why individuals acquire and sustain specific behaviors. The theory of reasoned action revealed that movement supporters, such as anti-vaccine campaigners, would work on internalised beliefs and feelings of individuals, initiating the emergence of movements.

Chapters 5 and 6 were devoted to answering RQ2 and RQ3:

RQ2: *What is the nature of vaccination sentiments raised on Twitter during the COVID-19 vaccine roll-out in South Africa?*

RQ3: *What are the key themes that were raised on Twitter during the COVID-19 vaccine roll-out in South Africa?*

Chapter 5 dealt with the research methodology adopted for the study. The positivist and the interpretivist research paradigm were explained and motivated. Data collection methods were applied and the collected data was analysed by using quantitative and qualitative approaches. In Chapter 6, the findings of the analyses were presented and interpreted. As per Chapters 5 and 6, the classification into negative, neutral and positive tweets on COVID-19 vaccines indicated that the majority (85%) of tweets from January 2021 to May 2021 expressed neutral emotions around COVID-19 vaccinations. Furthermore, tweets with neutral sentiments were the most prevalent during the entire period, and tweets with positive sentiments were the least prevalent during January, March and April of 2021. Between February and May of 2021, negative and positive sentiments were relatively balanced.

A thematic analysis of 150 tweets (which were equally sampled from negative, neutral and positive tweets), between January 2021 to May 2021, on COVID-19 vaccines, revealed a total of 25 topics that were grouped into seven overarching themes. In descending order, based on the number of tweets, the *vaccine delivery and roll-out* theme had 37 tweets, which accounted for 24.7%. Four topics under the theme included appreciation of medical professionals, vaccination experience, proper storage and transportation of vaccines, and vaccine accessibility and distribution.

The next theme, *vaccine acceptance*, included 30 tweets, which accounted for 20% and comprised of four topics, namely; open to taking the vaccine, sharing vaccine experience, saving lives and vaccination is a choice.

The third theme, *government trust* had 29 tweets, which accounted for 19.33% with four topics, namely: the government is doing a good job, the government mismanaged the vaccine roll-out, doubting the real intention of the government and the government should account.

Misinformation and fake news, information on vaccine roll-out and communication advocacy were the three topics featured under the *knowledge of vaccines and vaccination information* theme. This theme comprised of 19 tweets, accounting for 12.67%.

Vaccine hesitancy was the fifth theme with 15 tweets accounting for 10% of the overall sample, and included three topics, namely; alternatives to vaccines, vaccine side effects and vaccines developed abroad. The sixth theme, *vaccine efficacy and safety*, totalled 12 tweets, which accounted for 8.00% and comprised four topics, namely: post-vaccine side effects, vaccines and variants, vaccine safety, and vaccine quality and production.

Finally, *economic impact* gathered the smallest number of tweets, accounting for eight tweets (5.33%). The topics included: the negative economic impact of travel restrictions, employment and vaccines are key to kick-starting the economy.

The last research question (RQ4) of this study was: *What guidelines could the NDoH consider for future roll-out strategies?* As this research question was not addressed in previous chapters, it necessitates particular attention in the following section.

7.3   Recommendations for future vaccination roll-out strategies

This study investigated the opinions related to COVID-19 vaccines on Twitter. The importance of vaccine hesitancy as a factor in the delay in acceptance or refusal of vaccination was highlighted. As such, the findings of the thematic analysis and the

themes and topics that were revealed guide the recommendations to the NDoH for future roll-out strategies.

7.3.1   Vaccine administration and roll-out

The theme of *vaccine administration and roll-out* revealed topics on the appreciation of medical professionals, vaccine accessibility and distribution, vaccine experience and proper storage and transportation of vaccines. Based on the findings under this theme, it is recommended that social media platforms, such as Twitter, are used proactively before and during the roll-out to communicate vaccine safety concerns among other issues pertaining to the administration of the vaccine. According to (Schaffer Deroo et al 2020:2458), the public should be informed about the rigorous testing and ongoing monitoring required by the vaccine approval process.

7.3.2   Vaccine acceptance

Under the theme of *vaccine acceptance*, the topic vaccination as a choice was noted. According to Schaffer Deroo et al (2020:2458), arguments based on freedom of choice may reflect mistrust of the medical community. Other topics that were revealed under this theme included sharing vaccine experience and saving lives respectively. Also under this theme the topic of being open to taking the vaccine was observed (see also Table 6.4.).

Based on these findings, it is recommended that the foundation for public acceptance is properly defined and established before a vaccine for a health threat is made accessible. Early public support for a COVID-19 vaccine is likely to benefit the health community, and it is critical to capitalise on that momentum to ensure quick, widespread vaccination adoption once it is ready (Schaffer Deroo et al 2020: 2459).

7.3.3   Government trust

Government trust came up as a prominent theme in the research findings. The theme included the topics such as: government is doing a good job; government should take accountability; government mismanaged the vaccine roll-out; and doubting the real intentions of government. Based on the findings under this theme, it is recommended that the NDoH uses sentiment analysis to build government trust through the

development of country-specific social media strategies towards vaccine roll-out efforts in future. As discussed in Chapter 6: Section 6.3.2.3, the success of any vaccination campaign hinges on the trust in vaccines and the institutions that administer them.

7.3.4   Knowledge of vaccines and vaccine information

Under the theme *knowledge of vaccines and vaccination information,* the topics misinformation and fake news, communication advocacy and information on vaccine roll-out were discovered. Based on the thematic findings, it is recommended that the NDoH should create a strong COVID-19 vaccination education campaign that uses both conventional and social media, with the emphasis on incorporating social influencers and addressing misconceptions (Schaffer Deroo 2020:2459).

The combination of conventional media with social media links to elements and aims of the RAMS model, which proposes a more holistic approach for communication by health institutions when dealing with communicable diseases (Chapter 3: Section 3.3) The COVID-19 roll-out strategy should include linguistically and culturally competent messaging to address recognised potential barriers to vaccination acceptance.

The NDoH should explore public opinion and sentiments towards COVID-19 vaccination and implement an effective vaccination promotion scheme in addition to supporting the development and clinical administration of COVID-19 vaccines. Furthermore, the NDoH should consider the utility of social media platforms in policy framing and implementation.

Furthermore, as described in Chapter 2: Section 2.3.4, the ACME model could provide value to future roll-out strategies. For its emphasis on integrating campaign concepts that, among other things, support communication practice in developing digital and social media in terms of information transmission, the ACME model would assist the NDOH in the planning of future vaccine roll-out strategies. This model also emphasises the need to *evaluate* campaign initiatives by combining the design and execution of these efforts.

7.4   Contributions of the research

This study sought to contribute to the larger vaccination community by addressing gaps in the knowledge of vaccine-related sentiments on social media, focusing on Twitter. The lack of studies on the research topic in a South African setting supports the importance of these research findings.

Chapter 2 contributes to a theoretical understanding of COVID-19 vaccine-related sentiments of Twitter users in South Africa, from January to May 2021, through the review of literature pertaining to health communication. Chapter 3 draws on important viewpoints about social media and the essential concepts regarding this discourse.

Chapter 4 draws on theoretical insights from various disciplines – such as the social impact theory, social cognitive theory, theory of reasoned action and the resource mobilisation theory – to develop a fuller interdisciplinary understanding of the use of social media by public health agencies, and Twitter users with different viewpoints on COVID-19 vaccines.

Chapter 6 fills important knowledge gaps by providing a snapshot of COVID-19 vaccine sentiments on Twitter between January and May 2021 during the COVID-19 vaccine roll-out in South Africa.

When the nature of COVID-19 vaccination sentiments was investigated, it was discovered that the majority of tweets were neutral during the research period. The thematic analysis discovered seven themes related to the COVID-19 vaccine roll-out in South Africa; hence, the study adds new insights into Twitter users' opinions on COVID-19 vaccines.

The mixed-methods methodology employed to analyse tweets on the divisive public health subject of COVID-19 vaccination sentiments offers numerous methodological advances. The research design adopted for this study provides an original method for investigating opinions on vaccine roll-outs in the South African context. In the course of the research, a purely quantitative sentiment analysis would have only examined the *prevalence* of COVID-19 vaccination sentiments on Twitter, without discovering

specific reasons for expressing them. Therefore, the adoption of a mixed-method approach via sentiment analysis and thematic analysis added richness to the data analysis.

Traditionally, research on attitude, perception and behaviour has relied heavily on procedures such as surveys, interviews and focus group discussions. However, such traditional techniques can be time-consuming in their data collecting operations (Liew & Lee 2021:3). Twitter contains publicly available data, which has offered an accessible and less expensive option for this study, without the requirement to survey in person, thereby conserving resources and time for this project.

Twitter is one of the most appropriate platforms for monitoring vaccination sentiments during roll-out strategies (Liew & Lee 2021:4). In this way, vaccine roll-out strategies could be adapted to ensure that misinformation is detected, responded to and limited, and that the implementation of vaccines is favourably received by Twitter users. Because Twitter users freely voice their opinions on social media platforms it could assist institutions such as the NDoH to gain insight into opinions that may affect vaccine acceptance.

The research findings of the study may be of interest to institutions in charge of vaccine uptakes, such as the Department of Health, regional health organisations, such as the Africa Centres for Disease Control and Prevention, global health organisations, such as the World Health Organization (WHO), and social science researchers.

The most significant contribution of this study is obtaining an understanding of COVID-19 vaccine-related Twitter opinions.

7.5   Strengths and limitations of the study

In this section, the strengths and limitations of this study will be discussed.

7.5.1   Strengths

This thesis has a number of strengths. Firstly, social media usage for advocacy of vaccine roll-out strategies in the context of South African health interventions has been

understudied and, therefore, this study addressed gaps in understanding how COVID-19 vaccinations are regarded by South African Twitter users during the study period. Secondly, collecting publicly accessible opinions on Twitter provides a means of analysing the nature of COVID-19 vaccine-related opinions on Twitter in South Africa.

Thirdly, except for Twitter users named in a tweet, all tweets were anonymised by paying close attention to the ethical aspects surrounding data collecting on social media. Apart from geographic location, this study was not concerned with personal attributes or information about social media users and, therefore, the tweets in the corpus were not linked to people who tweeted during that time.

The mixed methods approach through sentiment analysis and thematic analysis employed in Chapter 5 assisted in categorising, quantifying and analysing the various COVID-19 vaccine-related sentiments, thereby allowing the researcher to achieve the study's objectives.

Finally, this dissertation used an interdisciplinary approach to inform the overall research design by drawing on literature from public health and health communication, social media and communication theory. According to Brewer (1999:328) "… interdisciplinarity generally refers to the appropriate combination of knowledge from many different specialities – particularly to shed new light on an actual problem." By using this approach, it was possible to select and apply the most appropriate approach to integrate the different components of the study to investigate this complex issue.

7.5.2 Limitations

The study focused solely on one social media platform – Twitter. There are various social media platforms, such as Facebook and Instagram, where individuals discuss and express their opinions and sentiments. This study purposely focused on original and quoted tweets only, which, to a certain extent, limited the insights that were obtained. Although South Africa has eleven official languages, the study was confined to English tweets, highlighting a shortcoming of the current study. Furthermore, this study employed hashtag-based data collection, which favoured Twitter users who include the relevant hashtag in their tweets.

As a result, only tweets from people who had access to Twitter and used the hashtags were included in the research and examined. These tweets may not be representative of the general population. Another significant limitation is that the time frame is cross-sectional, which does not allow for the study to be repeated over a longer period of time.

7.6   Recommendations for future research

While this dissertation makes important contributions to the vaccine policy community, it also raises additional questions that are worthy of exploration in future studies. It is recommended that further research is conducted on a larger scale – not only on Twitter but other social media platforms.
In future studies, researchers can collect and analyse data from these platforms for a more rigorous study. Therefore, comparative studies that investigate COVID-19 vaccine sentiments on different social media platforms are recommended.

The study found varied sentiments of Twitter users on the COVID-19 vaccine. To account for these different vaccination sentiments reflected by Twitter user vaccination sentiments, the underpinnings that govern future roll-out strategies should be influenced by both theoretical and empirical advances from various academic fields.

Moreover, to gain a deeper understanding of the reasons behind the sentiments raised on Twitter, a larger sample of tweets should be analysed.

7.7   Concluding remarks

This study contributes to the emerging picture of COVID-19 related sentiments on Twitter in South Africa. The study shows that Twitter sentiment and thematic analyses can be leveraged by studying the varying sentiments during the roll-out of critical health interventions such as the COVID-19 vaccine. The monitoring and assessment of sentiments on Twitter and other social media platforms can be promising for public health emergency responses and planning of vaccine roll-outs. As such, health communication could be a key tool in understanding the opinions of social media users about vaccinations and ultimately vaccine hesitancy.

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