ASSESSMENT OF HEALTH INFORMATION SYSTEM ADOPTION: A CASE STUDY OF GHANA'S HEALTH SERVICE

by

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A thesis submitted to the College of Science, Engineering and Technology (School of Computing) in accordance with the requirements for the degree of Doctor of Philosophy (PhD)

in the subject of
Information Systems

at the

University of South Africa

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(October 2020)

DECLARATION

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ABSTRACT

Globally, health information systems (HISs) have improved healthcare delivery in developed countries, yet despite the proven benefits, their implementation in many developing countries remains fragmented, failing to take into account existing infrastructure or human and logistical resources. This prompted the researcher to assess the benefits of using HISs in state-owned hospitals in Ghana.

Using convergent parallel mixed method design, the study aimed to assess the HISs used in Ghana's teaching, regional, district and quasi-government hospitals, to enhance the delivery of healthcare services in resource-constrained environments.

Data were collected using questionnaires, interviews and observation techniques. In total, 80 healthcare workers (doctors, nurses, health information officers and administrative staff) from ten hospitals across the country's northern, middle and southern geographical zones, were purposively and conveniently selected. The data from the quantitative study were analysed using frequencies and percentages, while thematic analysis guided the qualitative component.

The findings showed that although all ten health facilities had different forms of HIS applications in place, minimal related training (mainly focusing on basic computer skills) was being given to healthcare workers. A notable benefit was the confidentiality of patient data, which were password protected. While deemed safe, the respondents acknowledged the need for more stringent user authentication. Another identified concern was that one HIS did not communicate with other internal HISs in the same hospital: the out-patient department, for instance, did not interconnect with systems in the dispensary or oncology, thereby impeding operations. While all hospitals in Ghana are regulated by the Ghana Health Service (GHS), data generated in one hospital cannot be accessed in another, meaning information is not easily transmitted, processed or stored elsewhere than where it is captured. Poor internet connectivity and electricity supply were also deemed to limit the hospital-wide use and adoption of HISs.

The researcher proposed a Revised Health Information System Framework (R-HIS-F) to effect the interoperability and integration of health data and services across all hospitals in Ghana, through the GHS cloud service. The proposed R-HIS-F was validated by GHS experts, and certified as benefiting healthcare workers and improving healthcare delivery in Ghana.

KEYWORDS: Electronic Health; Ghana Health Service Framework; Health Care Workers; Health Information Systems; Hospitals; Interoperability; Symbiotic Equilibrium

ACKNOWLEDGEMENTS

My sincerest thanks and appreciation to Almighty God, for with God nothing is impossible. Be thou my guardian and my guide and hear me when I call. Let not my slippery footsteps slide and hold me lest I fall.

I would like to express my sincere appreciation and gratitude to my supervisor Prof Alfred Coleman, whose invaluable and committed guidance with his dynamism, sincerity, motivation, continual support and supervision have led to the completion of this study. I also extend my heartfelt thanks to his wife Dr Mary Coleman for her acceptance, encouragement and advice during my discussions with Prof Alfred Coleman. I am especially thankful for their trust and belief in my ability to complete this research. Thank you for your friendship, empathy, great sense of humour and for building me up academically.

Special thanks also go to the Ghana Health Service for their support and contribution towards this research. I am also indebted to the participants in the ten selected hospitals for giving up their time irrespective of their busy schedules to make this research possible

I also wish to express my heartfelt thanks to my colleagues and friends; Messrs. Michael Ansah-Nyarko, David Aboagye-Darko, Emmanuel Freeman and Fidel Botchway for their encouragement, discussions and support.

I am extremely grateful to the entire Quist family especially my brothers and sister: Deputy Commissioner of Police, Mr. Isaac E. Quist, Mrs Winnifred Ansong and Rev. Daniel A Quist for their love, prayers, care and support. I will also like to thank Sandra Kotei and my sister-in-law Charity Okronipa for their support.

Finally, yet importantly, I am very thankful to my beloved husband Dr Richmond Okronipa and daughters: Alexandra K. Okronipa and Arianna M. Okronipa for their love, understanding, prayers, encouragement, continual validation, support to complete my thesis and for always believing in me. Nene thank you for everything.

DEDICATION

To God Almighty:

> Through all the changing scenes of life, in trouble and in joy; the praises of my God shall still my heart and tongue. O magnify the Lord with me and exalt His name. Whenever I was in distress to Him I called and He came to my rescue.

In memory of my late parents, especially my mother, Madam Theodora Armerley Laryea and Mr John Nii Noi Quist.

On behalf of my husband, children, brothers and sister, I furthermore wish to express our gratitude to Prof Alfred Coleman.

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ABBREVIATIONS

ANT	Actor Network Theory
BMC	Budget Management Centre
CPOE	Computerised Physician Order Entry system
CPR	Computerised Patient Records
CHPS	Community-based Health Planning and Services
DHMT	District Health Management Team
ECLAC	Economic Commission for Latin America and the Caribbean
EHR	Electronic Health Records
EMR	Electronic Medical Records
EPI	Expanded Immunization Program
ERP	Enterprise Resource Planning
FP	Family Planning
GEHIP	Ghana Essential Health Intervention Project
HIS	Health Information System
HMN	Health Metric Network
HMS	Health Management Systems
ICD	International Classification for Disease
ICT	Information & Computer Technology
IDT	Innovation Diffusion Theory
MHR	Medical Health Records
MTHS	Medium-Term Health Strategy
PHS	Primary Health Care
RHA	Regional Health Administration or Directorate
TAM	Technology Acceptance Model
UTAUT	Unified Technology Adoption and Usage Theory
R-HIS-F	Revised Health Information System Framework

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CHAPTER ONE

BACKGROUND AND ORIENTATION TO THE STUDY

1.1 Introduction

The increase in the use of digital and networked technologies has turned the world into a global village. Several organisations including health organisations are making huge investments in various information systems to enable them to work effectively in most countries. Among such technology is the Health Information System (HIS) which now forms an important aspect of every health system globally ((Mutale, Chintu, Amoroso, Awoonor-Williams, Phillips, Baynes, Michel, Taylor & Sherr, 2013). The HIS has been defined as an interrelated technology that facilitates the generation of reliable and timely patient health reports with the capability of analysing information inside individual health organisations and receiving data from other systems within the wider national health organisation (Mutale et al. 2013).

According to Park, Sung and Cho (2015), HIS is currently accepted for use in health organisations due to its minimal rate of failure in terms of operations and service, delivery of accurate, reliable and timely information which aids decision-making. Secondly, HIS enables the analysis of information to generate reports as evidence to justify why certain resources are allocated to particular sections of the same organisation and why there are fewer investments in others. The two proposed strategic health plans currently being spearheaded in Ghana as the Ghana Essential Health Intervention Project (GEHIP) need careful attention in terms of strengthening HIS acceptance that could promote interactive operations with other systems in Ghana (Mutale et al. 2013). The first plan of the GEHIP strategy suggests that every district should have a system in place that retains information (electronic) as part of the district's health management information system to facilitate information sharing, planning, and retrieval. The second strategy suggests that a District Health Planning and Reporting Toolkit should be made available to management in the health sector to promote the identification and allocation of resources. Although plans and suggestions have been made regarding the acceptance of HIS in the health sector globally, some hospitals in Ghana are still lagging in terms of the acceptance and use of such systems.

Lippeveld, Sauerborn and Bodart (2000) suggest that HIS is essential to the stability of the health sector in developing countries. However, the lag in the acceptance of HIS by the health sector in certain areas in Ghana has a threefold challenge: (i) the complexity of the HIS, (ii) the

readiness of the health organisation, and (iii) financial issues. Furthermore, the role of employee perception of HIS has not been investigated.

Park, Sung & Cho (2015) suggest that the role of employee perception of HIS is a critical aspect for its effective use in the delivery of health care services. According to Robbins (2009), employee perception can be referred to as how employees arrive at meaning concerning their environment through the interpretation of their sensory impressions. Park, et al. (2015) suggest that understanding employee perception of HIS is essential for its successful use. Reason is the management of health institutions seeks to accept technologies that will enable employees to work effectively for the promotion of organisational success. Noticeably, when management deploys technology that cannot be used by employees, the organisation will be susceptible to failure because its success depends on how effectively employees maximise organisational resources. Hence, the purpose of this study is to examine the role that employee perception plays in HIS acceptance in Ghana.

1.2 Problem Statement (Ghana Health Service)

According to Wager, Lee and Glaser (2017), the provision of quality health care is based on two critical factors; namely, information that the health institution possesses about a patient, and the medical skill and knowledge that the health practitioners possess. Lenz and Reichert (2007) suggest that health care activities and successes are dependent on the level of communication and collaboration among health practitioners. This is why, there is a need to design and accept systems that will enable health organisations to easily access reliable, accurate and secured patient health records so they can make quality decisions concerning the appropriate medical service each patient requires. The HIS is specifically designed and developed for this very purpose in the health industry, as this technology enables health institutions to easily access patient records and information to make those quality decisions concerning the best health care service a patient should be given. These authors also assert that this is due to the minimal rate of failure in terms of operations and service delivery recorded by health institutions that utilise such systems. This is because the information produced by HIS provides reliable and timely information which aids decision-making. In addition, HIS can analyse information and generate reports to serve as evidence that justifies what resources in the organisation are allocated to certain sections and why there are minimum investments in others. However, the use of such systems to enable service delivery in Ghana is lacking in some rural and remote hospitals. Therefore, to ensure quality health service delivery in the health-sector, the Ghanaian governing bodies have mandated hospitals, clinics, and other health

institutions to provide professional health care services to Ghanaian patients as well as foreign patients. Also, hospitals provide quality health care delivery services to Ghanaian security services like fire services, immigration, and prisons. These hospitals, subsequently, need to keep a records department to ensure that the information on patients is secured and accessed in a folder and card format. However, this manual filing system is inconvenient at hospitals since retrieving records is cumbersome and slow; and patients are obliged to queue for hours before they are attended to by the doctors. Other hospitals use computerised systems in the daily running of their activities. Nevertheless, if the design of such systems does not address key procedures and activities that occur in hospitals there might be a case for HIS assessment and re-implementation by health institutions in Ghana.

The problem is, despite the benefits of HIS in many developed countries, the challenge for HIS is that it has evolved in a haphazard and fragmented way in many developing countries, including Ghana. These haphazard implementations and fragments of HIS have emanated from economic, legal or donor pressure from an external source. This current obstacle is further aggravated by the fact that available health data is often divided between several different ministries or institutions and further fragmented by disease-focus; often associated with diseases such as malaria, HIV/Aids or tuberculosis. This fragmentation of data problem has contributed to multiple parallel demands for information, thereby stretching the available resources (including human resources) beyond their limits. The concerns for overburdened Ghanaian health workers is the demand for too many reporting requirements from the current information system and subsystem considering that it is poorly coordinated. Furthermore, despite large volumes of data being collected by various health subsystems in Ghana, only a small portion is synthesised and used in the country. Ideally, it should be one system that has the capacity to deliver data that is accurate, timely and complete.

Problems/Issues/Lapses of the Health System That This Research Seeks to Address

A critical question in the effective health delivery is, what the current level of performance of HIS at the national and regional levels are for developing countries. The general response to the above enquiry is that a greater majority of HIS found at the national and regional levels of developing countries are performing below-average rate of success (AbouZahr & Boerma, 2005; Braa, Monteiro & Sahay, 2004; Lipperveld, Sauerborn & Bodart, 2000; Stansfield, Walsh, Prata & Evans, 2006).

The challenge is, as mentioned above, despite the benefits of HIS in many developed countries, the HIS has evolved in a haphazard and fragmented way in many developing countries including Ghana, this is aggravated by the available health data being divided between several different ministries or industries and further divided by disease-focus (malaria, HIV/Aids or tuberculosis). This causes many delays in information delivery which consequently overburden Ghanaian health workers through poor coordination of reports that lead to failure to deliver timely, accurate or even complete documents. Moreover, despite the large volumes of data collected by different subsystems in Ghana, only a small portion is synthesised and used to benefit the country as a whole.

Therefore, the purpose of this research is to conduct an assessment of the Health Information System in the Ghanaian Health services in terms of the following aspects:

- The fragmented sub-health systems in Ghana's health service
- The data quality
- The timely reporting and feedback from HIS
- The efficient use of information generated from HIS
- The relevance of HIS

Based on the findings from the assessment, a recommendation and a proposed framework was developed to assist the health care professionals in the efficient use of the HIS.

1.2.1 Research Questions

The main research question is:

RQ1: How can Health Information System (HIS) assessment be utilized for the purpose of enhancing delivery of health care services in resource constraint environment in Ghana?

To answer the main question, the following sub-questions are posed:

RQ1a: What are the current weaknesses and strengths of Ghana's HIS?

RQ1b: What are the ideas, concerns and expectations of health workers in Ghana in relation to regional HIS for administrative and clinical support?

RQ1c: How can the identified outcomes of the HIS assessment be used to compile a strategic HIS Framework for administrative and clinical work processes to support hospitals?

1.2.2 Research Aim and objectives

The aim of this research is to assess the health information system used by hospitals (Teaching, Regional, District and Quasi-government Hospital) in Ghana for the purpose of enhancing the delivery of health care services in resource constraint environment.

The objectives of this research are:

1a.To assess the current weaknesses and strengths of Ghana's HIS

1b. To assess the perception and ideas of doctors, nurses, administrative and health information professionals' on the usage of HIS for administrative and clinical work process

1c.To utilize recommendations of health workers to propose a strategic HIS Framework for administrative and clinical work processes to support hospitals

1.3 Literature Review

The literature comprises two aspects; research on Health Information Systems and the theoretical framework underpinning the study.

1.3.1 Literature on health information systems (HIS)

The HIS is now an important element in health delivery as it forms the basis for creating very accurate and good-quality data as well as providing a solid foundation for a better health system. According to the World Health Organisation (2007), the HIS aids organisations in health services to integrate several important processes such as the collection, processing, and reporting of relevant information needed to improve the efficiency and effectiveness of management across all levels of the health system.

The HIS can be grouped into two main categories: administrative/statistical as well as clinical functions. The main difference that exists between these categories is how data is used. In terms of the clinical function, the data generated is normally connected to a specific patient through a name or unique personal identifier. The fact that information on each patient forms the basis for every decision in the delivery of health service means that the demand for accuracy and correctness is generally very high. However, when it comes to the statistical function, the data is separated from the patient information and decisions on individual patients are often not made based on this available data or information. As a result, the level of accuracy and correctness is relatively lower compared to the clinical function of the HIS. Therefore, among other aspects, the extent of the usefulness of the data depends highly on the definition and how codes are compared in relation to their usage. There is a need to avoid the possibility that data

generated under the administrative/statistical system may not be linked back to the patients again.

The clinical aspect of HIS comprises two main features as follows:

- A clinical database that enables such data to be connected precisely to a specific patient;
- An evidence-based decision support and expertise system that provides the clinician with the latest critically reviewed scientific information or a support and expertise system that is based on evidence scientifically reviewed for the benefit of health professionals;

The administrative/statistical function of the HIS comprises three main features as follows:

- A reporting system for the business function in which information on production and the usage of services are provided to aid the benchmarking process and also assist management at all levels including the local, regional and national functions. This is referred to as 'health care statistics';
- An information system on epidemiology that holds relevant information such as the rate of spread of diseases, health hazards, health conditions, and also acts as an early warning mechanism and disease surveillance system;
- A system of quality control/assurance that guarantees a high-quality health service delivery to the population.

These functions are illustrated in Figure 1.1. below.

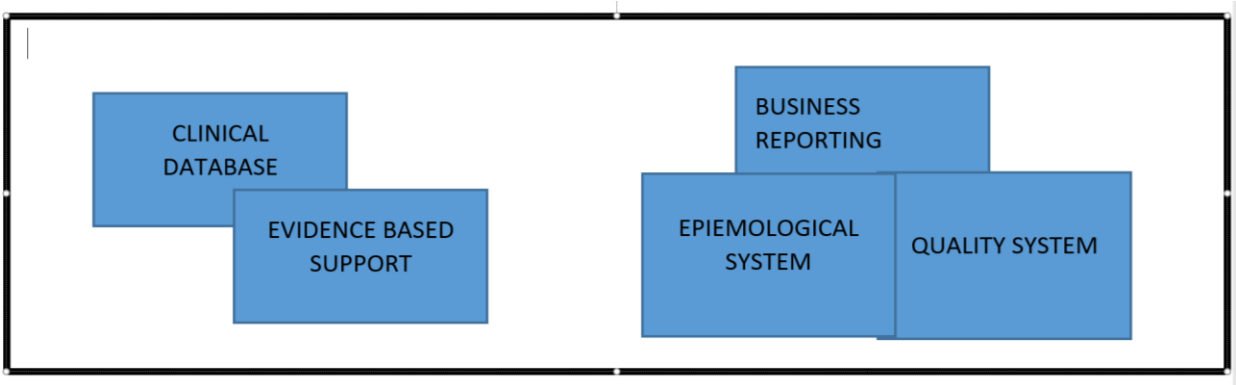

Figure 1. 1: The clinical and administrative functions of a HIS and its five elements.
Source: Wager, Lee & Glaser, 2017

It should be noted that several subsystems exist under the five main elements and these subsystems are connected in complex ways.

The next section discusses the research methodology used to attain the research objective. This study adopts a mixed-method approach involving qualitative and quantitative methodology in a single study to achieve the objectives.

1.4 Research Methodology

The first part would comprise the use of quantitative approach to assess the perception of stakeholders who are involved in the process of HIS management and planning. The main instrument to be used under this approach is the survey questionnaire after it has been validated. The validated questionnaire is then distributed among health planners and managers of the HIS.

The qualitative stage of the research comprises an in-depth and thorough assessment of the different facets or parts of the HIS. The assessment was based on the WHO affiliated health metrics network used in evaluating developing countries' HIS (the research method employed was a case study). Data collection mainly comprises documents analysis, literature review and the interviewing of relevant stakeholders who plan and manage the HIS. Collected data was analysed and interpreted to establish the real and prevailing picture of Ghana's HIS. The findings of the case study form the basis for the determination of the weaknesses and strengths of the current HIS of Ghana. The comprehensive assessment thus provides an in-depth appreciation of the current situation of Ghana's HIS and the type of changes required to improve the health system. Recommendations were made based on the findings for possible reforms in both the health system and more specifically the HIS.

Creswell (2009) indicates that mixed methods in health information systems have gained popularity in recent times due to the complexity of issues addressed by researchers in the social and health sciences. In this study, a mixed-method (between methods) approach was employed which combined both quantitative and qualitative. The two main approaches in designing the mixed methods (between methods) for this study are concurrent/simultaneous and systematic/sequential approaches. The concurrent/simultaneous approach is executed when the researcher simultaneously collects both qualitative (subjective reality) and quantitative (objective) data. The systematic/sequential approach at a given point in time gathers either qualitative or quantitative data.

The quantitative method of research analysis of HIS informs the perspective of HIS planners and managers who are the key stakeholders in the health system. According to Cooper, Schindler and Sun (2003), research strategy involves using the survey questionnaire under the quantitative approach to assess respondents' thoughts, opinions and feelings about a study

topic. Surveys are designed in three basic forms which include longitudinal, cross-sectional and ad-hoc. Ad-hoc surveys are designed to address specific issues or areas of empirical investigation by collecting data from one sample at one point in time. It is normally deployed when one wants to address a particular research need. Cross-sectional surveys gather data on a cross-section of characteristics to make inferences about a population of interest at one point in time. A longitudinal study involves repetitive observations of the variables under study over a period of time.

Of the three survey designs, the cross-sectional survey is the most appropriate to achieve this study's objectives since the researcher seeks a cross-section of characteristics and perceptions of the relevant stakeholders who have experience and knowledge on the topic. Cross-sectional data (information from respondents) is collected using a survey approach by administering a structured close-ended questionnaire.

The most distinctive feature of qualitative research is its capacity to understand people's perceptions of their world. Myers (2009) also argues that the qualitative research method allows investigators to carry out studies on phenomena within the context of the participant's natural setting. Therefore, a case study as a qualitative data source is used in this study. Yin (2003) describes a case study as a type of study in which an existing phenomenon is empirically studied in its real-life context, particularly when there is no clear evidence between the boundaries of the context and the phenomenon of study.

In a case-study approach, the focus is generally on the identification of existing dynamics in particular settings. A case study approach helps to investigate why, how, and what questions the researcher has little control over in the present set of events (Moon, 2007). Case studies generally take several forms. Each form is deployed according to the investigator's goal and/or objectives for the study; namely: illustrative, exploratory, cumulative and critical. These are described below:

- Illustrative cases are of a primary descriptive nature. It uses one or two occurrences of an event to show what a situation is like, and is used to familiarise the readers with a common discourse on the case at issue.
- An exploratory case study is done before a large-scale investigation or research is conducted. The primary aim is to help the researcher identify the right questions and the type(s) of measurement before initiating the main study.

- An explanatory case study (cumulative) serves to collect information from multiple sources at different times and to provide an opportunity to question what, how and why a phenomenon occurs. It consists of a precise description of a case's facts, considerations of alternative explanations and a conclusion based on credible explanations congruent with the facts. The idea behind this kind of case study is to allow for more generalisation.
- A critical case study examines one or more sources either to examine a situation of unique interest with little or no interest in generalisability or to question or challenge a highly widespread or universal claim. It is useful for answering questions about cause and effect.

The explanatory type of case study was used in the design of the qualitative part of the study.

A population of any study, according to Babbie (2006:196) refers to the total number of elements out of which a sample of the study is selected. It also represents total elements that can provide information to the researcher. The research population of interest for this study were health workers in Ghana.

According to Holloway and Wheeler (2002:122), a sampling technique is based on the principle of access to detailed, rich and objective information in research studies. Participants were selected and tested using convenient and purposive sampling techniques on the construct under investigation. Firstly, the study adopted a purposive sampling technique for selecting the population sampling frame. According to Babbie (2006:189), purposeful sampling refers to a type of sampling in which selected elements accurately represent the study population. The researcher was interested in the adoption of health information systems in hospitals throughout Ghana. Due to a lack of time and resources, all the key players and users could not be examined. Identifying the sampling frame using a purposeful sampling technique has meant that all participants within the frame are qualified to participate in the study. This is because
they have the same or similar characteristics that can give information about the health information system. As a result, the technique of convenience sampling was applied to recruit 80 study participants.

1.4.1 Research strategies

This study adopts the mixed method approach which involves a blend of both qualitative and quantitative methodology in a single study to achieve the objectives of the study.

The first activity comprised the use of the quantitative approach to assess the perception of stakeholders who are involved in the process of HIS management and planning. The main instrument to be used under this approach will be the survey questionnaire once it has been validated. The validated questionnaire will subsequently be distributed among planners and managers of the HIS

The qualitative stage of the research comprises an in-depth and thorough assessment of all the different facets or parts of the HIS. The assessment would be based on the WHO affiliated health metrics network used in evaluating HIS in developing countries. The research method to be employed is a case study. Data collection mainly comprises the document analysis, literature review and interviews of relevant stakeholders who are experienced in the planning and management of HIS. Collected data is analysed and interpreted to establish the real and prevailing picture of Ghana's HIS. The findings of the case study determine the weaknesses as well as the strengths of the current HIS of Ghana. This comprehensive assessment of the HIS would thus provide an in-depth appreciation of the current situation of Ghana's HIS and the type of changes required to improve the health system. Recommendations made are based on the findings for possible reforms in the health system and more specifically the HIS.

1.4.2 Mixed method

The researcher's approach is to generally apply three methods: quantitative, qualitative, and mixed (Creswell 2009). A mixed-method approach is adopted in this research study which involves a combination of both qualitative and quantitative in a single study to achieve this study's objective. Firstly, quantitative research methods will be used to analyse the HIS from the perspective of HIS planners and managers who are the key health system stakeholders. Secondly, it will use a qualitative approach to assess all other aspects of the Health Information System. Creswell (2009) indicates that mixed methods have gained popularity in health information systems in recent times due to the complexity of issues addressed by social and health science researchers. This research explores the strengths of both quantitative and qualitative methods of research to address the above-mentioned research problems. Moreover, the combination of both quantitative and qualitative methods provides more insight than either form by itself (Creswell 2009).

1.4.3 Quantitative methods

Quantitative research is normally a deductive logic form of enquiry in which a theory is tested and or variables of study that can be quantified and analysed using statistical procedures. Thus, the method is supported by positivist and scientific paradigms (Creswell 2003). Once the research objectives are formulated and data collection procedures have produced the form of data, the degree of flexibility in the research design determines whether to adopt a qualitative or quantitative approach or both (Creswell 2014; Ritchie et al. 2014). The questionnaire in this study is used to survey ideas, concerns and expectations of HIS from doctors, nurses and administrative officers.

1.4.4 Qualitative research method

Myers & Crowther (2009) argue that the qualitative research method is a type of research approach that enables researchers to conduct phenomenon studies in the context of the natural environment of the participants. Various types of qualitative research approaches exist, including ethnography, case study research, and action research. Qualitative data sources include interviews, questionnaires, documents and texts, as well as the researcher's impression and reaction, observation, and monitoring of participants (fieldwork). Straub, Gefen and Boudreau (2004) argue that the use of the qualitative research approach gives HIS researchers a few methods and techniques that allows to a response to research questions on human-computer interactions.

Against the above background, this study employs both quantitative and qualitative methods. One of the most distinctive elements of qualitative research is that the research enables the understanding of people's perceptions of their world. Quantitative research on the other hand is driven by the numerical outputs and how to draw meaning or inferences from them.

By using a qualitative method, the researcher will identify the different attributes of best practices frameworks from both a subjective and objective context. This study will also consider the subjective perspectives of the individuals involved, as a result of their tacit knowledge of the context in which they operate. The objective perspective relates to explicit knowledge from the various bodies of knowledge accessed.

1.4.5 Case study approach

A case study was used as a qualitative source of data in light of the above background. Yin (2003) describes a case study as research in which an existing phenomenon is empirically studied in its real-life context, especially when there is no clear evidence between the context boundaries and the study phenomenon. The main focus of the case study approach is usually identifying specific settings with existing dynamics.

The case study approach assisted in the investigation of why, how, and what questions that the researcher has little or no control over in the present set of events (Moon 2007). This current study adopts a case study approach because of its suitability for exploratory and explanatory research. In this study, the research questionnaire will pose ' how' and 'what' questions which are appropriate for the case study.

1.4.6 Data collection

According to McNiff & Whitehead (2002) data for research studies can be obtained from several sources, although the author believes that the choice of data collection method must be appropriate to the study and must be collected to gather evidence to improve practice. The study also employs triangulation as Oates (2008:37) argues that triangulation (which refers to the use of more than one method for gathering data) enables the researcher to use different ways to study a phenomenon. Additionally, triangulation of data improves the richness as well as the quality of the data used in research studies. The present study for this reason uses document analysis, interviews, a questionnaire and expert reviews to gather the relevant data for the study

According to Stake (2005) and Yin (2003), several procedures or steps exist as far as the conduction of case study research is concerned. Creswell (2007:74) emphasises the relevance of Stake's (2005) procedure for the case study research. This study, therefore, adopts the Stake (2005) procedure. The approach is made of six main steps which are enumerated below:

- **Determination and definition of the research question:** The primary step of case study research involves the establishment of the focus of the study to guide the researcher through the study's duration.
- **Case selection, data gathering and techniques for analysis:** This stage involves the selection for an in-depth examination of either single or multiple cases. In multiple cases, each is treated as a single case, and the conclusion for each case can contribute to the entire study**.**

- **Data collection preparation:** Systematic organisation of data is very important since large volumes of data are generated from multiple sources during case study research. This ensures that the focus of the study is not lost in the process.
- **Data collection in the field:** This step involves the systematic and comprehensive approach to data collection to facilitate the discovery of emerging patterns and themes. Therefore, the researcher must critically evaluate the object of the case study and identify the causal element linked to the observed phenomenon.
- **Evaluating and analysing the data:** This step involves the examination of the data for interpretation by establishing linkages between the research object and outcomes based on pre-determined research questions. It is, however, possible for the data to be triangulated in case studies which strengthen the conclusion when the study employs multiple data collection and analysis techniques.
- **Prepare report:** This involves the presentation of the findings in a format that ensures the intricate issues are transformed into an easily understood format to make meaning independent of the researcher

1.4.7 Research population and sampling

A study population according to Babbie (2007,p.196) refers to the total number of elements selected from a sample for the study. The study population at the selected hospitals and clinics consists of hospital administrators, doctors, nurses, and health information officers. For the study sample, the researcher takes a selected element of interest from the population (Cormack 2002). The sampling strategy used in qualitative studies is generally motivated by the need to gain rich in-depth information (Holloway & Wheeler 2002,p.122). A purposeful sampling and judgment technique was used for selecting the participants from the population in this research study. According to Babbie (2007, p.189) purposeful sampling refers to the type of sampling in which selected elements represent the study population accurately.

Eighty participants, with eight participants from each hospital and clinic were selected; namely, administrative officers, doctors, nurses, and health information officers in the hospital/clinic. As indicated in Table 1.1 below, each category had two participants:

Table 1. 1 : Classification of Participants (n = 80).

PARTICIPANTS	**HOSPITALS**										
	Korle Bu Teaching Hospital	Tamale Teaching Hospital	Cape Coast Teaching Hospital	Komfo Anokye Teaching Hospital	Greater Accra Regional Hospital (Ridge Hospital)	Dunkwa Municipal Hospital	Police Hospital	Mamprobi Poly Clinic	The Trust Hospital	Agogo Presbyterian Hospital	**TOTAL**
Hospital Administrative Officers	2	2	2	2	2	2	2	2	2	2	N=20
Doctors	2	2	2	2	2	2	2	2	2	2	N=20
Nurses	2	2	2	2	2	2	2	2	2	2	N=20
Health Information officers	2	2	2	2	2	2	2	2	2	2	N=20
Total	8	8	8	8	8	8	8	8	8	8	N=80

Source: *The Researcher* (2018)

Table 1. 2: Criteria used to select 80 participants

Sampling method		Sample size	Justify sample size
Group 1*	Purposive sampling	20	Several different types of health facilities exist in the region and this includes preventative care institutions, hospitals and administrative offices. The hospitals and participants selected for this study span across the entire geographical region in Ghana and are representative of health managers. The study selected 80 health professionals and this was based on the fact that managers of the health facilities are in a hierarchical structure and are scattered across the region. The study thus used a purposeful and judgmental sampling procedure to select the key management positions directly linked to strategic management. The basis for the selection of the health managers is, therefore, their involvement in the planning and management of health service delivery within the Greater Accra region since they are very conversant with (HIS) for their daily routine tasks. Therefore, the justification for purposive and judgmental sampling is that selected health managers will give the required response about HIS to achieve the expected objectives of the research study. The various positions and tasks of the selected health managers are displayed in Table 1.1
Group 2*	Purposive sampling	20	They use HIS to store patient records hence they were purposefully selected.
Group 3*	Purposive sampling	20	They were purposefully selected because they use HIS to provide supportive services to the doctors and nurses. Furthermore, they assist management in decision making.
Group 4*	Purposive sampling	20	They were purposefully selected because they install the software and provide technical services to the doctors, nurses and hospital administrative officers.

	Sampling method	Sample size	Justify sample size
Data set/document 1*	Purposive sampling	Six different documents from each of the 10 hospitals. They include: 1. Data Management Policy document. Which are Policies regarding the verification, accuracy, completeness, quality and timeliness of healthcare data. 2. Policies, laws and regulations mandating public and private health facilities to report indicators to higher authorities. 3. National Health Information System policy 4. Standards and guidelines for RHIS data collection, reporting and analysis 5. Review and assessment policies for HIS 6. Policies regarding the acquisition of ICT equipment including new software	Justification: These are health documents that provide relevant information which are useful sources to generate ideas and followed up using survey questionnaires and semi-structured interviews. The reason for pursuing document analysis is to achieve a better comprehension of the HIS at the regional and national levels. In addition, it reveals the impact on the management and planning of HIS.

Note:*The total number of participants for this study was 80.

1.4.8 Data analysis techniques

It is necessary to process and analyse the research data in some systematic fashion so that trends and patterns of relationships can be detected (Polit & Hungler,1993, p.269). This study is analysed in two phases: Phase 1: Analyses of the case study; Phase 2: Analysis of survey

- **PHASE 1:**

  A case study uses an interview instrument for data collection. The procedure for this study's interview was as follows:

  - Approach the Research & Development Division of the Ghana Health Service and obtain permission to use their health facilities.
  - Approach the participants to obtain consent for the interviews.
  - Develop an interview guide to incorporate HIS resource, Indicators of heath, Source of Data, Data management, Data quality and Information dissemination assessment.
  - Request an interview area within or around the hospital for the interview.
  - Interview the chief information manager and health information system officer in the hospital.
  - A maximum of 60 minutes was spent with each chief information manager and health information system officer.
  - An additional group interview was conducted for the administrative manager (60 minutes for the group interview)
  - Interviews were recorded using voice recordings for analysis.

  Procedure for administering the questionnaire instrument:

  - Phone participants for an appointment.
  - Deliver questionnaire instrument personally to recipients.
  - Give recipients three to five days to respond and complete the questionnaire.
  - Completed questionnaires were collected by the researcher in person.

  Procedure for gathering documents:

  - Government policy on e-health
  - Organizational HIS policy and strategy
  - Implementation plan and standards adopted for HIS

- HIS evaluation policy.

The analyses of the case study was then undertaken to**:**

- assess the strengths and weaknesses of HIS application for administrative functions (data used to support management functions and general operations of the hospital);
- assess the clinical information systems which contain clinical health-related data used by clinicians.

There are several strategies for analysing a case study to report meaningful findings. According to Hancock, (2006), three methods are used in the analysis of qualitative data: narrative analysis, thematic analysis and categorical analysis. Despite their differences, these three methods demonstrate some similarity in their process of analysis and this includes repetitive accumulated data reviewed to identify patterns and themes that are recurring.

This research used thematic analysis as the main data analysis tool to interpret gathered data. The data from respondents were repeatedly analysed and organised into themes that emerged and presented in a form of descriptions or diagrams.

- **PHASE 2:**

The second phase investigated health workers' ideas, concerns and expectations of HIS. The goal for the use of a survey questionnaire was, therefore, to examine the perceptions of the health care workers; namely, doctors, nurses and hospital administrators concerning the use of the Health Information System. The data obtained was statistically analysed using 'descriptive statistics' such as frequency tables, frequencies, means, standard deviation, percentage and tables. Descriptive statistics were chosen because it provided simple summaries about the sample and the observations that emerged from the data.

Table 1. 3: The analyses of case study & survey.

Phase 1: Analysis of Case Study			
Objective	**Data collection method**	**Data analysis tools**	**Data presentation format**
1. To assess the strengths and weakness of HIS application for administrative functions (data used to support management functions and general operations of the hospital). 2. To assess the Clinical information systems which contain clinical health-related data used by clinicians (in diagnosing, treating, and managing patient's care.	Case study Data sources: literature review, document analysis and semi-structured interviews.	The study will be analysed in two phases, hence phase one, and phase two. Phase 1: Analyses from Case Study To report meaningful findings, there are several strategies to analyse a case study. Hancock (2006) presents three examples of strategic methods: thematic analysis, categorical analysis and analysis of narratives. Although each of these strategies has its characteristics, all strategies have a common basic process. This consists of repeated ongoing analysis of accumulated information to identify recurring patterns, themes, and categories. This research uses thematic analysis to interpret the accumulated data through all data collection methods. Using this strategy, each new piece of information obtained will be examined to construct a tentative answer to each research question. The tentative answers are then	Diagrams, Narratives, Tables and Descriptions.

		categorised into themes and presented as descriptions or diagrams.	
Phase 2: Analysis of Survey			
3. To investigate health workers ideas, concerns and expectations of HIS.	Questionnaire – Survey (doctors, nurses and administrative officers, health information officers).	The survey questionnaire is used to examine the perceptions of healthcare workers (doctors, nurses, hospital administrators and health information officers) about the use of the health information system. The data will be analysed statistically using descriptive statistics, such as frequency and tables. Descriptive statistics are chosen because they provide simple summaries of the sample and the observations made.	Frequencies, means, standard deviations, percentages and tables.

1.5 Definition of terms

The following term used in this study is defined below:

- **Health Information System (HIS):** HIS is an interrelated technology that facilitates the generation of reliable and timely health reports and has the ability to analyse information related to health organisations and also defines the activities of other systems within the health organisation (Mutale et al. 2013).

1.6 Scope of the Study

The research focused on the Health Information Systems utilized by Ghana's public-owned teaching, regional, and district hospitals. The researcher was particularly interested in the perspectives of doctors, nurses, administrative and health information managers, and officers. The literature for this study was sifted via five major categories: the fragmented sub-health systems in Ghana's health service, data quality, timely reporting, and feedback from HIS, the efficient use of information supplied by HIS, and the relevance of HIS. The scope also included an assessment of Ghana's Health Information Systems, as well as the use of ICT tools by health professionals and the effectiveness of HIS in terms of its relevance, timeliness, confidentiality, accessibility, accuracy and availability.

1.7 Limitations of the Study

The following limitations are applicable to this study:

- Firstly, there is the inability to control the environment in a situation where respondents provide answers to interview questions. The ability of respondents to participate in the interview depended on how busy they were in view of their tight work schedule at the hospital.
- The second limitation of this research study is the fact that the framework developed for this study is yet to be tested in a real operational environment to determine its effectiveness and to identify areas of the HIS that can be improved upon at the various categories of health facilities. This could be attributed to the high cost associated with the implementation. Other projects exist in other domains in Ghana’s Health Service and therefore it requires some time and careful budgeting to implement the health information systems.

- Thirdly, another limitation is sampling bias arising from the use of purposive sampling. Sampling bias could have been introduced when extracting as much information as possible within a limited time frame, while simultaneously addressing the resource constraints.

1.7 Importance and contribution of the study

The significance of the study lies in its contribution to both theory and practice. In terms of the theoretical, the finding of the study provided new knowledge to fill the existing gap in the literature as far as HIS in Ghanaian hospitals is concerned. In terms of practical contribution, the findings of the study provided knowledge that can be applied directly to the improvement of HIS in Ghana. These are further explained in the following paragraphs.

The practical contributions of the study are as follows:

- The discovery of innovative ideas in HIS can be expanded to other health facilities in Ghana and possibly other developing countries.
- A presentation of validated Health Information System Assessment tool that becomes a template for the evaluation of HIS especially within the context of developing countries.
- A proposed strategic Revised Health Information System Framework (R-HIS-F). The proposed framework can be implemented as strategic reform measures for the improvement of the Health Information System of the regions and the entire country. The proposed R-HIS-F is the novelty of this study which can be adopted to assist the country (Ghana).
- This research has provided managers, researchers and students' insight into how assessment of HIS adoption by staff at Ghana Health Service can be conducted. It has enlightenened software designers and developers of HIS as to which aspects to lay emphasis on so that the acceptance of the system in hospitals can be increased. Further, the findings of this research can inform researchers and developers of HIS about the aspects of HIS that need to be improved and discussed to increase its acceptance in other African countries.

The theoretical contributions of the study are as follows:

- A report of documents on HIS research and practices in Ghana based on the comprehensive annotated bibliography;
- A good model that represents mixed-method approach involving the use of survey and case study strategies in a single study within the context of HIS research;
- A clear direction for future studies in the field of HIS within the context of Ghana which is a developing country;
- The findings of this research will inform researchers and developers on which aspects of HIS should be improved in Ghana and other developing countries.

1.8 Ethical considerations

Researchers are bound to uphold certain ethical principles and values in research (Willingham 2010). Several steps were taken in this study and these are as follows:

- **Ethical clearance.** Firstly, this was obtained from the University Research Ethics Review Committee (URERC) of the University of South Africa (UNISA) (see Appendix A).
- **Permission to access hospitals.** Secondly, permission from the Ghana Health Service Ethics Review Committee was sought for the selected hospitals used in this study. Thirdly permission was obtained from the ten (10) selected hospitals' heads/directors across the selected regions in Ghana (Greater Accra, Central, Ashanti, Northern, and Eastern) (see Appendix C).
- **Informed consent forms.** Fourthly, participants for the study signed informed consent forms and were then provided with a detailed summary of the study in areas such as aim(s), problem, significance and expected contribution. Clarity regarding the study was achieved when the researcher gave participants information on the benefits/rewards, duration, risks involved, privacy, confidentiality and voluntary right of participation. This meant that none of the respondents were coerced into the participation of the study, rather all respondents voluntarily agreed to participate in the study. Participants again had the option of responding to their questionnaires in their personal time. The researcher was available to resolve any challenges that arose and participants were briefed that they could withdraw at any time as there was no obligation to complete the questionnaire and no

vulnerable populations were involved. Participants were informed that the collected data will be kept confidentially.

- **Risk:** In terms of risk, there is no physical and psychological harm associated with the research. The only foreseeable risk of harm is the potential for the minor inconvenience as a result of the time commitment required to participate in the interview and questionnaire. All the participants were adults.
- **Privacy and confidentiality.** To ensure a very high level of confidentiality regarding any information provided, no contact details or identity was recorded. Answers were assigned code numbers or pseudonym and the data, publications, or any other methods of reporting the research, such as conference proceedings refer to respondents in this way. A password is used on computer captured data. Data was stored under lock and key, the personal laptop of the researcher utilised a pseudo name and password that could not be retrieved by a third party**.**

  The researcher has stored hard copies of the data collected from the study in a locked cupboard at UNISA Science Campus office no: 04-061, for future research or academic purposes, for a minimum period of five years. Future use of stored data is subject to further review and approval of Research Ethics, as appropriate. After five years of completion of the research, the data collected can be destroyed. Information gathered was used only for this research.

- **Voluntary participation.** Only those participants who read the detailed description of the study and understood what the researcher expected were included. In addition, only the participants who gave full consent to participate in the study were included in the research.
- **Withdrawal.** Participants were made to understand and to sign that they can at any point in time withdraw from the study if they feel uncomfortable. However, the only time such privilege ends is when the work had already been submitted for examination or had been published.
- **Declaration of conflict of interest.** Participation in the study is not intended to cause any potential level of inconvenience and/or discomfort to participants.
- **Compensation.** Participants did not receive any payment or incentives. They also did not directly benefit from participating in the study although the study indirectly benefits them

in terms of providing information that can be used to improve policies and support for Health Information Systems.

1.9 Quality Control/Assurance in the Protocol

Quality control and assurance are enforced in this research through the validity and reliability of the collected data. This is ensured through the data collection tools (questionnaire, scheduled document and interviews) triangulation methods and expert opinions to maintain credibility, transferability reliability, and confirmability to make qualitative research reliable and valid.

Triangulation is, according to O'Donoghue and Punch (2003), a 'method of cross-checking data from multiple sources to search for regularities in the research data'. Denzin (2006) has identified several types of triangulation. One type involves the convergence of multiple sources of data. Another type is methodological triangulation involving the convergence of data from multiple sources of data collection. A third triangulation procedure is investigator triangulation involving multiple researchers in an investigation. Two of the triangulation approaches cited above have been employed in this study. Multiple data gathering sources were used (convergence triangulation), and multiple (methodological) data gathering measures were used. The diagram in Figure 1.3 below shows the process of triangulation.

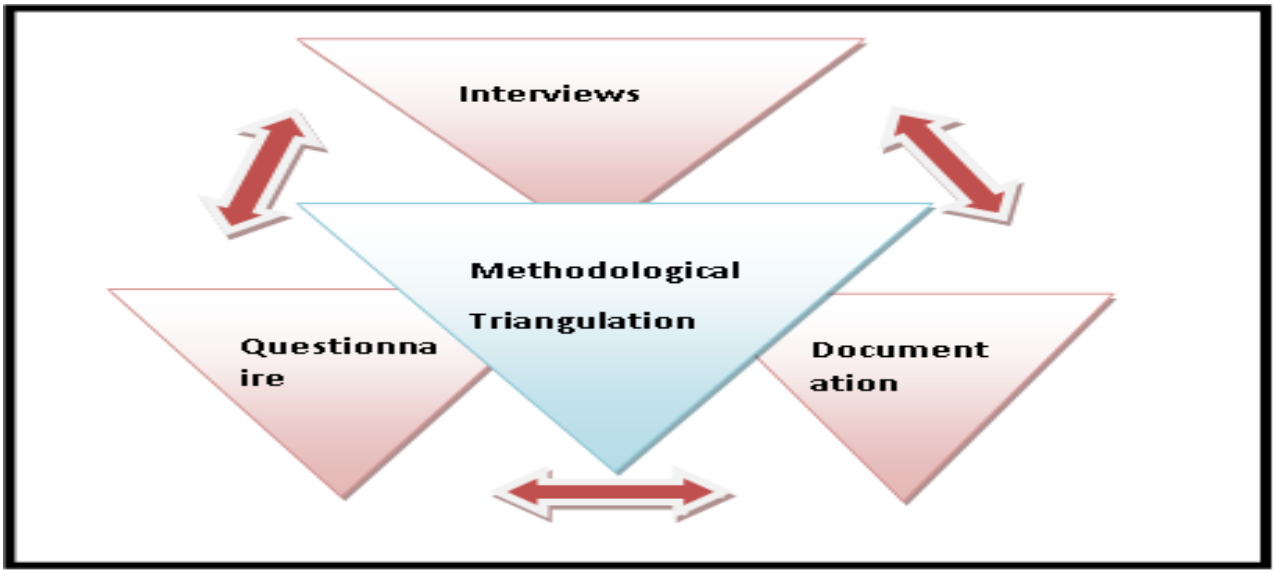

Figure 1. 2: Methodological triangulation diagram
Source: Fitzsimmons et al. (1997)

In this study, a methodological triangulation was used to collect data, including interviews, questionnaires, documentation and expert opinion support. In this mixed-method research, triangulation increases the credibility and validity of the research results.

1.10 Chapter outline

The study comprises seven chapters.

Chapter 1 is an introduction to the study and defines the existing problem, outlines the study goals, states the research questions and describes the study's significance and scope.

Chapter 2 deals with the literature review related to the study.

Chapter 3 presents a review of the literature under investigation, presents discussions concerning operational definitions and constructs as well as the theoretical frameworks adopted for the study.

The methodology adopted for this study is explained in Chapter 4. This includes the research strategy, data collection sources and method, data type as well as description of the analytical mode and data presentation.

Chapter 5 presents the research results from the data analysis and a summary of the discussion of the proposed Health Information Systems framework.

Chapter 6 is the final part of the study and presents the summary, reflection, completion of the research as well as the recommendations for the study.

1.11 Chapter Conclusion

This study evaluates the adoption of the Ghana Health Service's (GHS) Health Information Systems (HIS) as a case study. However, since little research attention has been done to assess the strengths and weaknesses of the HIS application for administrative functions, this study,therefore, investigates the strengths and weaknesses of the HIS application for administrative functions, more specifically the data used to support the hospital management functions and general operations. In addition, this study examines the health workers' ideas, concerns and expectations of HIS, as well as an assessment of clinical information systems that contain clinical health-related data.

Based on the above findings, a proposed strategic Revised Health Information System Framework (R-HIS-F) for improving hospital information processes and technology was developed was developed which can improve the daily routines of health care employees.

CHAPTER TWO

LITERATURE REVIEW RELATED TO THE STUDY

2.1 Introduction

This chapter contains an overview of the literature which is directly related to the research undertaken. Fink (2005) describes a review of research literature as a systematic, clear, and reproducible method for defining, evaluating, and synthesising the current body of completed and documented work by academics, scholars and practitioners. In this chapter, these general guidelines for conducting and producing a systematic review of literature guide the literature review (Fink 2005; Levy & Ellis 2006; Webster & Watson 2002). The purpose of these general guidelines was to study, review the literature and evaluate the literature in practice. It also involves a quality assessment, data collection, analysis and summary writing. Furthermore, the methodology for a systematic review of the literature needs to be documented in sufficient detail to allow for independent replication of the review results (Fink, 2005 p.3).

The analysis of the relevant literature aims according to De Vos et al. (2007) and Flick (2009), to contribute to a better understanding of the significance of the problem described, thus helping to reduce the risk of selecting outmoded or outdated knowledge. Potter (2008) recognises that the basis for such a report becomes an in-depth analysis of the work of other scholars.

Four areas of the literature review underpin this research:

- the topographic map of the health information system;
- the meaning and terminology used in health information systems;
- issues arising from health information management in developed countries; as well as
- research on health information systems in developing nations.

2.2 Health Information Systems

Healthcare Information and Management Systems Society (HIMSS) (2019) describes Health Information Systems (HIS) as computer systems that collect, store, process, communicate and display any health information, including records of medical patients. The World Health Organisation (2007) recognises Health Information Systems (HIS) as one of the six core components of the health care systems frameworks. Another five components are the provision of services, health care workforce, funding, medicines and technology, and leadership governance.

Health information systems (HIS) as set out by the World Health Organisation (2007) therefore, provide the basis for the generation of high-quality data that is a key building block for the health care system. HIS facilitates the collection, analysis, monitoring and use of the information required to enhance the quality and effectiveness of health care through better management at all levels of the health system.

HIS is divided into two main sections: the clinical and administrative/statistical sections. The difference between them is the way the data is used. In clinical practice data relates to a real patient by a name or a particular personal identifier and decisions on this patient is based on this. Consequently, there is a strong demand for the data's accuracy and consistency.

In the administrative/statistical portion of the system, data from the patient is no longer used in decision-making on specific patients. Therefore, the requirement for absolute correctness is not so strong. Rather, at this stage, the usefulness of the data depends heavily on meanings and the comparable use of codes among other things. Therefore, data from an administrative/statistical framework cannot be tracked back to the patient again. This idea functions as protection for the HIS data.

2.3 The History of Health Information Systems

Health Information Systems (HIS) can be traced back to the 1960s when they were known in hospitals as the 'information system'. These initial systems covered both administrative and medical functions, with a focus on billing and reimbursement of hospital activities. They managed appointments and provided stand-alone or ancillary services for individual hospital departments. They were developed to support manual procedures for the various disparate systems. However, it did not add value and functioning as a bonding element inside and outside the hospital.

Further development of health ICT came with the advancement of computer technology. The mini-computers debut in the 1970s marked the dawn of computer networks since they served as small mainframes. The interest in clinical applications increased during this period and such information systems were used to cut costs.

The 1980s saw the introduction of the personal computer which resulted in improved networking in the form of local and broad area networks. This period was characterised by increased use of personal computers, decentralisation of data processing and the expansion of hospital clinical

information systems. In the 1980s, two developments worldwide had a huge effect on how computer programs were used in hospitals: (i) The incremental transformation of payment schemes from a fee-for-service (cash and carry) basis to a fixed budget was one of the improvements; (ii) and the change in medical systems initially developed to simply automate existing processes into systems that support physicians, nurses and other health care providers in their daily activities.

In the 1990s, the new information technology was characterised by the World Wide Web, the growth of the Internet and the reduction in hardware costs. The health care organisations experienced growth of managed care during this period with the integration of delivery systems that took advantage of the internet and the wide range of HCIS products and/or services available. The adoption of the information technology for Electronic Medical Records (EMR) was, however, left behind due to lack of implementation.

The next decade experienced a call for health reform due to the great amounts of data being generated at this time. Health care organisations found it hard to extract meaningful information and struggled to implement EHR. Health care organisations sought to focus on analytics to deal with the data overload and this led to the resurgence of mainframe computers to handle wide-ranging business applications.

2.4 The Ghana Health Service: Background

Under Act 525 of 1996, the Ghana Health Service (GHS) was established as a public service body in Ghana, as required by the Constitution of 1992. The mission of the GHS is to provide and manage comprehensive and affordable health services with a particular focus on state, district, and sub-district primary health care in accordance with approved national policies. The GHS acts as an independent executive agency responsible for enforcing national policies through its board of directors under the supervision of the Health Minister. The self-governing nature of the GHS gives greater managerial flexibility in the fulfilment of its responsibilities. Its establishment forms an integral part of the core initiatives set out in the health sector reform process. The Medium-Term Health Strategy (MTHS) of Ghana outlines these measures and represents the steps required to build a more sustainable, efficient, affordable and responsive health care system. The reforms also include a sound organisational structure to extend the progression of the already assigned managerial responsibility to districts and hospitals. At the moment, the core themes of careful

management of scare capital, clear lines of duty and control, decentralisation and accountability for results rather than inputs remain relevant, as they were before reorganising.

2.5 The Organisational Structure of the GHS

The GHS structure is defined based on roles categorisation as stipulated by the Government of Ghana. This categorisation is based on either a functional or an administrative role with each having their own structure. The administrative classification includes the national, regional, and district levels. The national level has a 12-member governing body that oversees the overall running of the GHS. The Director General's offices and his deputy are assisted by the governing council, supported by eight national divisional directors. The different regions are headed by their respective regional Health Directors. The Regional Health Management Teams as well as the Regional Health Committees support these regional directors in turn. All districts inside the country are headed by Health Services District Directors. District Heads are supported by District Health Management Teams and District Health Committees as is the case at the regional level. In addition, Sub-district Health Management Teams are formed to provide additional support. In short, the functional classification consists of five levels. These are levels of the national, regional, district, sub-district and community.

2.5.1 Structures of Delivery of Services

Curative services are delivered at the regional-level. These services are provided at the regional hospitals and Public health services by the District Health Management Team (DHMT) as well as the Public health division of the regional hospitals. Regional Health Administration or Directorate (RHA) provides supervisory and management support for the districts and sub-districts within each region. District hospitals provide curative services at the district level, many of which are mission- or religious-based. Public health services are delivered through DHMT and the Public Health unit at district hospitals. The District Health Administration (DHA) provides its sub-districts with supervisory and administrative assistance.

The health centres offer preventive and curative services at a sub-district level as well as out-of-reach services within their catchment areas to the communities. Implementing a Community-based Health Planning and Services (CHPS) would be discussing essential neighbourhood and household level preventive and curative care for minor illnesses.

Figure 2.1.below illustrates the functional topology of the Ghana Health Service.

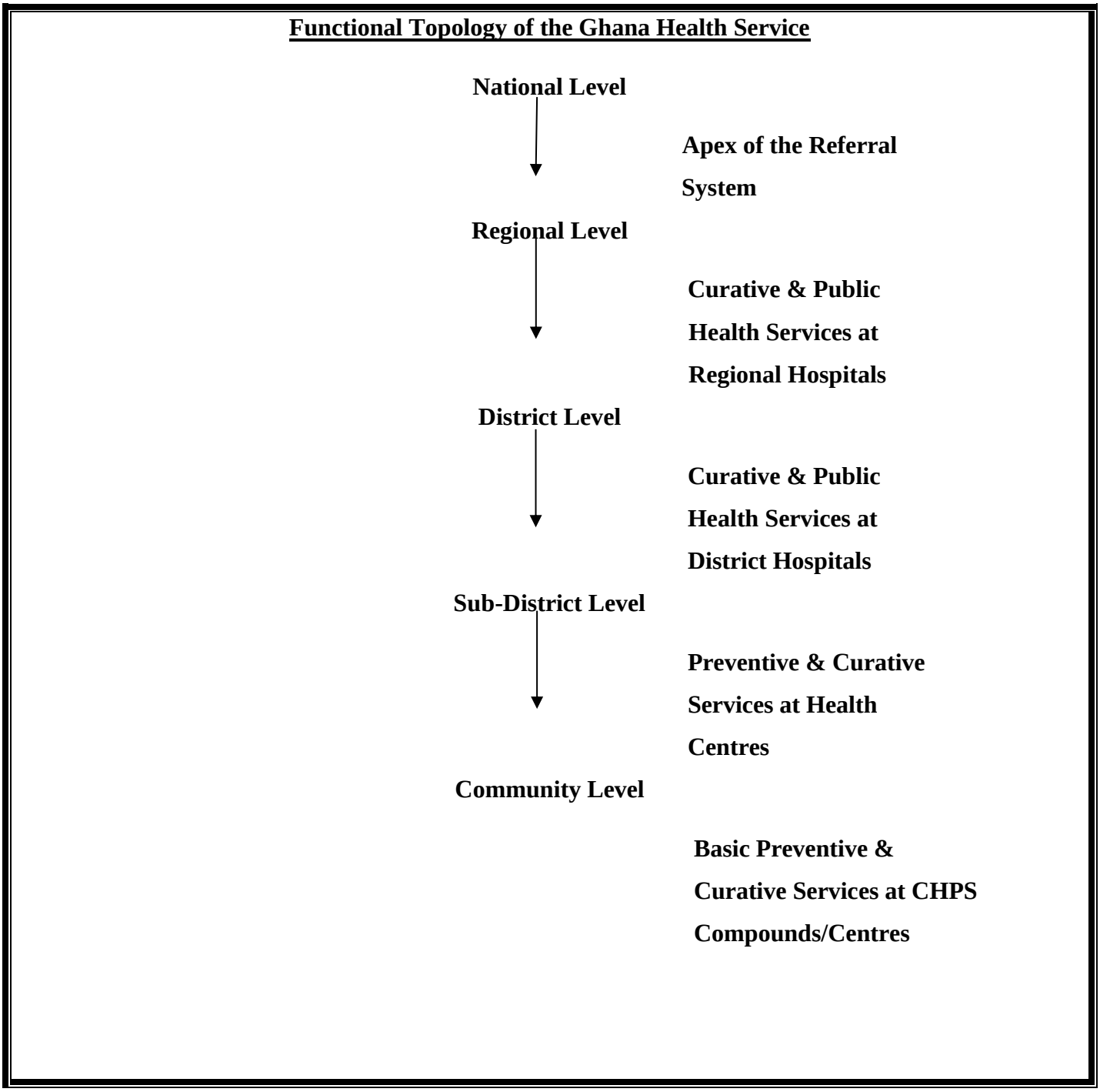

Figure 2. 1: Functional topology of the Ghana Health Service
Source: www.ghanahealthservice.org

2.5.2 Decentralisation and health sector reforms in Ghana

The start of decentralising reforms in Ghana's health sector is traceable to the 1978 Almaty Declaration. This declaration sought to provide primary health care (PHC) to every citizen's doorstep. This proclamation has since become the goal of many health care services around the world. The Harare Declaration, formulated in Zimbabwe in 1983, further underpinned this goal. The District Health Policy subsequently gained recognition as being able to deliver PHC as enshrined in the Almaty Declaration and was incorporated into the 1987 Harare Declaration.

The 1990 International Public Participation Conference in Arusha, Tanzania was a further step towards the decentralisation of the health sector. The conference was organised out of concern for the extreme degradation of human and economic conditions in Africa during the 1980s, the awareness of the lack of success in achieving popular participation, and the lack of full understanding of the role of popular participation in the process of recovery and development.

In addition, the 1993 World Development Report actively promoted the health reform movement with an emphasis on decentralization. Furthermore, a report by the World Health Organisation (WHO) identified decentralization of health system structures and management as a key issue for many countries in achieving 'health for all by the year 2000' as well as in developing primary health care.

In addition to providing the populace with equitable access to quality health care, the health reforms aim to increase service delivery efficiency as well as provide effective interventions. Furthermore, the health reforms are aimed at improving the quality of care and developing linkages with all partners and providers.

2.6 Benefits of HIS in Other Countries

For WHO, the importance for all health information systems is relevance, precision, completeness, timeliness and effective dissemination and disclosure of information (Lippeveld, Sauerborn & Bodart, 2000). Having quality information is not sufficient to justify collecting it until it is put to effective use (Aqil, Lippeveld & Hozumi 2009). Recognising the importance of timely and accurate health information, several countries have invested in systems that ensure comprehensive recording and monitoring of causes of death, patterns of disease and chronic health conditions.

Such registration continues to be developed globally in western countries and parts of Asia and is the most advanced. Several international initiatives for better-documenting health data in low-income countries are under way. There is a plethora of documentation on the successful journey of countries embarking on the adoption and continuous improvement of health information systems implemented to protect and promote the health of their citizens. Three decades ago, Malta acknowledged the need for a dedicated health information system. Such system was aimed at providing basic statistical and epidemiological information, conducting surveys and evaluating health programs (Gatt & Distefano 2019).

Zhao, Yan, Chen, Mao, Wang and Gao (2019) conducted a study to evaluate and design a public health information management system based on medical and health information for primary health care units in China. Their aim was to understand more accurately the role of information management systems in the primary care unit public health perspective. Results indicate that there are excellent management functions of the public health information management system established in that study. The functions include management of health records, child health, maternal health and elderly people's health. Moreover, both patients and medical institutions at grassroots level indicated high satisfaction with the system.

2.7 'Topographic map' of health information system

Nenonen and Nylander (2002) point out that there are two functions for any HIS. It consists of a clinical part and an administrative/statistical purpose. How data is used is the main difference between the constituents. The clinical module operates by connecting to a patient either by name or a unique personal identifier. Consequently, decisions concerning this patient are reached based on this information. Therefore, making the right decisions about a patient requires the data to be highly accurate and correct. It should be noted that the clinical modulus consists of two elements: the clinical database, and the system of support and expertise for evidentiary decision making. The clinical databases keep the patient's clinical data in order and ensures that this data is linked to that specific patient. The evidentiary decision to support an expertise system provides the clinician with the most recent critically reviewed scientific information from a patient. These two elements for the clinical modulus are shown in Figure 1.1 (see section 1.3.1).

On the other hand, data within the administrative component of the system is separated from the patient. Such data is no longer used in the decision making of individual patients. The usefulness

of the data in the statistical module depends heavily on definitions, comparable usage of code and the like. The data from an administrative/statistical system can under no circumstances be traced back to the patient again. This principle is also key to data security within a health information system. The system's administrative/statistical function as shown in Figure 1.1 (section 1.3.1) above, consists of three elements: business reporting, epidemiology information, and quality systems. The business reporting system provides information about the production and use of services for benchmarking as well as local, regional and national management purposes. This element has traditionally been referred to as 'health stats'. An epidemiological information system contains information on the incidence, prevalence and similarity of diseases or health conditions, living habits and health hazards. This system also serves disease monitoring purposes and early-warning mechanisms. Finally, the quality system ensures that the services bestowed to the population are of high quality.

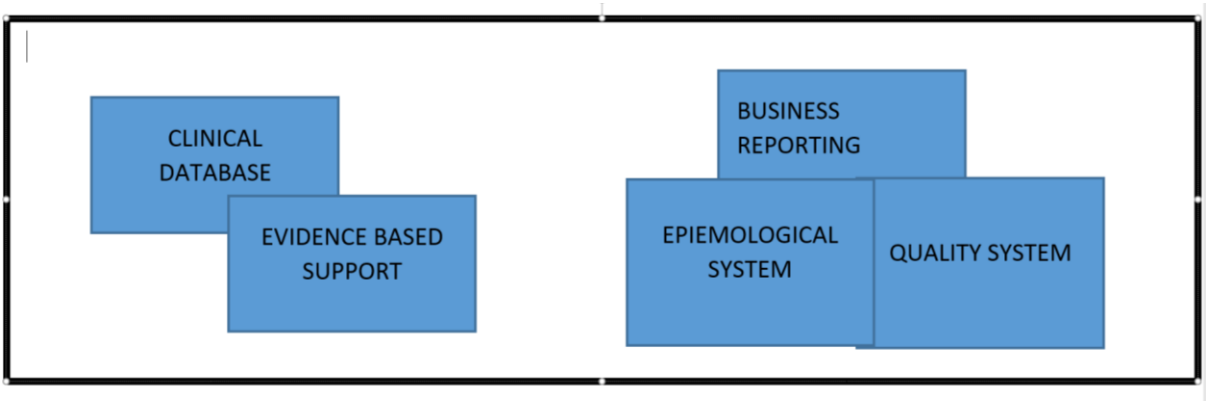

Figure 2. 2: The Clinical and Administrative part of a HIS and its features or elements

These five main elements are composed of several subsystems and are also interlinked in a complex fashion, as shown in Figure 2.2. It should be remembered that the base for feeding the knowledge to these subsystems are the clinical databases. The data collected is produced and stored in these databases and is used in clinical work during interaction between patients and health workers such as physicians, nurses, and the like. Additionally, some administrative information is collected for local use as well. Such administrative data is relayed with coded (e.g. ICD-10, ICPC, ICIDH2) clinical data to the administrative/statistical systems. Only for administrative/statistical purposes, data collection should be avoided as far as possible. The business reporting systems or

national health statistics were traditionally based on the causes of death statistics. Increasingly countries have developed either register-based or survey-based systems for hospital discharge statistics. As the health care focus moved away from institutional settings, these were extended to include outpatient treatment. The latest development in business reporting has been the interest in the economic side of health care (Organisation for Economic Cooperation and Development (OECD) 2000). This requires the inclusion of data about health-care personnel and equipment.

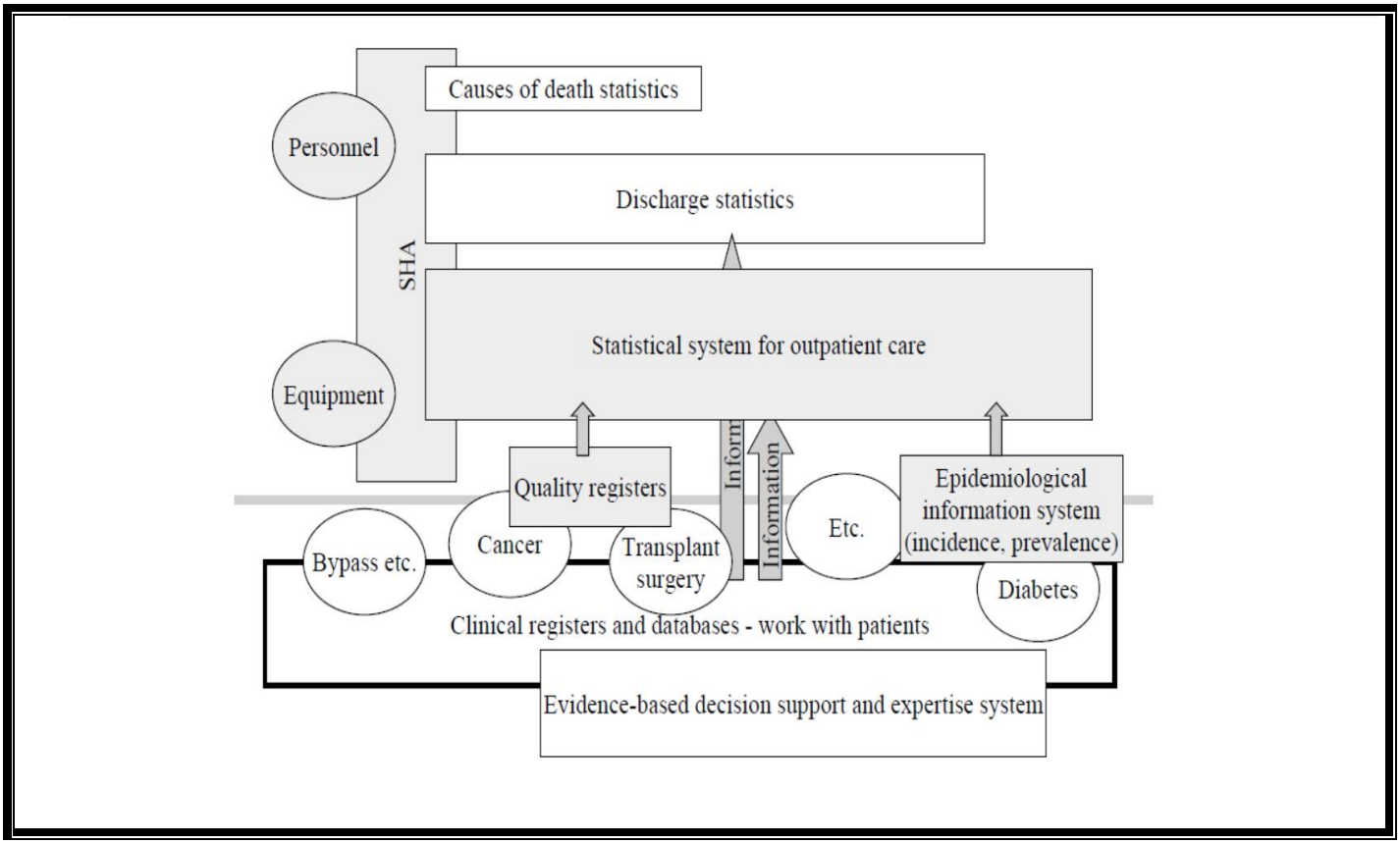

Figure 2. 3 Health Information Systems (HIS) components.
Source: Adapted from Papanicolas and Smith (2013)

The boundary between the (bottom) clinical and (upper) administrative/statistical structures is depicted as a line. Information at the patient level crosses the boundary in just one direction. (The Health Accounting System = SHA).

2.8 Main Sources of Data from Health Facilities

The key sources of facility data, according to the United Nations (USAID) Measure Assessment (2013), include individual patient records, family record cards, as well as admissions and discharge

registers. Ward lists and tally sheets, reports at a neighbourhood level, and reports of health services provided in non-health settings are also included. These key sources are divided into three classes, for the sake of simplicity. There are individual monitoring systems, including electronic medical records (EMRs), records from the hospital, and records from the community.

2.8.1 Individual record systems

The majority of the data obtained at health facilities is personal reports. The extent of such data must be kept to a minimum as the burden of data collection is on health personnel. All individuals require a card or file to document their health care provider contact details. This critical document includes crucial descriptions of the identity of the patient, as well as diagnosis and care obtained during all visits to the health facility. While some health authorities retain this type of record for each patient, others use a simple school 'copy book' for recording their data. Others capture data onto an electronic database as well. Individual patient management data is potentially huge and involves the careful implementation of data collection systems to ensure that only a minimum amount of data is transmitted to the next phase of the health care system. Such data gathering includes:

- Name, address, and other identifying features
- Clinical diagnosis, laboratory results, and diagnostic tests
- Prescribed drugs
- Earned money
- Health education and other information provided to the patient regarding possible risks and future care plans
- Preventive activities (e.g., Expanded Immunization Program (EIP), Antenatal Care (ANC), Postnatal Care (PNC) and the like) is undertaken
- Promotional activities (e.g. communication, change of behaviour, healthy lifestyle, nutritional education and the like
- Rehabilitation (e.g. prosthesis, rehabilitation of nutrition, physiotherapy, among others.)

2.8.2 Electronic health records (EHR)

The use of paper-based systems for collecting individual records is prevalent in the lowest to middle-income countries. As technology is improving and computers are becoming increasingly available, the use of electronic health records (EHRs) is becoming more frequent. Clinical care providers are increasingly collecting data from the beneficiaries

using computers, mobile phones and tablets to record data electronically. There are many obvious advantages, provided the necessary skills and expertise are readily accessible. The key benefits are set out below:

- Data is entered only once, saving a lot of time and trouble for personnel
- Ensures continuity of care, and reminds follow-up clients and service providers
- Improves quality of care through diagnostic algorithms and support from service providers
- Allows communication between the various medical and administrative units
- Facilitates coordination between clinical providers, pharmacies and laboratories to ensure that requests from clinicians are responded to swiftly and that results are fed back immediately
- Provides clients with health education
- Provides immediate diagnostic input to the computer by clinical care workers, especially for in-patient and hospital diagnoses
- Reduces the burden of completing data collection forms on health care workers
- Facilitates and speeds up facility reporting and system management processes
- The administrative functions such as billing and inventory control are directly linked to client care.

On the downside, deploying electronic health record systems requires advanced technology and networking skills. Moreover, maintenance service is seldom available, particularly at distant facilities in developing countries. Furthermore, there is the challenge of understanding and using the data collected. This challenge is often exacerbated by the temptation of increasing the volume and complexity of the electronic data collected. It must be emphasised that there is a need for qualified personnel to use these tools and resources for their training

2.8.3 Facility-based registry systems

These systems include admission and discharge registers, ward registers, and condition registers that require long-term follow-ups; namely, antenatal care, vaccination, family planning (FP), tuberculosis, or other chronic conditions. The details kept in the registers are the minimum required to provide a summary of the patient's care and to ensure follow-ups such as on vaccinations given, the FP method administered, and the treatment given for TB or HIV. In addition, the register also facilitates the compilation of indicators of periodic reports. This compilation of indicators is made

possible because data managers need only flip through the register to aggregate customer services, therefore, access to all of the individual patient records is no longer required.

Continuity implies a far greater quality of care than merely the number of services provided. Most priority program areas require continuity and should have registers that allow a nurse to observe immediately which patients have attended clinics as expected and who needs community monitoring or tracking. Regular review of the registry allows for the identification of patients who must be actively pursued to ensure:

- completion of immunization
- timely continuation of contraception
- full TB treatment
- regular monitoring and control of blood pressure.

While paper registers are very useful in ensuring continuity of care and in facilitating reporting, they are expensive to produce and require more effort to maintain effectively.

Hospital discharge data particularly is a specific form of the routine health care registry data. They are widespread and very useful for monitoring the quality of health services and for capturing treatment interventions. This source almost always includes individual records capturing different dimensions of individual interactions with the health service. Overall, the data comprise individual attributes such as age and gender, treatment, and interventions. Other attributes captured include cause of admission and cause of the discharge. All these attributes are often caught using the International Classification for Disease (ICD). Using the ICD nomenclature allows for a reasonable comparison between the information. This information is reasonably comparable though obviously dependent quality in the case of a patient dying in hospital and being assigned a cause of death based on ICD.

2.8.4 Community recording systems

The Primary Health Care Strategy embraced by most governments around the world calls for a twofold reorganisation of the existing health services system: (i) adapting health care delivery to community-level needs and constraints; (ii) involving and encouraging the population in planning and management of the local health services. This involves reforming health information systems

to provide a better understanding of community needs for health care administrators and providers, and the improvement of community involvement in collecting and using information.

Ministries of Health and non-governmental organisations have extended the classic methods of collecting data from health units to include community data collection for specific purposes. These goals include using such data collection to support other accessible community-based health services planning and tracking community-based health events. In addition, a data collection drive such as a register on births and deaths would generate representative data on the community's health status and living environment.

2.9 Definition and Terminology applied in Health Information System

Since its inception, the health management system (HMS) has undergone a significant evolution. This evolution is corroborated by Wang, Zhao, Dang, Zheng and Dong (2020) who compared the high-frequency medical subject heading (MeSH) terms in six countries during the period 1957 to 2016. Finally, they observed that publication hotspots in the field of electronic health records (EHRs) had shifted from issues related to the adoption of EHRs to the use of EHRs, which suggests that the structure of knowledge had become systematic.

The EHR can be considered as that which drives health care delivery and hence HMS. The EHRs provide a systematic and structured way to store information about a patient. A typical EHR consists of different data types such as demographic data of a patient (e.g. age, gender) and results of the laboratory tests (e.g. blood pressure, heart rate). In addition, an EHR includes a wide range of knowledge related to the status of a patient before, during and after they are admitted to the hospital. The extensive information stored in an EHR can repeatedly help improve health care services (Qu, 2020).

The proliferation of terminologies and their acronyms defining the subject area of health management systems is inextricably linked to their progressions. In addition, understanding the context in which such terminologies are used within a subject area requires definitions to remove any ambiguity about what information is being conveyed. Similarly, acronyms become vague and need to be clarified as to what they represent. For instance, the acronym DBA which stands for ‘Database Administrator’ in the context of information management could be understood as an academic qualification such as a Diploma in Business Administration. Terminologies and the respective definitions, in general, enable the language of a particular subject area to be

communicated with a distinctive character. It must be noted, however, that certain terminologies overlap and are used interchangeably for that matter, and may therefore cause confusion. Computerised Patient Records (CPR), Electronic Health Records (EHR) and Medical Health Records (MHR) are examples of such overlapping terminologies.

2.9.1 Data and Information

The Healthcare Information and Management Systems Society (HIMSS, 2019) defines data as 'factual information' used as a basis for reasoning, debate or calculation. Data such as a patient's laboratory test result is described as a source, raw, or atomic data when not processed for meaningful use. These are discrete entities (fields of data), which are objectively described without interpretation. A database structure comprises the smallest components making up data fields in which data are entered via data capturing and finally outflowing to data. Increasingly amidst the other building blocks are the cumulative complex data records and data files.

Furthermore, information is data that has been processed, organised, structured or presented in a given context in order to make it meaningful or useful. Inextricably linked to information is computer science which is essentially information science. Informatics is defined as studying any system's behaviour and structure that generates, stores, processes, and subsequently presents information. The information technology sector takes into consideration the interaction between information systems and the user. It also considers the construction of interfaces between the two, such as the user interface (HIMSS, 2019).

2.9.2. Definition of Systems

A system is a set of elements or components *(www.whatis.techtarget.com)* that are structured for common purposes. HIMSS (2019) describes a system as a combination of hardware and information processing software. As in any system, such as the Electronic Health Record system, the component hardware and software portions are integrated to work in tandem for desired results. Such a desired outcome could well be reported on the health status of a patient or group of patients or other characteristics of interest. Different types of systems exist and are employed in different industries to facilitate their operations. The Enterprise Resource Planning (ERP) and the Health Management Systems (HMS) are good examples of such. The HMS is an amalgamation of smaller and independent systems that fit into the overall management of health services. For example, the billing and electronic health record systems are both components of the HMS.

All of these systems are essentially information systems that guide decision-making to promote the performance of duties such as the provision of health care and the like at work. In essence, information systems consist of technical and human resources that provide storage, computation, delivery and communication of the information needed by all or part of, for instance, a company *(www.whatis.techtarget.com).*

2.9.3 Information systems

Information systems serve to process data and information in an organisation. Both manual and automated methods are an integral part of information systems. The various types of information systems are based on the customisation or category of use to which they are put. Information systems categories include health management systems, processing systems for transactions, decision support systems, knowledge management systems, database management systems, and office information systems.

2.10 Problems in Health Information Systems (HIS) in Developing Countries

The objective of health information systems (HIS) is to provide information. This section looks at the health risks and problems faced by emerging world health care systems in countries, nations, and societies that traverse the developing world. The health systems that encounter those problems are, however, grappling with insufficient infrastructure and capacities. Therefore, health officials must focus on maximising the potential of the available resources and seeking ways to make health systems operate as effectively as possible.

The only way to schedule, impact and calculate health interventions is to provide clear data on the success of various sectors of the health system. Successful improvement of health systems would require sufficient, reliable, and accurate information about health system performance itself. A hospital consists of separate organisational structures with various groups of health care practitioners, with different tasks. Often these units appear to be in very different hospital locations. A good example of this would have to be the doctor who takes a patient to a clinic who is then moved to a hospital. Each time the patient travels from one place to another, knowledge is recorded about his condition. This could lead to a lack of knowledge or double registration due to insufficeint communication between the various stations for the doctor, pharmacy, hospital and insurance. There is also a clear difference between the necessary information and the exchanged

information. Important patient information is also not available when and where it is needed, and therefore prolonging the whole process.

One way to reduce this challenge is by providing sound internal contact between organizational entities and health care professionals as well as access to other stakeholders such as insurance companies and general practitioners outside the system. This means switching from primary care to comprehensive treatment. By merging hospitals and individual practices into larger integrated health care networks, such integrated care can be realised. This is known as a decentralised health care delivery network which is replacing hospitals as the only care delivery centres (Bossert 1998). These improvements mean the current hospital information systems have taken on a much wider reach.

A study by the World Health Organisation (WHO) on improving health information systems recognises the need for quality health care in developing countries. It focuses on fighting poverty and hunger through enhanced health. Therefore, one way to achieve improved health is by the incorporation of information systems into health care. The WHO Secretariat has set its own goals for calculating health improvements and other developmental aspects; for example only some programs are successful in developed countries due to the obsolete available data which makes it especially difficult to determine patterns. Precise medical information is most needed in these countries which consequently calls for skills and experience in statistics, public health and biomedicine.

According to the WHO study, a multitude of institutions is haphazardly producing and using the knowledge. These departments include ministries of health, national statistics offices, as well as education, social security, planning, and finance ministries. Other institutions include the private sector, civil society, sponsors and organisations responsible for development assistance. Health information systems have evolved under logistical, economic, legal or donor constraints with an overwhelming supply of data and have been further disrupted by the demands of disease-focused services and the variety of donor criteria and foreign initiatives.

2.11 Factors Contributing to the Implementation of an HMIS

Many issues contribute to the effective implementation of an information system for health management. Several scholars have established these causes and the problems. Kuhn and Giuse (2001) suggest that appreciating technology in this case as an enabler and not a catalyst places greater emphasis on the significance of the people employed in these emerging types of information systems as well as their effect on them and, by extension, on the enterprise as a whole (Kuhn & Giuse 2001). To reinforce the claim of Kuhn and Giuse (2001) a project's success rate is 80% based on the developer's social and political interaction skills and 20% or less on the implementation of hardware and software technologies. The statistics put forward illustrates that the implementation of an HMIS is influencing many social and political problems.

The problems impeding the management of HMIS have been classified into six main broad headings as follows:

- Limited financial and infrastructural resources
- Development of health IT programs
- Incapacitating ambiguity, morals and authorised deliberations
- Absence of mutual interoperability ethics
- Absence of skilled personnel
- Regional and district incorporation.

2.11.1 Limited financial and infrastructural resources

Although workable electronic health systems are in place, developed countries face various economic and systemic barriers. The infrastructure needed to ensure successful implementation is limited and spread unevenly. Some of the typical difficulties encountered in developing countries are the intermittent availability of electricity as well as the low but very high cost of internet services. There may, however, be variations between different regions within the same country. In addition, in the case of private or public projects, the infrastructure may be very different. They are most evident in rural areas (Frazer & & Niehm 2004; Simba, Mwangu & Msamanga 2004).

Important systemic differences exist within the physical networks of the developed nations. These weaknesses are the result of high charges, the existence of topographical distribution and a large proportion of the rural population. The possibility of using cellular networks and the widespread

adoption of cell phones helps to address this problem. Cell phone penetration is becoming increasingly popular in developing countries (Lewis, Hodge, Gamage, and Whittaker, 2012). This development contributes to the possibility of implementing programs that could allow for fresh and innovative use of fewer resources (Barclay, 2009). For these purposes, mobile health (part of the wider area known as telemedicine) is effective in preventing the lack of adequate infrastructure (Asagansi & Braa, 2010). However, these solutions present new challenges, such as fragmented details and difficulties for the project.

Hardware procurement is another challenging issue. However, given Moore's legislation (Brock & Moore, 2006) the cost of hardware continues to decline. This proven prediction has enabled previously unattainable technologies to be accessed by developing nations., Increasingly, several governments are adopting policies aimed at reducing the digital divide. These programs include giving low-cost, portable computers to children. Uruguay's 'Ceibal' software, for example, has outperformed its millionth device delivery (*www.ceibal.org*, c2013). In addition, more than 3.5 million netbooks *(www.conectarigualdad.gob.ar, c2013)* have already been distributed through the 'Conectar Equality' program in Argentina. Rwanda has also distributed the largest number (210,000) of computers to children in Africa *(www.wiki.laptop.org/Go/Rwanda, c2013).*

The open-source movement enables resource-limited countries to use free software to implement HIS. One such framework is a proven, secure and efficient open-source object-relative database system, PostgreSQL. OpenMRS is another open-source application forum based on the data model of the Regenstrief Institute. This framework allows the development of personalised electronic health records (EHRs) with little programming experience (Mamlin, Biondich, Wolfe, Fraser, Jazayeri, Allen, Miranda, & Tierney, 2006; Mohammed-Rajput, Smith, Mamlin, Biondich, Doebbeling & Open MRS Collaborative Investigators, 2011). OpenMRS has therefore been implemented in many developing countries in Africa, Asia and Central and Latin America (Gerber, Huber, Doherty, Dowling and Ha, 2010; Fraser & Niehm 2004).

It is noteworthy, however, that there are potentially high direct costs for implementing the HIS. Consequently, to achieve such an objective requires long-term obligations to support such implementations. Donor funding for the HIS pilot phase is common (Gordon & Hinson 2007). However, alternative sources of funding are needed when looking for opportunities to scale up. Such funding can be difficult to obtain in resource-constrained nations where the e-health program

has to meet more basic needs such as food, health and education (Lewis et al. 2012). Accordingly, the World Bank (2006) advises that such network, hardware and software infrastructure limitations must be measured prior to the planning of the e-Health project in developing countries.

2.11.2 Development of Health IT Programs

A comprehensive national e-health program that addresses most of the issues discussed in this review is complex (Gerber et al. 2010). In recent years, the production of health IT programs has gained increasing interest. The United Nations, the World Health Organisation (WHO) and other international organisations have been promoting the need for health IT strategies to help build and accommodate IT projects (WHO 2012).

While large volumes of electronic data are collected worldwide, the dispersed information is not advantageous for high-quality decision-making. To be of perfect value, further development of HIS would require the introduction of consistent data ethics. This situation needs a strong commitment plan for the development of e-health (Giokas & Dennis 2005).

In developed countries, e-health systems have suffered from a lack of appropriate focus and distorted targets. A small number of them have, however, sufficiently powerful and successful HIS to meet all their diverse needs. Approximately 20 developed nations have worked together on health information development strategies. This initiative is supported by the WHO Health Metrics Network − a global collaboration established between 2005 and 2008 committed to the assessment and strengthening of the national HIS in the Eastern Mediterranean (Jabareen, Khader & Taweel, 2020).

Many developed countries have advanced e-health programs, including Canada, Australia and Denmark (Carnicero & Rojas, 2010; Deloitte Touche Tohmatsu 2008). The Economic Commission for Latin America and the Caribbean (ECLAC) has reviewed the progress made by its member nations in implementing the e-Health programmes. Similarly, Belgium, Sweden, Spain, the United Kingdom and Denmark did the same thing concerning the problems they had to overcome while carrying out e-Health actions in 2010 (WHO, 2011). In this respect, the discovery of these programs could have a positive impact on private initiatives. International companies could use monetary incentives and specialised training programs to advance the development of local or country-wide programs that facilitate the implementation of HIS programmes.

2.11.3. Incapacitating ambiguity, morals and deliberations

The implementation of each new project is often a task of disabling uncertainty and delay. To overcome such a challenge during the HIS execution process, a broad and explicit directive is required. In the absence of such a wide-ranging and explicit opposition to the approval of the directive, there may be a barrier to overcoming it (Were & Meslin, 2011).

Early accreditation is also required for the principal discussions (Amatayakul, 2004; Campbell, 2007). Patients who are enrolled in health care systems must trust those who have a duty to protect their personal data (Chalmers & Nicol, 2004; Meslin, 2006). Globally, the challenges are similar. However, their relevance is less significant in developed countries, as their legal agendas have better support for digital programs (Carnicero & Rojas, 2010).

In addition, safety subjects and permissible liability could constitute a significant obstacle to the execution process (Detmer, 2010; National Academy Press, 2000). The high levels of legitimate uncertainty that are present in most developed nations may act in two aggressive ways: the lack of legalisation on the ground could provide an incentive to work more freely; but the lack of the necessary regulations could delay the start of executions, while nations are waiting for an agenda to shape such programmes. Comparatively, the number of initiatives in developing countries is lower than projected.

Local health professionals need to acquire knowledge of the legal bases and medical ethics to succeed in these challenges. There is an urgent need to improve the discipline of teaching at both the undergraduate and postgraduate levels in Nigeria (Fadare, Desalu, Jemilohun & Babatunde, 2012). This teaching must be accompanied by any effort to make it workable (Glaser & Strauss 2011).

2.11.4 Absence of mutual interoperability and ethics

With HIS, fragmentation is very common, incomplete, deceptive and isolated. This is more apparent in developing nations. Consequently, such heterogeneity results in information silos and information that cannot be used for the care of patients or the analysis of data found in silos (Hammond 2010).

Similarly, effective use of moral principles is of vital importance in tackling this problem (Sass & Feko, 2011). The willingness to communicate and use information across various structures is an

important prerequisite for achieving health goals (WHO, 2013). The greatest advantage of the lack of interoperability is the loss of consistency of care between experts. In this regard, WHO has, in a resolution at its 66th World Assembly, urged member nations to follow an ethical approach to the effective sharing of information between health care stakeholders and the implementation of eHealth (Hersh, Margolis, Quirós & Otero, 2010).

A great deal of ethics is required to set up interoperable systems in developing nations. Such ethics are similar to those expected in developed nations. The challenge of non-interoperability arises when various organisations pursue different sets of ethics for the same reason. Governments and stakeholders need to be aware of the overlap and establish ways of achieving a consensus on the acceptable and successful application of ethics. International programs demonstrating the benefits of proven ethics could improve and promote the process of recognising such ethics in the creation of districts. The international norm is to help these nations by publicising their principles and educating workers in the process of implementing these interoperability schemes.

2.11.5 Absence of skilled personnel

Adequately trained workers are a vital dimension to the achievement of sustainable development. The start of a collective agreement may well be a starting point. The shortage of trained medical staff coupled with their non-proportional geographic distribution undermines the manpower requirements that are necessary for health IT acceleration (Fadare et al. 2012; Palmer & Palmer 2010).

In 2008, a general prototype emerged from the e-Capacity meeting held in Bellagio to train the required personnel. During the meeting, the components of the education plan were established to train clinical experts and increase the level of informatics knowledge, skills and attitudes of both officially and loosely qualified health workers (Hersh & Williamson 2007).

With educational services exploding all over the world, different degrees of specialisation is necessary. These specialisations can vary from long-term graduate to short-term courses. The American Medical Informatics Association (AMIA) 10-10 program was aimed at educating 10 000 health informatics practitioners by 2010 (Otero, Hersh, Luna, Lopez Osornio & Gonzalez Bernaldo de Quiros, 2007). Since its growth, AMIA has collaborated with local organisations in developing countries such as Argentina and Singapore to create an international version tailored

to local needs (Margolis, Joglar, De Quirós, Baum, Fernández, García, Arredondo & Hersh, 2013; US National Institute of Health, c2013).

Both practices are recognised as vital to the development of education programmes and the incorporation of policies in a manner compatible with the needs of local culture and healthcare. In addition, practices should be associated with existing initiatives by educational working groups of the International Medical Informatics Association (IMIA) (Paton, Househ & Malik, 2013).

2.11.6 Regional and district integration

The US State Health Information Management Coordinator Office and the Medicine Institute understand the importance of incorporation and sharing of knowledge. To this end, they are committed to helping companies share strategies to maximise their probability of success. The flow of information needs to be developed in such a manner that potential issues with patient safety, like those involved in the execution of HIS can be communicated.

Historically, the dissemination of medical knowledge, study and invention has remained in the domain of publications in scientific journals. To date, this contact route has meant a hindrance in developed countries, including health information systems. The HIS research material can be published and recovered quickly with relatively limited expenditures compared to other required investments. The open-access publishing method helps authors to share information more efficiently and cost-effectively in underdeveloped regions (Vose & Cervellini, 1983).

Through its growth workgroup, the IMIA has concentrated on this mission and a central repository has been created for all current IT-related health initiatives in an attempt to address this challenge. The final goal of linking all players working on HIS solutions for developing nations is expected to be achieved. The repository was introduced in 2013 and is relatively new, and the management of input data by project leaders has proved difficult due mostly to a lack of platform expertise (Vose & Cervellini, 1983). However, efforts to communicate successful interventions in the field and to share expertise in the production of interventions and teaching resources may have a future significant impact on the implementation of these initiatives.

2.12 Research on Health Information Systems in Developing Countries

Many scholars have written about HIS in developed countries. These include factors influencing the implementation of HIS evaluations, the ideas of health workers, the fears and aspirations of HIS, as well as the advantages and drawbacks of HIS in developing countries.

2.12.1 Factors affecting HIS assessment and adoption

Effective implementation of health information technology includes analysis of factors that influence their adoption and use. The technology acceptance model is the most important model used to identify factors affecting the health system's implementation of information technology. Furthermore, in recent years the Unified Technology Adoption and Usage Theory (UTAUT) paradigm have seen many applications globally in the health system. In embracing health information systems, ease of use, utility, social effects, promoting consumer experiences, attitudes and behaviour are important considerations.

The move towards health information systems was initiated to improve access to electronic health records (EHRs) in various health care sectors, particularly in hospitals, as it offers great potential for improving the quality of the services provided. With HIS staff productivity and performance is therefore improved through administrative cost reduction. However, recent studies have shown that the use of complex health system electronic records creates several obstacles that include organisational preparedness and preparation for the workforce. It is therefore important that scholars and policymakers operating a modern health information system measure the system's acceptance among the target population. Evidently, acceptance computing would provide considerable support for efficient system execution, therefore, technical and non-technical aspects have to be defined before execution and furthermore, the obstacles to implementation have to be eradicated (Block, 2008). Many models describe the process of introducing new technologies by assuming a range of structural variables that predict performance in the implementation phase either jointly or independently (Kijsanoyotin, Pannarunothai & Speedie, 2009). Implementation of health information systems can fail because the users reject them. It is therefore, important to anticipate the reasons why the new information system might have to be accepted or rejected by medical team members. This knowledge allows an organisation to introduce changes effectively to make the new structures more appropriate (Tsiknakis & Kouroubali, 2009).

The five different factors that contribute to the successful development and use of the health information systems include lack of funds, training and time; security and confidentiality; anxiety; and lack of standards. It is obvious, therefore, that system design interface, communication, motivations and management should include these factors. These are expanded below:

2.12.1.1 Cost

The cost of implementing the HIS is a big concern for health care professionals. Government HIS systems are thus high-priced and, as a result, physicians coincide with an obstacle to the adoption of such systems. For small health care providers, their key concerns are costs, the scale of their practice and the lack of technological capital. Comparatively, scaled-up organisations, such as hospitals, commit more money to technology than smaller ones. Researchers also describe the financial burden of obtaining HIS as an obstacle to its implementation. In addition, it is difficult to assess the real cost-benefit that could theoretically be attributed to the introduction of HIS (Wiseman & Johnson, 2008). Help is inadequate in countries such as South Africa, Sweden, Germany, France and the Netherlands. Sweden, France and South Africa have already made strides towards a national government-funded system, while Germany and the Netherlands are still far behind. Fifty per cent of planning plans were found to have failed due to inadequate technological expenditure (Wiseman & Johnson, 2008).

The HIS requires the expense of both hardware and software. On the one hand, hardware components support workflow processes which usually include the printer, scanner and network costs. On the other hand, the expense requires installation and maintenance. A better choice would be for HIS providers to share device maintenance costs. Another expense would entail training health care practitioners for HIS, therefore, the cost of continuing education should also be included in the implementation budget of HIS. In the recent issue of the Cardiology Magazine (Dove 2007, Hewlett Packard Development) doctors in large institutions show concern about the need to fund high HIS prices and the lack of universal equipment requirements and interoperability issues. While in small and medium-sized hospitals the allocation is of more concern, rural hospitals, in a similar way, are more concerned with funding than urban hospitals.

Costs can also be a major concern due to uncertainty about the return on investment. A study conducted on the Healthcare Financial Management Association (HFMA, 2006) found that there

was a ‘lack of return on investment research’ in peer-reviewed scholarly publications. According to the HFMA, 38% of the total population surveyed reported that financial returns were of great concern to low-level hospital adoptions (2006; Menachemi & Brooks, 2006).

The HFMA believes that the benefits of acceptance can only be appreciated after HIS has been fully implemented. It also claims that the government should play a crucial role in the adoption of HIS through cooperation with private companies as well as through the use of financial instruments such as tax cuts, incentives and grants.

2.12.1.2 Lack of Training

Lack of staff preparation affects the willingness of doctors to implement the HIS technology. Improving the quality of health care means a blend of well-trained personnel with the implemented technology. Owing to a lack of adequate training, discontent among health care personnel can arise. Without proper preparation, the majority of workers do not feel comfortable using HIS technology. Specialised training (Piliouras & Piliouras, 2011) is required for the effective implementation of HIS for health care employees. End-user enthusiasm and commitment to studying and using HIS is a key factor in its success.

2.12.1.3 Lack of Time

Health care professionals face a time constraint. A study by Meade, Buckley and Boland (2009) reveals lack of time and financial resources, as well as knowledge of computer skills are the main obstacles preventing general practitioners from using electronic records over paper systems. The apprehension of doctors over the lack of time stems from their heavy schedule. They are also of the opinion that more time spent on training would affect their job schedule by reducing their efficiency. To address these potential impacts, training programs should be designed so as to bypass their daily schedule of work. It is really important to consider the elements of health information systems and workflow processes. To illustrate this understanding, preparation should be designed in such a way that specific training components are provided to specific individuals who use only that component in their work. Alternatively, integrated time planning can be used to execute HIS.

A time-motion study by Pizziferri, Kittler, Volk, Honour, Gupta, Wang, S., Wang, T., Lippincott, Li, and Bates (2005) in the USA found that HIS takes less time during the primary care session compared to a paper-based system. This shows that HIS benefits can be anticipated without

physicians wasting their time. However, a study conducted by Piliouras (2011) in India reported that the time spent between EMRs and paper records was not substantially different.

2.12.1.4 Security and Confidentiality

A primary concern in hospitals has centred on security and confidentiality. Physicians are required to keep patients' information from being accessed by unauthorised users. Such patient protection increases the confidentiality of medical records and reduces the incidences of abuse. In the US, HIPAA's expectations of privacy and protection are one of the obstacles in HIS deployment (Stanberry, 2011). The versatility of a HIS system is the ability to enhance reliability, efficiency, accessibility as well as increase the quality of health care services. However, the implementation and acceptance of HIS systems cannot be effective if the privacy and security problems are not in place. Privacy and defence continue to be significant problems in Australia and the United States (Cripps & Standing, 2011). In addition, HIMSS has created the global HIMSS task force to investigate a battery of HIS elements within each country comprising protection, efficiency, sources of funding, and obstacles (Stanberry, 2011).

2.12.1.5 Anxiety

One cause of the negative impact on the adoption of HIS systems has been demonstrated as anxiety. Health care practitioners harbour apprehensions of the level of productivity during the transition period between the changes from a paper-based to electronic-based HIS system.

Their anxiety stems from the perception that patients could be enabled to switch their primary care providers should an electronic-based system be implemented. Another perceived anxiety is the likely deterioration of the relationship between the patient and physician due to the indirect nature of care when electronic-based systems are implemented. Most of the studies have indicated a negative impact on the physician-patient relationship while using HIS systems. Nurses confirm such indirect patient care while using HIS systems. However, a few studies have confirmed that there is no effect on the physician-patient relationship while using HIS (McGinn, Grenier, Duplantie, Shaw, Sicotte, Mathieu, Leduc, Légaré, & Gagnon, 2011).

2.12.1.6 Lack of Standards

Despite the lack of criteria that would prohibit doctors from following HIS, many countries have begun a series of initiatives to follow those criteria. The principal explanation for these expectations may be inadequate behaviour and proposals by the government. Since 2002, the

Government of Canada has initiated a funding program for Canada Health Data to build national policies and health care infrastructure (Romanow Commission, 2002).

2.13 Health Workers' Ideas, Concerns and Expectations of HIS

Health Information Systems are advanced computerised decision support systems that link detailed patient information to the electronic health records with health professionals for decision-making. Although health care information systems have the potential to improve the quality of patient care, health professionals often fail to implement its recommendations since the mere provision of such a system does not guarantee its uptake (Liberati, Ruggiero, Galuppo, Gorli, González-Lorenzo, Maraldi, Ruggieri, Friz, Scaratti, Kwag & Vespignani, 2017). Health professionals reject the use of system-generated evidence in environments where HISs have been implemented due to some apprehension of undermining rational thinking, medical judgment, and professional autonomy. Scientific evidence has contradicted deep-rooted hierarchies and power structures based on seniority. The use of health information systems is affected by the trust of users in the sense of emergency medicine and the quality of inter-occupational ties among health professionals.

Where the technology is first implemented, the EHR system is viewed as a challenge that could alter current work practices and inter-professional relationships as well as communication. The implementation of an EHR method is viewed as having a detrimental impact on the relationship between doctor and patient in terms of the traditional relationship that exists between them. This understanding is seen as a possible barrier to the establishment of trust ties between patients and clinicians. The diagnostic and therapeutic process confers power and authority on physicians. To maintain such power and authority, some physicians have sought to preserve their physical interaction with their patients and perceive the introduction of an EHR system as relegating them to the role of a data entry clerk when they must use the computer as an integral part of their work. Undoubtedly, such assumptions of health care professionals can cause some resistance to change in their work environment, especially where it pertains to technology if they consider that their expertise, conscience and experience is humiliated by being substituted by a computer.

Kim and Kwon (2019) found that some patients have concerns about EHRs themselves, and customer decisions on the electronic sharing of health information are affected by their attitudes towards EHRs, as well as their expectations of research benefits and individual controls. Patients have claimed that EHRs provide less privacy than paper records (Perera, Holbrook, Thabane,

Foster & Willison, 2011). These questions are posed not only by patients who are adversely affected by EHR but also by subjects who believe that EHRs are more effective than paper records (Choy, 2015). A study by Anthony, Campos-Castillo, and Lim (2018) found that patients who withhold information are more from doctors using EHRs than those using conventional paper records. This result is not restricted to individuals who have no knowledge of computers. Ifinedo (2018) studied the use of HIS by nurses and found that fostering organisational conditions was the only variable that suggested the intention of nurses to use HIS at work which emphasises the value of developing computer literacy or competence before its adoption.

2.14 The Advantages and Disadvantages of HIS

Information systems are designed to attain specific objectives. Currently, several systems are designed to aid the health care industry. The Health Information System (HIS) is one such system designed for the collection, storage, management and provision of available patient information important to the health care delivery system *(www.vittana.org).* The hospital information system is one sector of the health information system, that records patient-related data, and updates such data to make it available for use by clinical staff. Such data are used for patient diagnosis and monitoring as well as making treatment decisions by hospital professionals.

2.14.1 Advantages

Electronic health records offer a higher level of accuracy as well as provide instant access to patient's health history *(www.vittana.org).* These benefits include financial, faster record retrieval, initiation and access, time-saving, accurate billing and use as a tool in preventative health care. These are further described below:

- **Financial motivations for medical providers**
  Medical professionals who digitise their conventional records with a licensed HIS provide the requisite evidence of practical use provided by the US government. This helps them to obtain or continue to receive the financial benefits provided by such services as Medicaid or Medicare. Government programs promote the use of HIS for more quality patient care.
- **Easy and faster documentation**
  Most electronic health recording systems allow for models to be developed. These templates guide caregivers to enter detailed notes or records for each patient, allowing accurate patient-to-patient recording of the required details. While numerous visits can require different

documentation, the HIS helps to avoid data loss by providing reminders about what needs to be done.

- **Easy access**

  As far as the transition to electronic health records is concerned, many health centres have established online portals. These portals allow customers to store their medical records for as long they want, providing there is a stable data or internet connection. As a consequence, any patient can refer to a care plan or completely understand how their doctor can view their most recent state of health at any time.

- **Time-saving**

  A HIS system coupled with a patient portal enables patients to input data directly into their respective records. Such a provision slashes the time that would otherwise be spent filling out paperwork at a physician's office. Furthermore, before a visit, such data can be completed in a record way. Instead of having to spend 20 minutes filling out forms at the doctor's office before a visit, such data could be filled in directly, days if not weeks before their scheduled visit, into their files. It saves them time and it saves the medical provider the administrative work. Cloud computing has the potential to improve health care services by allowing patient data to be transferred directly to the physician. Thus, such a cloud-computing-enabled HIS aids physicians to address their problems in the shortest possible time especially where physically transporting a patient in a particular instance is not advisable (Varga, Birch & Dillingham, 2015).

- **Faster initiation**

  HIS systems facilitate the immediate placement of orders via a Computerised Physician Order Entry system (CPOE) for services such as imaging, laboratory work as well as prescriptions by doctors. A CPOE is a computer application that electronically accepts orders from a physician. This application replaces both handwritten and oral historical orders. Such a capability eliminates the use of handwritten requests and decreases the likelihood of an error occurring if the doctor's handwriting is hard to decipher. An electronic order can be sent directly to a pharmacy of choice for a patient to pick up medicines without delay. Though not in widespread use, such systems can alert doctors to a service like imaging, laboratory work or a prescription that has already been ordered.

- **Accurate billing**

  HIS-enabled electronic records capture the use of facility resources more precisely. Patients, furthermore, may not realise the effect of this advantage. However, a third-party payer like an insurance provider would have a full record for operation and payments catalogued. The above shows how to optimise the income generated by a health care provider.

- **Preventive Health Tool**

  Providers of health care and/or doctors who have access to recommendations for clinical practice and other services such as computerised notifications and warnings use electronic health records as preventive instruments. Electronic health records allow immediate access by medical professionals to all patient data and enable enhanced surveillance and monitoring of patient conditions, especially of a chronic nature. In addition, defects in the prescription are reduced to a minimum. Thus, cancer scans, cholesterol levels as well as other possible preventive measures that could be required may be conveyed reliably to the respective patients. In addition, as a preventive health aid, the doctor can prescribe an upgrade of the tetanus vaccine in annual check-ups for a person with a 10-year lapse.

2.14.2 Disadvantages

The downside of the HIS system is its digitized format where there is an inherent danger that it can be accessed by an unauthorised group like hackers. There are other slip-ups as well, for example, the US Department of Health and Human Services reported a case in which the HMO sent a full medical report without authorisation to a disability insurance company *(www.vittana.org).* Other disadvantages include: hacker intrusion, unauthorised data access, outsourcing, irregular updates, unavailability of devices, expensive HIS systems, staffing and skills and implementation of software design. These are explained below.

- **Hacker intrusion and restriction**

  Hackers intrude into some databases and use malware to restrict access to the rightful owners of the information. Access to such information is restored upon the payment of a ransom. The malware is malicious software that encrypts the HIS and as a result, renders it inaccessible. The Ransomware attacks on electronic health record servers in 2017, as well as other security access issues, cost many hospitals thousands of dollars per incident.

However, there is no assurance that hacked files will not be copied and disbursed to other entities upon payment of a ransom.

- **Unauthorised data access**

  The creation of electronic health records necessitated its maintenance as well as storage using computer technology. In addition, the health care industry permits the accessing of data by personnel from outside the confines of the workplace. Using information technology as well as remote access to such data poses new challenges in protecting patient rights and confidentiality. The Health Insurance Portability and Transparency Act (HIPAA) was first adopted in the United States in 1996. HIPAA's goal is to incorporate security policies that can be used to reduce possible threats to health information (Wager et. al., 2009). A Health Insurance Portability and Accountability Act (HIPAA) breach will cost anywhere from $100 to $1.5 million when it is reported or observed. Violation instances include one that accesses the file or converses with a patient's family without permission. These violations can hamper the medical treatment a patient is receiving without adequate training.

- **Issues Arising from Outsourcing**

  Businesses and the like are following the global trend of outsourcing parts or elements of their operations to enable them to focus on their core function. Similarly, health care providers have outsourced the installation and maintenance of their information systems to application service providers (ASPs). However, disadvantages accompany contracting out non-core activities. Often such ASPs are of a standard off-the-shelf product with little, if any, customisation. In this instance, the health care provider will have to adapt to the design of the ASP software. Though technical support generally supplements such software, ASPs hardly possess an intimate knowledge of the operations of the health care provider. Further issues arise from data ownership, security and privacy concerns.

- **Irregular updates**

  An electronic health record platform, like any software system, must receive frequent updates so that it can function as expected. Not every creator of software does so. If a care facility chooses a device that provides uncommon updates, it may be weakened over time compared with facilities that receive daily updates.

- **Unavailability of devices**

  The availability of working resources for gathering patient information at all times is of the utmost importance. Many experts have interview rooms that are permanently built on a computer. However, this is not the case for general practitioners or family members. Small offices can have a doctor keeping a laptop or a tablet to maintain an electronic health record. In the event that the doctor forgets that the information gaps in the electronic system will begin to appear in the medical record. The data collected in real-time is more accurate than the data reported.

- **Expensive Health Information Systems**

  Medical facilities' health information systems are costly. Such medical facilities must make a substantial investment in setting up, sustaining and educating people on a HIS. Additionally, device upgrades will cost them. To keep the system running as efficiently as possible, many facilities need to employ IT specialists or outsource their infrastructure requirements.

- **Staffing and skills**

  Vo (2009) noted that the shortage of resources and expertise of personnel involved in the development and maintenance of health information systems is crucial. The organisational architecture of the health information system and the training and expertise of the workers must be consistent in order to reduce the potential for inconsistency. Quality workers are required to produce positive results. Such a situation can occur when conventional paper-based information systems are replaced by electronic health information systems.

- **Type of Health Information System implementation/sourced**

  The software design of a health information system implementation impacts the outcomes achieved. Negative impacts occur when the health information needs are not considered in the context of a particular country. Vo (2009) refers to the failure of an American health information system that was introduced in the Philippines. For proper operation, the American software required skilled programmers and project managers, a sound technological infrastructure as well as information output similar to that in the United States. In this instance, there existed gaps regarding information, technology, staffing as well as skills.

2.15 Chapter Conclusion

This chapter offers a review of the literature on Health Information Systems (HIS). The HIS is explained and its clinical and administrative parts clarified. The history of the HIS is traced and the study is put into perspective by presenting the context of the Ghana Health Service as well as the organisation of its operation.

Under its hierarchical framework, a hierarchy of service delivery and decentralisation, including reforms in the health sector, has been established in Ghana. Furthermore, a cross-country overview of selected countries is covered and a topographic map of the health information system is provided. The key sources of data from health facilities are identified which include individual record systems, electronic health records (EHRs), facility-based registry systems which are community information systems.

The principles and terms used in HIS space are discussed in the next chapter and are followed by challenges in the management of health information in emerging economies. The factors leading to the introduction of health information systems are addressed and the six main broad headings are described. The factors influencing their evaluation and adoption are elaborated under the research section on HIS systems in developed countries. The final section of the chapter describes the concepts, concerns and aspirations of HIS programs of health staff.

CHAPTER 3

THEORETICAL FRAMEWORK UNDERLYING THE STUDY

3.1 Introduction

This chapter examines three main theoretical frameworks and draws some constructs to guide the development of a conceptual framework to underpin this research. A theoretical framework, according to Tetteh, (2014) is the main backbone of any research study. A concept used for the three theoretical frameworks for this study in the assessment of Health Information System adoption in Ghana. These theoretical frameworks are Actor-Network Theory (ANT), Innovation Diffusion Theory (IDT) and Technology Acceptance Model (TAM). as depicted in the diagram Figure 3.1.

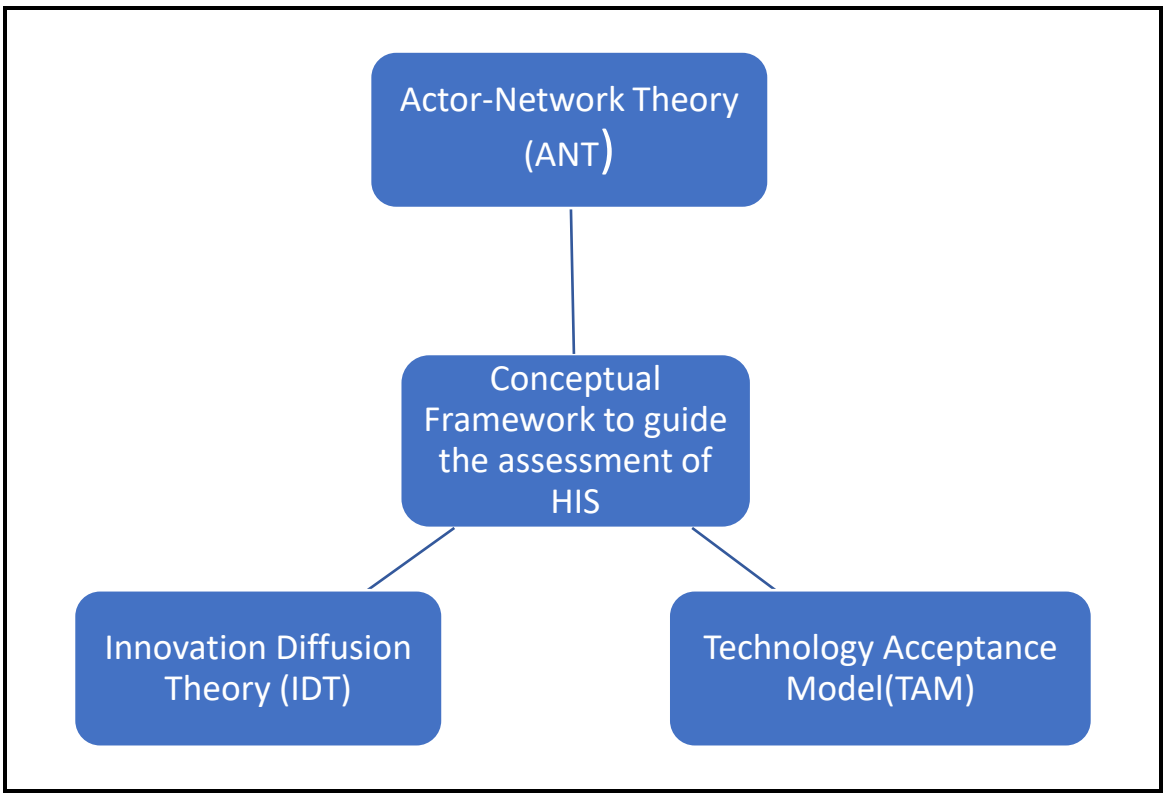

Figure 3. 1: Theoretical frameworks

The subsequent section expounds on these theoretical frameworks and based on this, the research will recommend a conceptual framework for assessing the HIS in Ghana.

3.2 Actor-Network Theory (ANT)

It was Bruno Latour (1996) who propounded Actor-Network Theory in an attempt to explain the mechanisms of technological progress and the development of scientific knowledge. The Actor-Network theory declares the universe to be full of hybrid entities (human and non-human) (Latour 1996). This theory was developed to examine circumstances in which it is difficult to separate humans from non-humans (Callon 1999).

Actor-Network Theory describes an organisation's actors/factors involve human and non-human entities that develop their shape and characteristics when they communicate with each other in the context in which they find themselves. This means that any mechanism that we experience can be addressed more efficiently if we consider all the parts of the system whether they are normal, technical or individual as an engaging and active participant. According to this theory, every person, every piece of technology, and every natural force has an equal part to play in the system and must be taken into account.

The theory's core concept is to analyse and theorise the following:

- how networks came into existence
- track what relationships occur
- how they travel
- how actors are enrolled in networks
- the system's strengths and limitations
- how networks achieve temporal stability.

However, an actor may only act in tandem with the other actors and in constellations that give the actor the possibility of acting; this is because the fact is believed to be actively performed in a given time and place by different actors. A network is a group of actors in such a way that there are relationships and connections between the actors, which is why the Actor-Network Theory posits that elements achieve their type and character only in relation to the others.

Actor-Network Theory helps conceptualise how various actors perceive and implement different realities, and gives rise to a more complex image of the complicated relationships between different actors without neglecting their interrelationships. The leading theory is that scientific knowledge is an outcome of existing relationships of scientific practices between objects, animals

and humans. Therefore, in line with Actor-Network Theory, Ghana Health Service should concentrate on analysing the micro context (e.g. persons communicating with technology or health information systems and hospitals) and use the findings to conclude the health-related macro-context. This could be achieved by analysing actors and their network within Ghana's individual health facilities to know how they operate, which in effect would indicate a broader picture of the healthcare system in Ghana. Therefore, to provide accurate and reliable information on the Health Information System (HIS) in Ghana, individual health facilities must be properly evaluated to verify whether such facilities exist.

The theory posits that to understand health information system adoption, there is the need to examine actors at play. With the current study, HIS is one actor and the health workers are the other. To establish network/communication between the two, health information systems must be examined on the dimensions of user-friendliness, credibility, reliability, flexibility and relevance. On the part of the health workers, there is the need to understand the knowledge level of the technology, hindrances and facilitating factors. Adoption of HIS is therefore achieved when the right actor networks exist. Reluctance to adopt HIS occurs when there are conflicting actor networks.

Fenwick (2014) used the ANT for mapping how information spreads through a context of emergency mental health services and includes clinicians, paramedics, police, hospital personnel, psychiatric nurses etc. This hypothesis suggests that the understanding by a physician with regards to which health information system technology is user-friendly, influences both understanding of utility and attitude towards using the technology. Vandenberghe (2002) notes that it is high time, after this loose discursiveness, to once again catch our theoretical senses on the hard edges of our social world, to feel the sheer power of things. Against this background, the Actor-Network Theory gives recognition to the influence of things and accepts that the work taking place in our world is being done by a collaboration of humans-things. The theory's main premise is that the mechanism and medium used in organising their activities and actions must be accentuated among themselves. It is also the duty of researchers who use this theoretical point of view to learn and understand the actions of actors in terms of what they do, how they do it and why they do it.

Savage (2009), a sociologist, states that the theory seeks to distinguish itself from the current scientific methods and methodologies. The point is that the theory subscribes to actors' narrations,

explanations and perceptions and the relationships from their natural environment that make it difficult to differentiate between effective and unsuccessful explanations. Meanwhile, there is the need to use proper observational research methods to provide specific and relevant events for reporting and decision making. Researchers also point out that much is lost when researchers fail to use more sophisticated analysis methodologies to explain just what they observe since the entire world cannot be reduced to a responsible explanation (Krarup & Blok 2011). That it is equally important for researchers to uncover the mechanisms and causes (Young, Borland & Coghill 2010)

Meanwhile, some commentators have praised the theory for questioning the methodology and hypotheses of scientific science. The ANT theory's important contribution is that it has turned theories and approaches from 'matter-of-fact' into 'matters-of-concern' (Latour 2004) and probes conventional organisational thought approaches (Alcadipani & Hassard, 2010; Whittle & Spicer 2008;). Although causes and explanations are key essences, we owe it to nature to give details and unique descriptions of the relationships existing between different actors in society. Remembering that, relationships/networks existing between actors may vary, hence it is unfair to generalise relationships between fewer actors on less. Therefore, cause and effect explanations may not always suffice, rather we must concern ourselves with what works for different actors depending on the understanding derived from the interactions. In addition, the strength of the theory lies in the description of techno-scientific issues of humans and machines. Once the Health Information System is understood to be about the human-machine interface and interactions, using the ANT theory as the basic descriptive understanding of how the interaction takes place is a plausible thought.

There are strong implications for management, especially in healthcare facilities in Ghana when human and non-human types of entities are generated and modified through ongoing relationships with other entities via the Actor-Network Theory. The theory explains that humans influence technology and technology influences humans, through ongoing negotiations and translations exposure. For example, compare a person's way of thinking, feeling, and behaviour while using favourite devices and their gadgets against when there is no such opportunity. Undoubtedly, when people are exposed to technologies that are more nuanced and harder to comprehend in which they have enough awareness and ability, it improves incentive to work than when such technology is not available. Therefore, the principle admonishes managers and leaders to take stock of what is

now being achieved and to learn of different ways that staff/people and technology can work together to produce a larger result. That is, if the hospital facility uses a manual system for administrative and clinical information purposes, the principle of actor-network recommends the implementation of an automated system to make the job more effective and efficient with minimal risks.

3.3 Innovation Diffusion Theory (IDT)

In 1962, E.M. Rogers introduced the Innovation Diffusion Theory to classify individuals based on their likelihood of adopting technology, and to classify organisations based on their stage of adopting new technology. This theory describes how new ideas and technologies are gaining traction and spreading across a particular population or social structure, when, and at what pace. This theory suggests that four key factors affect the dissemination of the new concept which is: creativity itself, means of communication, time, and a social structure by which it is heavily dependent on human resources. The theory suggests that the introduction of a new concept, technology, action or product into a social environment does not occur simultaneously but rather is a mechanism by which some individuals are more likely to embrace innovation than others. An invention is 'a concept, process, or object perceived as new by a person or by another unit of adoption' (Rogers, 1995). On the other hand, diffusion is 'the mechanism by which the participants of a social system transmit an idea through certain networks over time' (Rogers, 1995).

According to this theory, it explains the five established categories of adopters, which include the following three types: those people who first seek innovation and are interested in new ideas (innovators); those who are already aware of the change and are therefore very comfortable adopting new ideas (early adopters); and those people who typically need to see evidence that innovation works before they are willing to adopt it (early majo). The theory also identifies several attributes of innovation that are key to influencing behaviour in adoption. According to Rogers' theory, the following three attributes are:

- the degree to which innovation is perceived to be superior to current practice (Relative Advantage)
- the degree to which innovation is perceived to be compatible with socio-cultural principles, previous innovations and/or perceived needs (Compatibility)
- the degree to which future adopters can see the impacts of innovation (Observability).

These are illustrated in Figure 3.2 below:

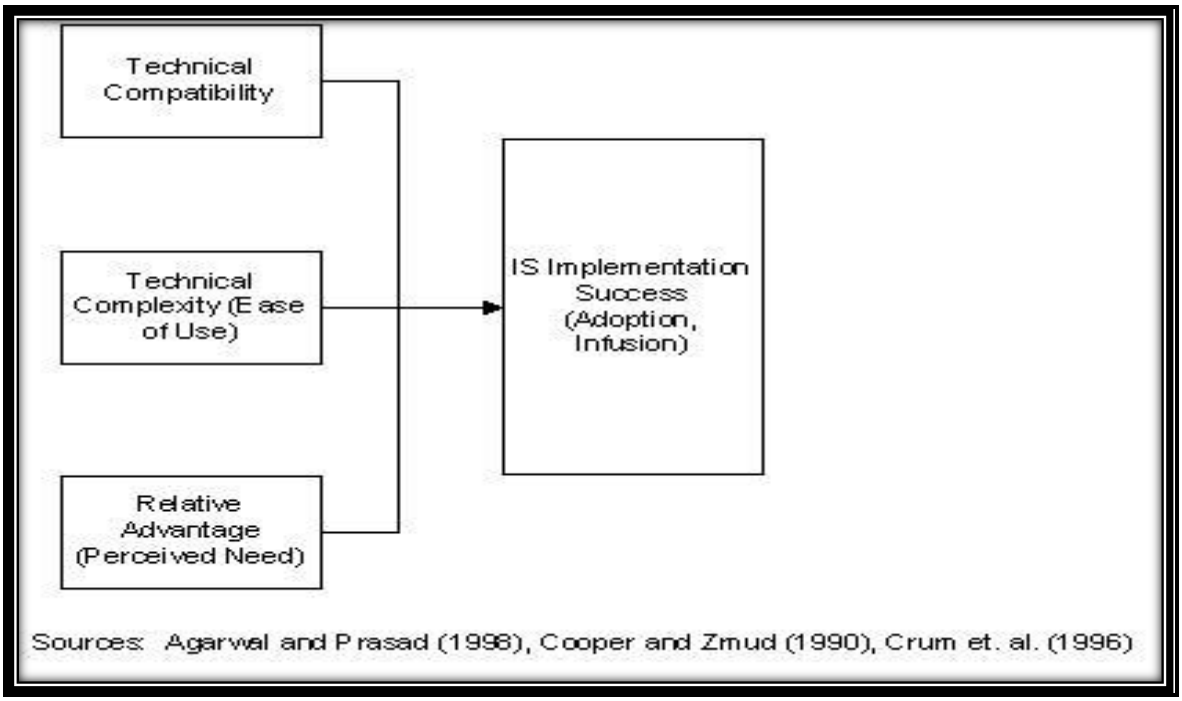

Figure 3. 2: IDT Model

Optimising the implementation of evidence-based practice is a major factor in determining healthcare outcomes and in keeping with the forgotten premise, meaning and features of the theory. Therefore, potential innovation adopters need to learn about innovation, be informed of innovation merits, vote to adopt, introduce innovation, and confirm (reaffirm or reject) the decision to adopt innovation this term observability.

Observability refers to how evident the outcomes of an innovation are to others. Some ideas' outcomes are simple to notice and express to others, but some innovations are harder to notice or define. Many of the innovations examined in previous diffusion studies are technological concepts. There are two parts to a technology: 1) a hardware aspect, which includes the tool that incorporates the technology as material or physical items, and 2) a software aspect, which includes the tool's information base. Because the software component of a technological invention is less visible to the naked eye, innovations with a strong software component have lower observability (Rogers, 1995). Since HIS is understood to be observable and these participants were to give their

testimonies and perceptions regarding HIS existence, it was understood that this attribute already existed hence was not included in the proposed model.

The studies by Downs and Mohr (1976) and then Damanpouer (1991) shows that innovative behaviour within an organisation remains relatively underdeveloped due to unconvincing, conflicting research findings of organisational innovation. This is characterised by a low level of explanation. The theory has been used and proved promising to investigate the implementation of telemedicine information systems in Uganda (Isabalija et al. 2011).

To situate the theory's explanatory point of view in this current study, the health information system was evaluated in eight thematic areas: relevance, timeliness, accuracy, availability, accessibility, confidentiality, compatibility and interoperability. Knowing the various adopters of the theory, some differential levels of HIS adoption in the health facilities studied were anticipated. That is, as the main referral hospital in Ghana, Korle Bu Teaching Hospital may have instituted a complete health information system compared to Cape Coast Teaching Hospital due to the higher expectations of the State and the general public.

In view of this, spreading innovation theory in health information system evaluation is a very relevant theory that can assist the Ghana Health Service, information technologists, and nursing informatics experts to provide a platform for preparing informant-related developments as well as to change their goals.

As pointed out in the Actor-Network Theory, the Diffusion of Innovations Theory has similar shortfalls. The DIT theory suggests that all new methods or innovations are helpful and productive but it fails to give room for filtering methods during implementation. Some innovations do not suit the culture, purpose and values of the company and thus should not be implemented although the principle does not threaten innovation as such. In addition, the DIT assumes that all innovations adopted produce positive results and outcomes which may not always be the case (Gos & Karel 1979).

Despite the flaws, there is one explanation why the theory is suitable: that the effectiveness of implementation of innovation depends on how it is adopted. Before a decision is taken together with complete acceptance or adaptation, the philosophy promotes in-depth consultations and conversations to consider the innovative needs of the company and the citizens. It also examines

the processes used to communicate information to people and organisations over time and possibly for leading the use of innovation. The better performing leader or person in charge will, therefore, not sit back and allow inventions to come to him or her. Instead, such a leader or manager is continually and aggressively searching for ideas and other innovative solutions that could help solve daily challenges and boost results.

3.4 The Technology Acceptance Model (TAM)

The Technology Acceptance Model is an information system theory developed by Fred Davis (1989) to explain behaviour in technology usage. The purpose of this model is to predict the acceptability of a tool or information system from measures taken after a period of interaction with the system and to identify the continuous improvement or modification that should be communicated to the system to make it more efficient and effective for users.

The assumption of this theory is that what determines the use of information technology is the behavioral intent. This behavioral intention is also determined by two convictions perceived to be useful (the extent to which a person believes that using an information technology will improve his or her job performance) and perceived ease of use (the extent to which a person believes that using an IT is effortless). These two variables combine to generate a user's attitude toward a particular system, which determines the intention to use and ultimately the actual usage behavior. Hence the Technology Acceptance Model simply states that perceived usefulness and perceived user-friendliness predict IT or system acceptance through attitude towards using and behavioral intent to use.

This means that individuals or users will consider what task and how well a system can perform, as well as the degree to which these tasks match their job goals or job relevance. This model is shown in Figure 3.3. below.

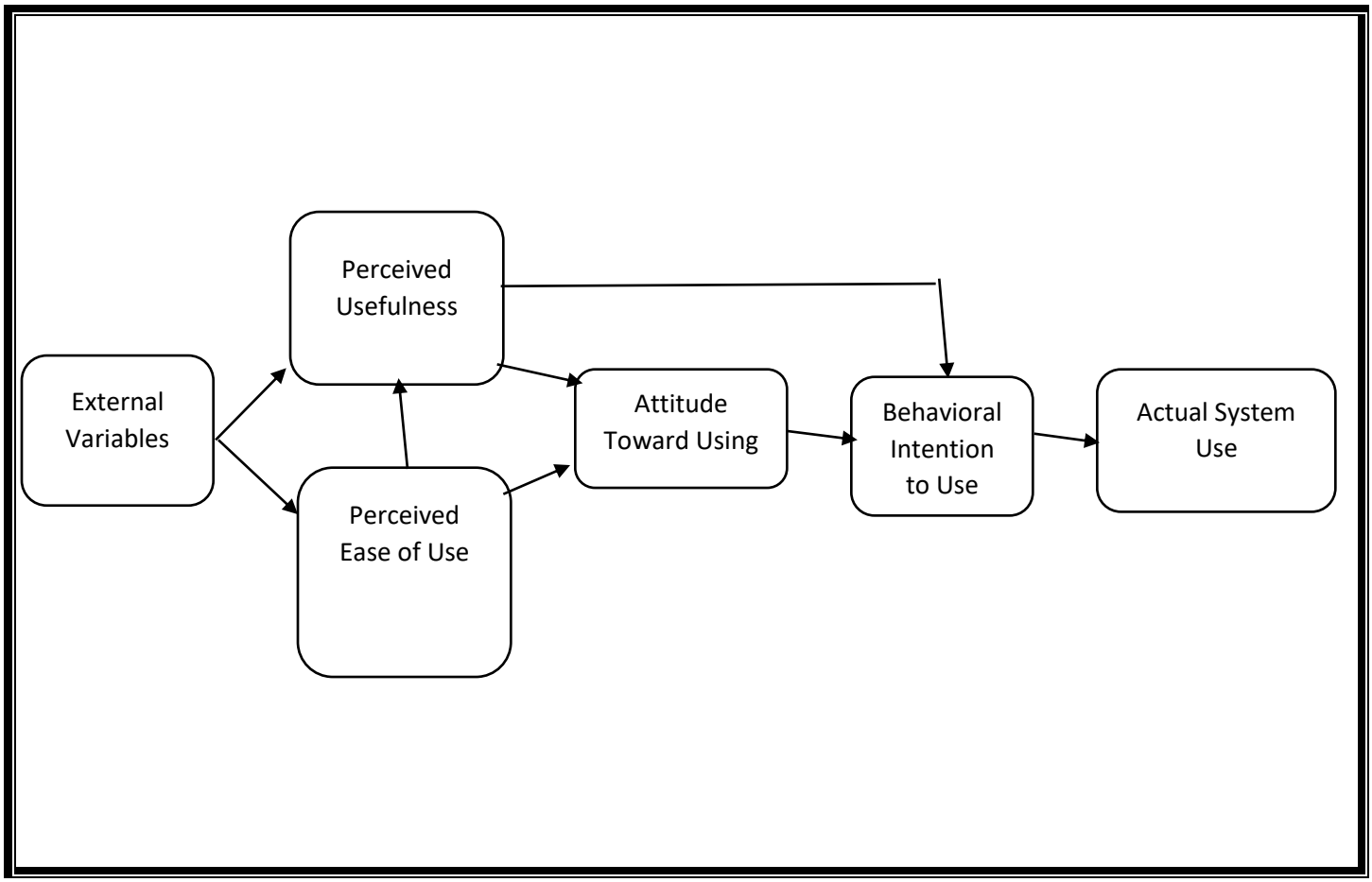

Figure 3. 3: The Technology Acceptance Model
Source: Davis, F.D. (1989)

The model has exerted tremendous influence in studies which sought to identify, clarify and forecast why organisations are introducing, embracing and using information technology. The model has also been tested and proved useful in a range of empirical studies (Chen et al. 2011; Legris, Ingham & Collerette, 2003; Shih et al. 2011; Turner, et al. 2010). Chau (1996) and Igbaria et al. (1997) have jointly suggested that the Technology Acceptance Model (TAM) provides a reasonably appropriate explanation and estimate of users' acceptance of the information system or technology. They argue that TAM has a well-researched and validated inventory of psychometric measurements that make its implementation operationally attractive and also a dominant paradigm for researching technology adoption by consumers. The importance of theory testing for information systems research (it is desirable to analyse or confirm current user-technology acceptance findings) should be emphasised especially when findings include different technologies or user populations (Ar & Baki 2011). This illustrates that the model has been used

by researchers in developed countries to measure the acceptance of health sector information systems.

It was, therefore, helpful, fascinating and refreshing to note the effort to utilise the Technology Acceptance Model to determine the adoption of the Health Information System in Ghana, as the theory has proven to be a valuable theoretical model in helping to understand and clarify user behaviour when implementing the system.

In several empirical studies, the TAM theory has been used to analyse the adoption of emerging technology (Liu et al. 2015). TAM describes and forecasts the use of systems by Perceived Utility and Perceived Ease of Use (Elbeltagi et al. 2005) with external variables having an effect. For example, health facility managers and leaders view that the use of the Health Information System (HIS) can be affected by several external variables such as their previous usage, job vicissitude, situational involvement (Sligo, et al. 2017); external computing preparation, internal computing support (Igbaria et al.,1997); educational level, prior technical related experiences, engagement in the Health Information System (HIS) (Agarwal & Prasad,1999); subjective norms, and job relevance (Venkatesh, 2000).

3.5 Conceptual Framework to Guide the Assessment of HIS

Assessment of any health information system is understood to be possible when some factors are in place. According to the three theories (Actor-Network Theory, Innovation Diffusion Theory and Technology Acceptance Model), assessment of health information system with a particular health facility should pay critical attention to the plausible synergy between the new technology and the individual user. To achieve a perfect interaction interface, there is the need to examine the characteristics of both user and the new technology. The key characteristics of users that are required to be examined are the user's knowledge of the technology, age, gender, perceptions regarding technology, and readiness to change. In terms of the technology (HIS) it, however, needs to be examined on the grounds of the characteristics of the technology from the view of the user in terms of relative advantage (whether it is superior to the previous method), and whether it is compatible with the cultural values, perception, beliefs of the users, observable, trial worthy, useful and easy to use (complexity) and what functions it serves (data collection, data transmission, data processing, data storage and information retrieval). The idea is that any incongruence between the characteristics of the users and the new technology during an assessment, signifies a need for

proper health information system framing/modelling for optimum effectiveness and efficiency. That is, if the characteristics of the new technology are either inferior or superior to the knowledge of the users, this will violate their cultural values, perceptions and beliefs, and deprive users of enjoying certain rewards. Also, if it is difficult to use, users may struggle in its usage, hence make them ineffective. Compatibility or congruence occurs when the two actors reach optimal synergy.

The three theoretical frameworks map unto the conceptual framework which was used as the basis for the HIS assessment. The table below maps out the theoretical framework to the conceptual framework which informed the HIS assessment.

Table 3. 1: Link of theoretical framework to conceptual framework of HIS assessment

Theoretical Framework	Conceptual Framework
ANT	HIS Features; human and non-human entities Staff experience Staff characteristics
TAM	Perceived usefulness of HIS Perceived ease of use of HIS
IDT	Ease of use of HIS Technical compatibility of HIS Perceived need of HIS

Below is the diagram of the conceptual framework in figure 3.4

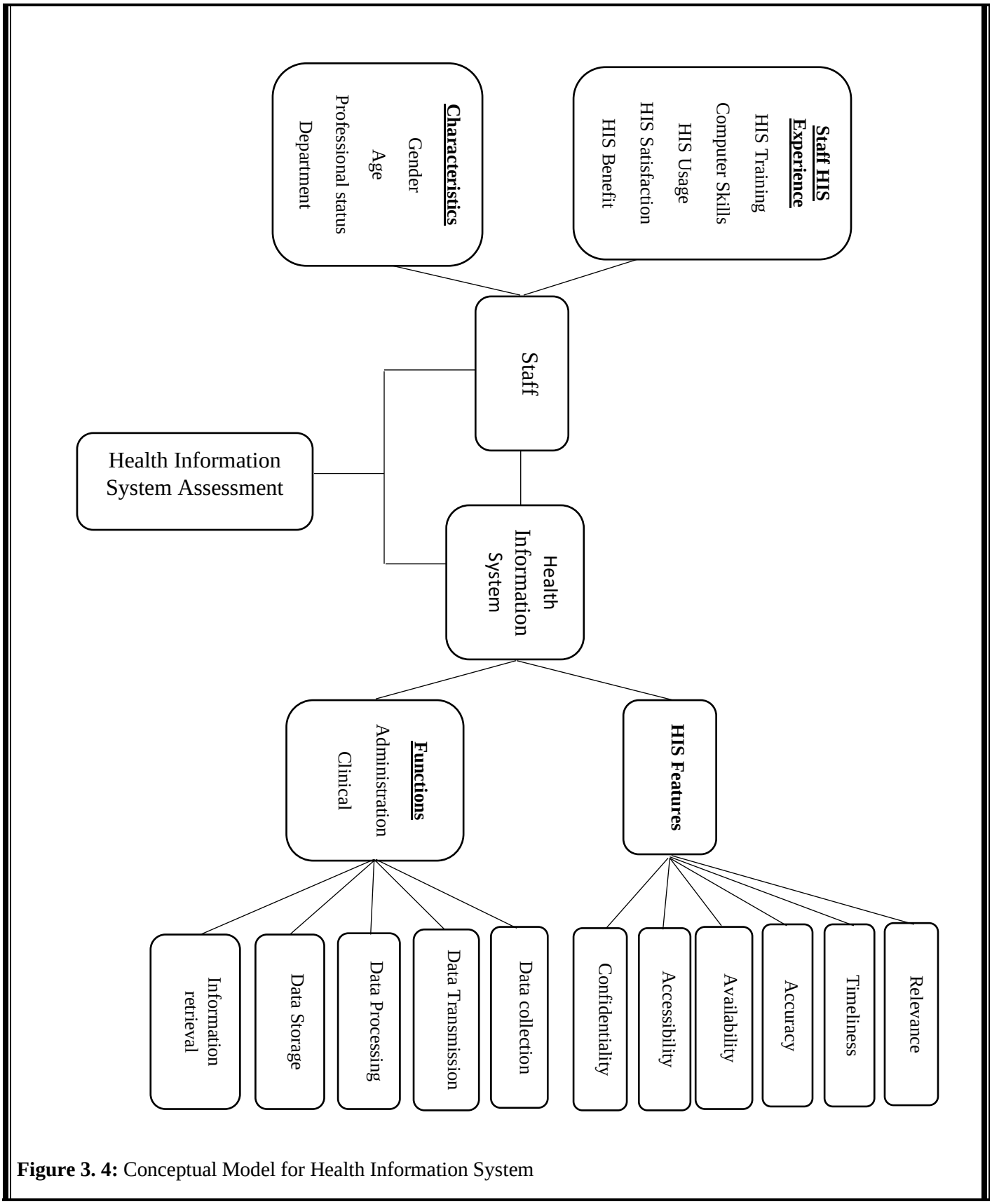

Figure 3. 4: Conceptual Model for Health Information System

3.6 Description of HIS Framework

From the conceptual model, Health Information Systems of the various hospitals in Ghana were assessed on two main thematic areas; namely, staff and health information systems. The definitions of the constituents for each theme are described below:

3.6.1 Staff

The Health Information System is designed for hospital staff utilisation. Hence, when analysing and assessing the HIS system, there is the need for the staff to be analysed as well. This was done in two main areas: characteristics and experience in HIS. These factors are further described below:

3.6.1.1 Characteristics

This part of the model examines the demographic characteristics that describe the users of health information systems. Staff at the various hospitals can be distinguished in terms of gender (male, female), age (different age groups such as young or old), professional status (administrators, medical doctors, nurses, information technology specialist etc.), and departments (administration, medical and surgical etc.)

3.6.1.2 Staff HIS experience

This aspect of the model examines knowing and understanding whether the staff within the various hospitals in the selected areas have had experience in the Health Information System. Firstly, the model examines whether they have undergone HIS training and the nature in which the training was conducted. Furthermore, the model seeks to examine the computer skills of staff, and whether or not they are comfortable with HIS usage and satisfied with the HIS system in their facilities. Finally, the model examines the benefits they have derived from HIS adoption and implementation.

3.6.2 Health Information System

The following section deals with the administration and clinical functions of HIS.

3.6.2.1 Functions: Administration and Clinical

Health Information Systems could be used for various reasons. However, due to the objectives of the current study, the model concentrates on administrative and clinical functions only.

In particular, the areas of attention are data collection, data transmission, data processing, data storage and information retrieval.

- **Data Collection:** The researcher investigated the processes that the users (administrators, medical doctors and nurses, IT professionals) undertake to gather and measure information of administrative and clinical relevance within the hospital setting.
- **Data Transmission:**The model also captures the processes in which users of HIS in the hospital setting transfer data among themselves and between two or more digital devices (computers). Specific attention was given to the type of networking system available for easy and convenient sharing of information between the records unit (administration), laboratory unit, medical unit and pharmacy unit.
- **Data Processing:** This function examines the clinical and administration methods used to carry out operations on data, specifically how data is retrieved, transformed and classified for easy description, understanding, explanation, prediction and control.
- **Data Storage:** This part of the model tackles how recorded HIS data is stored and retained. Especially how data is protected from a third party and theft.
- **Information Retrieval:** This captures the ease of tracing and recovering specific clinical and administrative data from storage.

3.6.2.2 HIS Framework and Features

This part examines the distinctive attributes of HIS that make it unique from other technologies. Specific features examined in the study are as follows: relevance, timeliness, accuracy, accessibility and confidentiality.

- **Relevance:** This aspect of the model examines the appropriateness of the HIS system necessary to help perform clinical and administrative functions.
- **Timeliness:** This focuses on whether the HIS system provides an accurate and useful time frame for operations.
- **Accuracy:** This requires an examination as to whether the HIS system will provide quality, correct and precise data for operations within the hospital.
- **Accessibility:** This aspect examines whether the HIS system provides the opportunity for data to be used and retrieved easily.
- **Confidentiality:** This feature is scrutinised in the HIS system determine whether it has the capacity for keeping administrative and clinical data safe from a third party or cyber theft.

3.7 Chapter Conclusion

This chapter captured three main theoretical views that provide the basis for establishing the conceptual model for health information systems assessment. The chapter begins with an introduction followed by a review of the Actor-Network Theory, Innovation Diffusion Theory and the Technology Acceptance Model. Integration of the theories are made to produce this study's conceptual model. The chapter concludes with a description of this conceptual model.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

This chapter provides a detailed account of the methodological processes used in the study, which were organised into ten (10) broad categories with their subunits. This chapter begins with the purpose of the research and research objectives (including philosophical assumptions underlying the study and the researcher's philosophy for the conduct of the study). It is followed by describing the research design (including mixed-method research, convergent parallel mixed method design, and procedures for conducting mixed method). It continues with describing the mixed-method data collection (including the selection of the hospital, site entry, design of an open and close-ended questionnaire format, the piloting of the questionnaire, interviews and face-to-face questionnaire administration, document analysis and expert reviews). The following section covers the description of the population and sample for study (sampling technique and selection of study participants), data analysis techniques (data analysis, phase one analysis, phase two of the analysis and integration of quantitative and qualitative data), measures of trustworthiness, ethical consideration and conclusion.

4.2 Purpose of the Research and Research Objectives

The study investigated the strength and weaknesses of the health information systems currently found in Ghana and how the perception of the users has influenced the acceptance of HIS. The main aim was to generate and design a standard health information system framework to be adopted by the various health centres in Ghana for quality health delivery and patient's satisfaction. On that note, certain procedures and processes were followed. To achieve the stated goals, the following objectives were formulated:

- To assess administrative functions
- To assess clinical information systems
- To understand health workers' ideas, concerns and expectations of HIS
- To compile a strategic HIS framework.

Several models outline the organisation of a good health information system framework but for t the current study, the World Health Organisation's Health Information System Framework and

Standards are known as the 'Health Metric Network (HMN)' has been identified as appropriate for the development and global agencies. The HMN sets out two main or core requirements and purposes for a country's health information system to be strengthened:

Table 4. 1: The Health Metric Network

Requirements of HMN	Purposes for HMN
The need to improve the whole health information and statistics system	Investment and technical assistance on standardising and developing health information systems, and to serve as a benchmark for system baseline assessments.
The need to focus efforts on strengthening country leadership in the production and utilization of health information.	Permit access to and better use of improved national and global health information.

Source: World Health Organisation (2012)

The Health Metric Network organises the framework and standards of the health information system into three key thematic areas. The first task was to assess the rationale, approaches and vision(s) of the health information system. Health information systems are developed using the gaps in the present health system. It is the developer's responsibility to adequately monitor, examine and identify the strengths and potential weaknesses that make the current HIS obsolete. This includes the gaps (rationale) along with other technological knowledge and best practices, and the needs of individuals and countries to set a clear vision for the country's health information system. This vision with adequate knowledge on health assists the creators and developers to understand the appropriate approaches required to achieve the vision of HIS. This is further divided into three main subthemes as follows:

- The rationale for strengthening health information systems
- Approaches to strengthening health information systems
- The power of partnership − the Health Metric Network.

The current study assessed and questioned the heads or leaders of two key departments (administration and MIS) as well as the medical doctors, nurses and staff from the two main departments about these core requirements. This was undertaken to identify what the leaders did

in line with recording, managing and controlling health information, what remained undone, and the capacity needed to ensure continuous improvement of health information systems in the different health centres in Ghana. Two main data (administrative and clinical) were collected to assess the state of the health information system at the various health facilities in Ghana. The hospital administration and clinical information were the means to define the strengths and weaknesses of the health information system in Ghana.

The second task was to examine the components and standards of the health information system on seven (7) key elements, namely: introduction, resources for the health information system, indicators, data sources, data management, information products and the use of information. As part of the first three (3) goals, the researcher assessed the health information system to identify what health information resources were available to the hospitals: indicators, data sources (patients, peer-reviewed, books, etc.), data management system, and how the hospital and other key stakeholders use the information generated.

The third task explored how to improve the frameworks, values, processes and methods of health knowledge under the three subthemes below:

- Guiding principles for health information system development.
- Implementation processes for strengthening health information systems.
- The way forward for the evolution of the health metric network.

4.2.1 Philosophical assumptions underlying the research

By using prescribed methods and procedures the researcher is guided by some philosophical orientation of organising and understanding reality and research. The philosophy helps to describe and understand the researcher's perceptions, beliefs and assumptions about the nature of knowledge and social reality. The philosophy also influences the theoretical and empirical bases of the research and how to conduct the study from beginning to end. In addition, the researcher's philosophical perspective helps to identify sources where data can be gathered and how the findings should be analysed and interpreted (Esterby-Smith 1997). There may be a research philosophy or paradigm in different orientations including positivism, constructivism/interpretation, and pragmatism.

4.2.1.1 Positivism

According to Creswell and Creswell (2018, p.42), a positivistic orientation is based on:

> Rational, empirical philosophy that originated with Aristotle, Francis Bacon, John Locke, August Comte, and Emmanuel Kant [Mertens, 2007], and echoes a deterministic theory in which outcomes or consequences are likely to be determined by causes.

Philosophical inclination towards positivism assumes that culture forms the individual. In reality, society consists of 'real truth' that exerts arbitrary influence over individuals. Hence, the aim is to uncover the laws regulating human action just as scientists have discovered the laws governing the physical universe. Thus, positivists believe that truth is empirical and can be defined and clarified by quantitative properties independent of the researcher (value-free) and his or her measurement techniques (Krauss, 2005, p.750; O'Leary 2004, p.5).

Oates (2005) describes and explains the features of the positivistic assumption as follows:

- **The world exists independently of humans:** There is a physical and social world to be studied, captured and measured 'out there' not just in our minds.
- **Measurement and modelling:** By making observations, measurements and producing models or theories of how it works, the researcher discovers this world.
- **Objectivity:** The researcher is an impartial observer and is neutral and objective. Facts or global information, can, therefore, be discovered independently of the personal values, emotions, and beliefs of the researcher.
- **Hypothesis testing:** Research is based on the empirical testing of theories and hypotheses that lead to them being confirmed or refuted.
- **Quantitative data analysis:** Mathematical modelling and proof of statistical analysis are often strongly preferred. Using mathematics provides a logical, objective means to analyse observations and outcomes.
- **Universal laws:** Researchers are looking for generalisations, universal laws, patterns or irrefutable facts that can be proved true irrespective of the researcher and the opportunity.

Given the validity of the findings obtained through such thought and the methodology of the study, the human perspective (typically addressed by constructivist or interpretive approach) is not taken into consideration. Oates (2005) suggests that the positivist approach is less suitable to study the

social context of people's lives, organization of group structures people build, the culture they create, and the sense they place on things.

4.2.1.2 Interpretivistic paradigm

Interpretivism or constructivism is a common philosophical paradigm subscribed by the social sciences and it is made up of philosophical hermeneutics, a constructionist perspective and sociology. This paradigm plays a critical role in the examination of the text to determine the meaning and how people use languages and symbols to define and construct social practices aimed at understanding the behaviours of people (Shamsudin 2014).

Using an interpretivist research paradigm also assists in understanding the world of human experience and suggests socially constructed reality (Martens 2005). Creswell (2003, p.9) argues that the constructivists/interpretivist researchers rely on 'the view of the situation being studied by the participant' and recognises the effect of the research on their own experiences and background. However, unlike positivism, interpretivism usually does not begin with a theory; rather it 'generates or inductively develops a theory or pattern of meanings throughout the research process' (Creswell 2003, p.9).

4.2.1.3 Pragmatic approach

Creswell (2003, p.11) also emphasises that pragmatism as a paradigm helps to focus on 'what' and 'how' of the research problem, although early pragmatistic researchers 'vetoed the scientific notion that social research could only access the "truth" about the real world through a single scientific method' (Martens 2005, p.26). For mixed methods, the use of the pragmatistic paradigm is appropriate (Bridget & Lewin 2005). It can, however, be seen that in any methodology, mixed approaches can be employed. The realistic model places 'the science problem' at the centre stage and applies all methods to understand the issue (Creswell 2003, p.11). With the research question as 'key', the methods are chosen to collect and analyse data which is most likely to provide insight into the problem without any intellectual loyalty to an alternative paradigm.

4.2.2 Researcher's philosophy for the present study

For over a decade, researchers who have gathered empirical data and studied the strength and weaknesses of health information systems argue that it is always limiting when a researcher uses one approach. If a researcher employs only close-ended questions to seek to uncover the thoughts

and perceptions of individuals on health information systems, there is the possibility that certain vital nuances could be missed which would then render the knowledge inadequate for policy and practice (positivism/quantitative). In the same way, if a researcher uses only open-ended questions to understand health information systems, there is the likelihood of omitting vital objective data (interpretivism/qualitative).

The argument, therefore, is that for the best knowledge and wisdom of HIS, the researcher needs to gather both objective and subjective data (pragmatic/mixed method). The explanations for this are that a combination of findings resulting from two or more approaches raises expectations and accepts that the results are accurate, true and not an artefact of methodology (Bouchard 1976, p. 268). Interestingly, in the early 1950s, Boring (1953, p. 222) predicted this concept of philosophy, although he did not employ the term mixed method:

> As long as a new building has only the single explicit definition obtained at birth, it is merely a building. When it gets two alternate operational definitions, it starts validating. When the defining operations are numerous due to proven similarities then it becomes reified.

In the 1960s Webb et al. (1966, p. 3) had this to say:

> Once a proposition has been confirmed by two or more independent measurement processes, the uncertainty of its interpretation is greatly reduced. The most persuasive evidence comes through a triangulation of measurement processes. If a proposition can survive the onslaught of a series of imperfect measures, with all their irrelevant error, confidence should be placed in it. Of course, this confidence is increased by minimizing error in each instrument and by a reasonable belief in the different and divergent effects of the sources of error.

As mentioned earlier, Creswell (2003, p.11) also clarified that pragmatism provides an opportunity for the researcher to concentrate on the ‘what’ and ‘how’ of the study problem and disagrees with the empirical notion that social science can only reach the 'facts' about the real world through a single empirical process. It is best to use the pragmatistic paradigm for mixed methods (Bridget & Lewin 2005); however, mixed methods could be used with any paradigm. The realistic model places ‘the science problem’ at the centre stage and applies all methods to understand the issue (Creswell 2003, p.11). Key methods are chosen to collect and analyse data for the research question

as those most likely to provide insight into the problem without any intellectual loyalty to an alternative paradigm.

Denzin (1978) draws a distinction between pragmatism (using multiple qualitative or quantitative approaches) and pragmatism (using both quantitative and qualitative approaches). Researchers have argued that the method orientation has limited value since it uses only one paradigm (e.g. quantitative or qualitative only).Denzin, (1978) therefore, recommended the use of between-method orientation, explaining that by employing between-methods, the bias within a particular data source, researchers/investigators, and a particular method is likely to be annulled when used concurrently with other data sources, investigators/researchers, and methods. Denzin also stated inter-methods would allow the outcome to converge on the reality of the phenomenon being studied.

Base on the suggested philosophical orientation for health information systems studies and the benefits thereof, the researcher organized the thoughts along the lines of pragmatism using the between-methods approach.

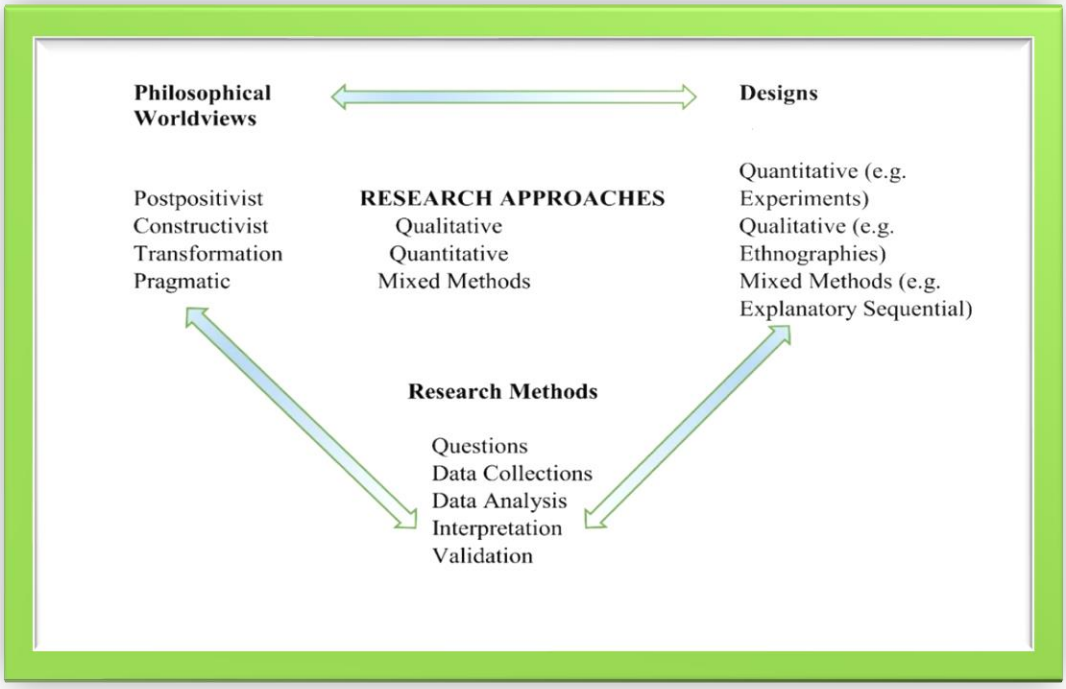

Figure 4. 1: A framework for research - The interconnections of philosophy, design and research.
Source: Creswell (2014)

4.3 Research Design

Settling on the philosophy which guides the research, now places the researcher in a position to determine how the research should be planned. The researcher not only selected positivism (quantitative), interpretivism (qualitative), or pragmatic (mixed methods) philosophies and methods for conducting the analysis but also agreed on the type of study that was chosen within the option. Research designs are typically inquiry styles through qualitative, quantitative, and mixed-method systems which provide clear guidance for research design procedures. Others have named them Research Techniques (Denzin & Lincoln, 2011). Walliman (2006) says research design provides a data collection and analysis structure and also suggests which research methods are suitable for a particular sample. The way a researcher uses a specific approach also helps the researcher achieve the goals and objectives set out in the Research Report.

4.3.1 Mixed methods research

A mixed-method approach (between methods) was employed in this analysis which is a mixture of both quantitative and qualitative. In designing the study of mixed methods (between methods) there are two main approaches, these are concurrent or simultaneous and systematic or sequential approaches. A concurrent/simultaneous approach is implemented when both qualitative (subjective reality) and quantitative (objective) data are collected by the researcher simultaneously. The systematic/sequential approach gathers either qualitative or quantitative data at a given point in time.

4.3.2 Convergent parallel mixed methods design

In the present study, the researcher used a convergent parallel mixed method design (a mixed-method case study design) was used to study the HISs in ten (10) hospitals in Ghana. According to Creswell (2014), such a study must gather both quantitative and qualitative data, analyse them separately, and then compare the results to findings in order to validate or disconfirm them with each other (see Figure 3.1). The central postulation of this approach is that both qualitative and quantitative data may include different forms of information (i.e. mostly participant's views are qualitatively accurate and instrument scores are quantitative); however, together they must deliver results that should be the same. This method is based on the historic concept of the multimethod, multi-trait idea developed by Campbell and Fiske (1959) who thought it best to understand a psychological characteristic by collecting various types of data. Conceptualisation by Campbell

and Fiske, however, included only quantitative data but this form of mixed-method approach expands the idea to include qualitative data collection. Therefore, to understand the health information system within a health facility, it is expedient to have quantitative data on system features and functions from users, administrators, and information technology professionals. Again, considering qualitative data in terms of their experience with the system, the challenges and recommendations of how the system could be made user-friendly is vital. In terms of specific designs employed for both quantitative and qualitative design, the subsequent sections provide more clarity.

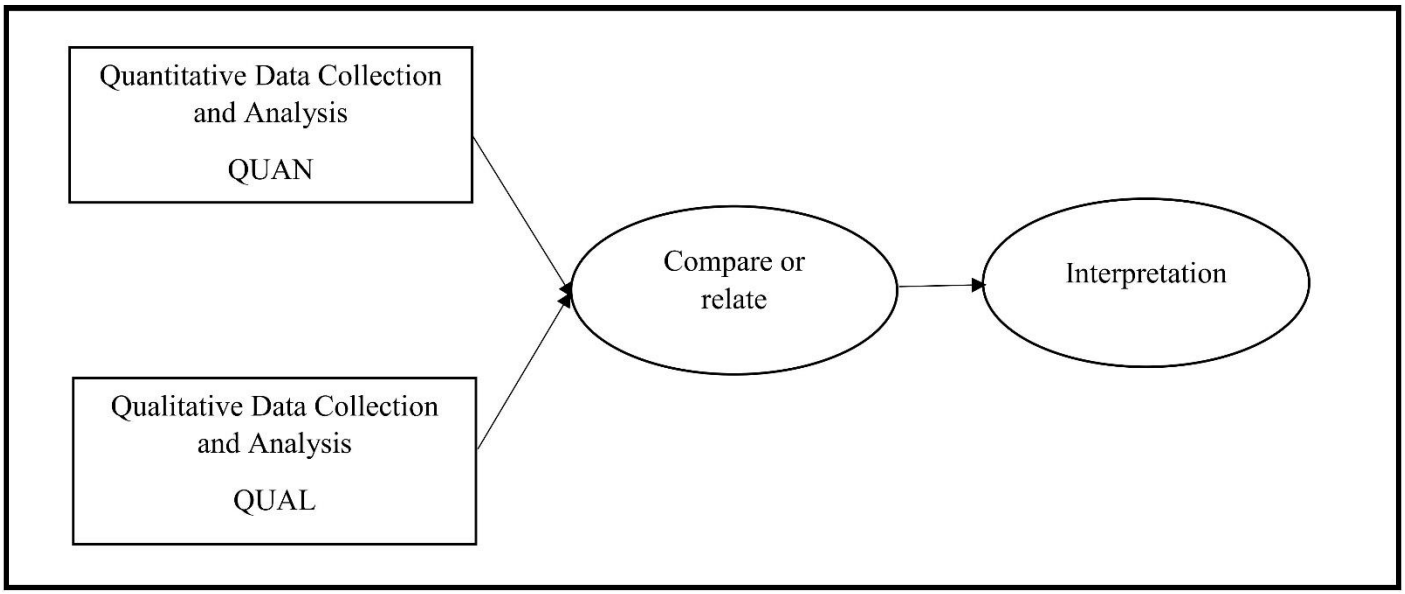

Figure 4. 2: Convergent parallel mixed-method design.
Source: Creswell, 2018, page 290

4.3.2.1 Quantitative research

The quantitative aspect of the mixed approach focuses on data collection and processing in an observable manner that can be rigidly and systematically subjected to rigorous quantitative analysis. This research method is subdivided into research methods which are experimental and non-experimental. The experimental study requires broad consideration of the effect of a specific procedure on an outcome; conclusions may then be made on the outcome observed. Some examples include true experiments (that are normally random treatments) and quasi-experiments (that are normally non-random treatments). The experimental quantitative approach, on the other hand, produces a numeric description of the opinion of a research population, attitudes and some trends. It involves the use of questionnaires or structured interviews in collecting data in a

longitudinal or cross-sectional study. The intent is to ensure that the characteristics described in the data can be used to make conclusions from a sample of the population. An example of a quantitative study is non-experimental surveys. The quantitative research approaches analysed the views of core healthcare and management stakeholders of the health information systems in the current study.

4.3.2.1.1 Survey research approach

The quantitative analysis aspect was conceived by use of a survey. Cooper, Schindler and Sun (2003) have stated that a survey approach may be used for data collection when questionnaires evaluate the thoughts, opinions and feelings of the respondents about a study topic. Surveys are formulated ad hoc, cross-sectional, and longitudinal in three basic ways. Firstly, ad-hoc surveys are designed to solve specific problems or areas of scientific study by collecting data from a single sample at a time. It is normally deployed to address a specific need for research. Secondly, cross-sectional surveys collect data as a cross-section of characteristics at one point in time and make inferences regarding a population of interest. Thirdly, a longitudinal study involves repeated observations of the same variables over short to long periods (e.g. sample).

In this study, the cross-section of characteristics and attitudes of key participants were assessed for information and views within a single point in time to provide valuable perspectives about the study. Of the three survey formats, the cross-sectional sample was the most suitable to achieve this study's goals; therefore, information from respondents was collected, using a survey approach by administering a structured close-ended questionnaire.

4.3.2.2 Qualitative research

One of the most distinctive elements of qualitative research is the idea that by using their interpretations of their environment, people are enabled to understand it better. Myers and Crowther (2009) also state that the qualitative analysis approach helps researchers to investigate phenomena in their natural environment, which is why, a case study was used as a qualitative source of data in light of the above.

4.3.3.2.1 Case study approach

Yin (2003) describes a case study as 'an empirical enquiry that investigates a contemporary phenomenon in its real-life context, particularly when the boundaries between phenomenon and context are not evident'. The approach to a case study focuses on defining the presence of

complexities in unique settings. The case study methodology helped this researcher explore why, how, and what questions (including the question sequence of who, when, where, how, and why) that challenge the present collection of events that the researcher has little or no influence over (Moon 2007). A case study approach can take many forms. For this study, each type was deployed depending on the purpose and/or objectives; namely, illustrative, exploratory, cumulative and essential examples. These are further described below:

- An illustrative case study uses one or two occurrences of an event to demonstrate what a situation is like, and is essentially used to familiarise readers with a common discourse on the case in question.
- An exploratory case analysis is carried out before undertaking a large-scale investigation or test. The primary aim is to help the researcher define the right questions and the type(s) of measurement before the key analysis is initiated.
- An explanatory case study serves to gather information at different times from multiple sources and to provide an opportunity to question what, how and why a phenomenon occurs. It consists of a detailed summary of the facts of a case, suggestions for alternative explanations and a conclusion based on plausible explanations which are consistent with the facts. The concept behind such a case study is to allow for greater generalisation.
- A relevant case study explores one or more sources to investigate a situation of particular interest with little or no interest in generalisability, or to question or challenge a common or universal argument that is widely used. It is mostly useful for answering causal and effect questions.
- Cumulative and essential

The explanatory style of the case study was used to design the qualitative feature of the analysis.

4.3.3 Procedures for conducting a mixed-method research

The mixed-method procedure is clearly defined and explained in sections 4.3.1 and 4.3.2 above. Detailed step-by-step procedures have been outlined by Johnson, Onwuegbuzie and Turner (2007) for successful convergent parallel mixed method as follows:

- The collection of both qualitative (open-ended) and quantitative (closed-ended) data should take place. Therefore, a questionnaire instrument was administered by the researcher to obtain both quantitative (close-ended) and qualitative (open-ended) data.
- Analysis of both data forms must be obtained from the participants. In other words, the procedures for both qualitative and quantitative data collection and analysis (adequate sampling, information sources, data analysis steps) need to be rigorously conducted. This step was indicated and followed (see section 4.7 below).
- In design analysis, the two forms of data should be integrated by merging the data, connecting the data or embedding the data.

These processes were integrated into a separate system of mixed methods which also included the timing of data collection (concurrent or sequential) and the priority (equal or unequal) for each database.

4.4 Mixed Method Data Collection Process

This section has been classified into seven main elements; namely, selection of hospital; site entry; open and close-ended questionnaire; interview; face-to-face questionnaire administration; document analysis; and expert review. These are further described below:

4.4.1 Selection of the hospital

There are various healthcare facilities in Ghana, such as hospitals, facilities of preventive care and administrative offices. Only hospitals were selected which met the requirements for inclusion. The inclusion and exclusion criteria are as follows:

4.4.1.1 Inclusive criteria

- The HIS should be functional whether administrative or clinical;
- The HIS does not necessarily have to be available in all hospital departments.

4.4.1.2 Exclusive criteria

- Non-availability of HIS.

Hospitals were carefully selected to provide nationwide distribution to the study. Included were the major teaching hospitals which cover all health zones in Ghana (the northern, middle and southern belt). A good representation of the health system in Ghana's regional, district, mission

(CHAG) and quasi-government hospitals was included to give a good assessment of the national health system at all levels.

4.4.1.3. Breakdown of Hospitals

Table 4.2 below gives the breakdown of hospitals according to their categories and zones.

Table 4. 2: Breakdown of hospitals in categories and zones

HOSPITALS	Categories	Health Zone
1. Korle-Bu Teaching Hospital	Teaching Hospital	Southern Zone
2. Temale Teaching Hospital	Teaching Hospital	Northern Zone
3. Cape Coast Teaching Hospital	Teaching Hospital	Southern Zone
4. Komfo Anokye Teaching Hospital	Teaching Hospital	Middle Zone
5. Greater Accra Regional Hospital (Ridge Hospital)	Regional Hospital	Southern Zone
6. Dunkwa Municipal Hospital	District Hospital	Southern Zone
7. Police Hospital	Quasi-Government	Southern Zone
8. Mamprobi Poly Clinic	District Hospital	Southern Zone
9. The Trust Hospital Limited	Quasi-Government	Southern Zone
10. Agogo Presbyterian Hospital	District/Mission (CHAG) Hospital	Middle Zone

Source: Ghana Health Service

4.4.1.4. Regional breakdown of the health zones

The regional breakdown of the health zones is further illustrated in Figure 4.3 below:

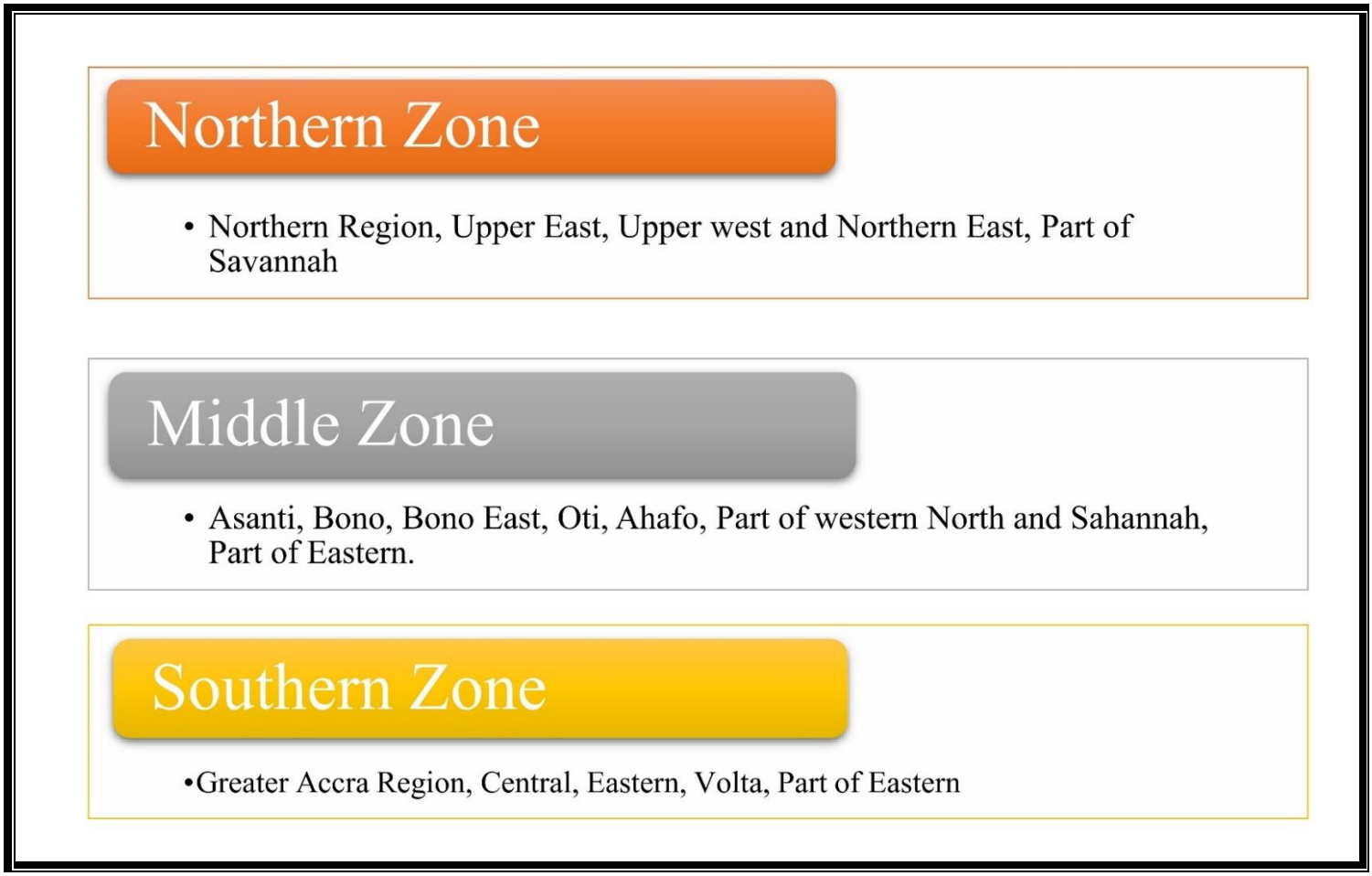

Figure 4. 3 : Regional breakdown of health zones.
Source: Ghana Health Service

4.4.2. Site/hospital entry

To start any research enquiry at any hospital in Ghana, one needs ethical clearance from the Ghana Health Service Ethical Review Committee. This covers all public health institutions and is acceptable to most private health facilities, as the health system in Ghana has a hierarchical structure represented in all the regions. After receiving approval through the Ethical Review Committee's authorisation letter, the researcher requires permission from the institutions of interest through the Regional Health Services Director followed by the Medical Superintendent.

The Medical Superintendent subsequently assists in recruiting the research participants. The researcher then personally approached each respondent to hand them over the questionnaire.

4.4.3 Open and close-ended questionnaire instrument

Open and close-ended type questionnaires were used to elicit responses on the strength and weaknesses of adopting a health information system among the four categories of health workers. The Health Information System managers and their officers were furnished with the same open and close-ended questionnaires to elicit technical information on health information system implementation (see Appendix F). The administrative managers and their staff were also given open and close-ended questionnaires to elicit information on HIS usage in hospital administration (see Appendix H). Doctors and nurses also responded to questions pertaining to using the health information systems in patient treatment. Interview questions followed for the Health Information System managers and their officers and thereafter with a questionnaire for doctors and nurses (see Appendix G). All three independent questionnaires were divided into two sections (A & B). Section A is a brief report on respondent demographics. Section B houses information on the health information system features namely, use, power, weaknesses/challenges and the way forward. It took between fifteen to forty-five minutes to complete this questionnaire.

4.4.3.1. Questionnaire for doctors and nurses

Section (A) evaluated the general profile of the respondents, which included elements such as 'gender (male, female), age (21-29, 30-39, 40-49 & 50 years and above),' occupational health status (physician, nurse, junior doctor) and their respective department (medicine, obstetrics/gynaecology, anaesthesia, surgery). Section B analysed clinical information systems that include data relating to public health used by doctors (to diagnose, treat and coordinate patient care). The questions also assessed HIS ideas, concerns and expectations for health workers. Sample questions are:

- *How do you rate your computer skills when it comes to knowing how to use routine applications like Microsoft etc.?*
- *How many patients are you treating every day?*
- *Do you use the ICT system or application to record/collect information on patient health?*

4.4.3.2. Questionnaire for the administrative manager and administrative staff

Section A evaluated administrative managers and administrative staff's biographical details such as 'gender (male, female), age (21-29, 30-39, 40-49 & 50 years and above)' and professional status (administrative manager, administrative staff)'. Section B assessed the strengths and weaknesses

of the HIS application for administrative functions (data used to support administrative functions and general hospital operations). Sample questions are:

- *What is the size of your hospital/clinic?*
- *What processes are involved when a patient arrives at the hospital for the first time and how long do these processes take?*
- *How is the hospital patient health information stored?*

4.4.3.3. Questionnaire for health information systems managers and health information system officers

Section A assessed the biographical details and professional status of the both Health Information System manager and officer such as 'gender (male, female), age (21-29, 30-39, 40-49 & 50 years and above)'. Section B evaluated how to compile a strategic HIS framework to improve the processes and technology of hospital information that influence the daily routines of employees. Sample questions are*:*

- *What health information system does the hospital use?*
- *What are they used for?*
- *Do health information personnel and other hospital staff receive regular in-service training in the health information system?*

4.4.4. Piloting of Questionnaire

To establish suitability for the main study and to help identify potential challenges that may arise in the actual data, the research instrument (questionnaire) was first given to ten (10) different individuals within similar health settings for their response (Burns, Grove & Grey 2011). This was to ensure that the items on the questionnaire elicited the responses that would help answer the research questions. After piloting the questionnaire, the items were found to be suitable in achieving the aims of the study.

4.4.5. Interview

This is a method of data collection that includes an oral interview of respondents, either as individuals or as a collective group (Denscombe 2001).

Before the COVID-19 pandemic reached the Ghanaian community, the interviews were conducted face to face with one person at a time. The interview sessions were carried out in study hospitals in nine (9) different regions (Greater Accra, Central, Ashanti, Brong-Ahafo, Western, Northern,

Upper East, Upper West, and Eastern regions based on an old categorization) of Ghana for convenience and to observe and capture the reality in the field. After collecting contact information of the participants through the administrative heads of their respective healthcare institutions, prior arrangements were made for the interviews, in consultation with the participants. Therefore, participants had sufficient time for the interviews in which the researcher followed diligently to avoid setbacks and disruption from the study's busy schedule. The average interview time for a participant was one (1) hour.

The interviews were semi-structured, driven by interview protocol. The interviewees were asked predetermined questions using the interview procedure which were flexibly worded. It then used follow-up questions to further analyse problems. The researcher was direct in administering the interviews. Data from the interviews were handwritten during the interview, and then transcribed and combined to explicitly develop themes and codes during the data review process.

4.4.6. Face to face questionnaire administration

This is a primary type of data since the researcher acquired first-hand data directly from the respondents within the various hospitals. With the objective of the current study, the researcher depended heavily on information or data from health workers which include medical doctors, nurses, hospital administrators and hospital information technology professionals. Specific data that was retrieved from these participants include demography (bio information), perceptive and subjective information regarding health information system adoption, its challenges or weaknesses and strengths.

4.4.7. Document analysis

Document analysis relates to data collected by someone other than the user. Common sources for such data include a census, governmental and departmental information, organizational records, data originally collected for other research purposes among others. Based on the research objectives, the researcher depended heavily on information and documents from hospitals and the Ghana Health Services websites, such as related empirical studies that have variables necessary to describe, explain and predict what is likely to occur in the course of the study in the following areas:

- information technology adoption
- information technology and healthcare delivery

- appropriate theoretical explanations and models
- appropriate research philosophical standpoint
- appropriate research design and methodology
- the challenges expected to be experienced.

Also, the study makes use of the World Health Organisation's model of information technology adoption and implementation, scholarly commentaries, documentary reviews, books, dictionaries and other expert knowledge, especially for the development of the open and close-ended questionnaires. In terms of earlier sources referred to above, the secondary data provided information on issues about past and current trends of HIS adoption; theories explaining technology acceptance and adoption; philosophical grounds for HIS studies; and experts' thematic areas for designing the questionnaire for the current study.

4.4.8. Expert reviews

The expert opinion review is described as a method of collecting data involving the use of expert opinions and expertise in functional areas as measures of the project outcome (Center for the Advancement of Community-based Public Health CACBPH 2000). The research review was conducted by consulting experts in the field of medical science, evaluators of health technology, and the developers of e-health models for their exceptional knowledge of the subject. The researcher then refined the study questions and interviews after consultation with the experts. Again, before final acceptance and implementation were made, the researcher consulted the experts for their feedback when the HIS system was created to strengthen the structure.

4.5 Data Collection Method

Data collection is seen as a step-by-step medium through which data on variables of interest is collected and measured systematically to respond to:

- specific research goals and questions
- examine hypotheses
- evaluate results (Kabir 2016).

The aspect of data collection in research methodology is common to all fields of study that include the physical, the social, the sciences and the humanities. However, while data collection methods may vary according to disciplines, the significant goal remains the same: to ensure accurate and

honest collection of quality evidence that can be converted into rich data analysis and to facilitate the development of a compelling and credible response to the questions posed. Regardless of the area of study or data classification choice (quantitative, qualitative) accurate data collection is, therefore, necessary to preserve the integrity of the research. Both the selection of suitable instruments for data collection (existing, updated or newly developed) and delineated guidelines for their proper use reduce the possibility of errors.

In the current study, eight (8) stages of data collection processes were followed. Data collection begins with the selection of hospitals followed by clearance and piloting as well as validation of research instruments. Subsequently, the researcher proceeded with data collection (with site entry approval) from participants who had met the requirements and who were willing to participate. Following the selection of participants, who were first asked to complete the questionnaire and a one-on-one interview took place after the questionnaire administration. After both questionnaire and interview, the researcher continued with key document evaluation and the expert review created out of the data gathered. The flow chart of the processes is shown below in Figure 4.4.

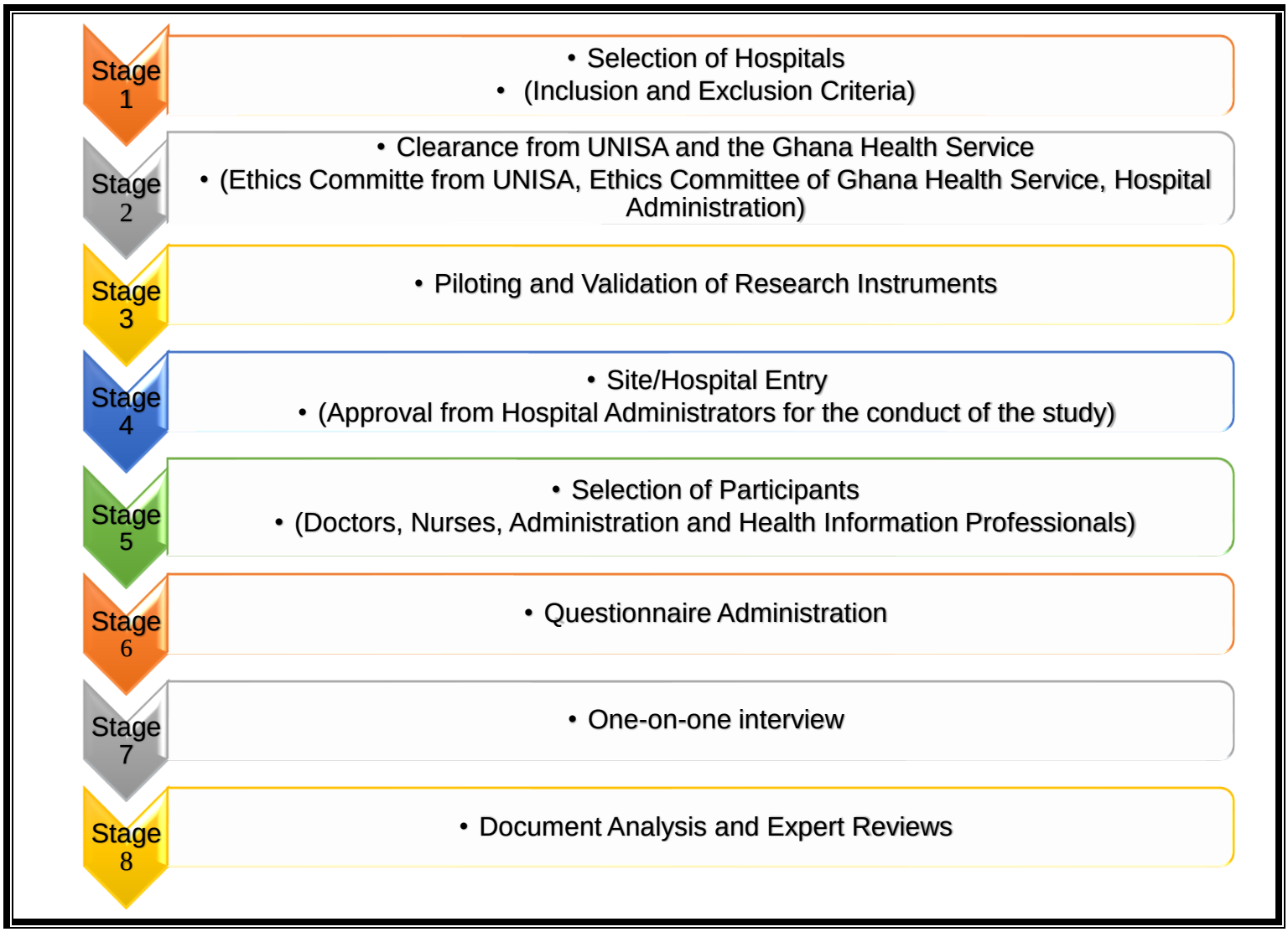

Figure 4. 4: Flow chart for data collection.

4.6. Population and Sample for the Study

According to Babbie (2007), a research population or participants are the whole set of elements from which a sample is selected. It is the total elements that can impart the details to the researcher. The research population of interest for this study were health workers in Ghana who comprised of the following:

- Hospital administrative managers and administrative officers (who understand the benefits and disadvantages of applying the health information system to administrative functions) and who have expertise with respect to the research goal;
- Health Information System Managers and Health Information System Officers (who have the technical skills, procure, implement and knowledge of the strategic health information

system framework that could improve hospital information processes and technology which affect the daily routines of other employees);

- Physicians and nurses (who use health information systems for clinical and health-related purposes).

These three groups of health workers were selected as a sample frame since they are key participants whose expertise and experience provide valuable insight into the acceptance and implementation of the health information systems at hospitals in Ghana.

4.6.1. Sampling technique

According to Holloway and Wheeler (2002, p.122), science's sampling method drives the concept of obtaining rich in-depth and objective knowledge. Therefore, for this study, participants were firstly selected and tested by using the model under investigation, with simple and purposeful sampling methods. Secondly, the purposeful sampling technique was to select the sampling frame for the population. Babbie (2007) refers to purposeful sampling as being the selection of the most useful or representative units or elements for the study. The researcher's focus of interest is the adoption of health information systems in hospitals across Ghana. The identification of the sampling frame (using a purposeful sampling technique) meant that all participants within the frame were qualified to participate in the study because they have similar characteristics capable of providing HIS information. Thus, eighty (80) participants (Hair, Black, Babin & Andersen, 2010) were recruited for the study using the convenience sampling technique (see Table 1.1 above).

4.6.2 Selection of study participants

Ghana's hierarchical healthcare workers are scattered across the country. The study required a purposeful and judgmental sampling method in the selection of all eighty (80) health staff by researching the organisational framework of healthcare for the primary management positions directly related to strategic management. These health workers (deliberately chosen and enrolled) are actively interested in healthcare preparation and management in Ghana and are using the HIS for their daily routines. As the main users, they were expected to provide the necessary information to answer the research study's intended objectives. Table 4.1 below, displays the classification and main management responsibilities of the chosen group of health managers.

The participants were carefully selected based on their job descriptions. The first and second groups were purposefully selected since they utilize HIS to store patient records and provide supportive services to the doctors and nurses as well as assist management in decision-making.

The third group of health information professionals were purposefully chosen for they install the software and provide technical services to doctors, nurses and hospital administrative officers.

The fourth group comprising of health administrative officers who assist in day-to-day hospital administration that includes maintaining the hospital staff details and records of patients, as well as the procurement of hospital products. These health administrative professionals are actively involved in the preparation and management of hospital healthcare and use the HIS for their everyday routine mission. Therefore, the justification for purposeful and judgmental sampling, is that the selected health managers have a grasp of the required responses to questions about HIS for the stated objectives of this research study.

Table 4. 3 : Category of participants (n = 80)*

PARTICIPANTS	**HOSPITALS**										
	Korle Bu Teaching Hospital	Tamale Teaching Hospital	Cape Coast Teaching Hospital	Komfo Anokye Teaching Hospital	Greater Accra Regional Hospital (Ridge Hospital)	Dunkwa Municipal Hospital	Police Hospital	Mamprobi Poly Clinic	The Trust Hospital	Agogo Presbyterian Hospital	**TOTAL**
Hospital Administrative Officers	2	2	2	2	2	2	2	2	2	2	N=20
Doctors	2	2	2	2	2	2	2	2	2	2	N=20
Nurses	2	2	2	2	2	2	2	2	2	2	N=20
Health Information Officers	2	2	2	2	2	2	2	2	2	2	N=20
Total	8	8	8	8	8	8	8	8	8	8	N=80

Source: The Researcher

*Note: The Inclusive criteria and Exclusive criteria were used in the hospital selection. In addition, the participants were purposively selected because they are directly involved in planning, management and the use of HIS in their daily routine.

4.7 Data Analysis Techniques

Retrieved field questionnaires were first screened through an individual review of the items on the questionnaire. This first screening assisted the researcher to identify whether all questions were answered and also, if the respondents were suitably qualified people to respond to the questionnaires. After the first screening, all questionnaires were identified to be well filled and passed the first screening test. The questionnaires were then entered into an Excel spreadsheet; the Statistical Package for the Social Sciences (SPSS) and saved. This helped the researcher to maintain a backup for the data on the questionnaires and also to assist in the data analysis.

4.7.1. Data Analysis

Research analysis was conducted in two phases, hence the first phase; case study analysis, and the second phase is the survey analysis. The case study analysis was twofold: (i) to assess the strengths and limitations of HIS application for administrative functions (data used to assist functions of hospital management and general operations); and (ii) to evaluate clinical information systems that also include clinical health-related data used by professionals (in diagnosis).

4.7.2 Phase 1: Case Study analysis

Three theoretical examples of empirical approaches present a concrete finding in a case study review (Hancock & Agozzine 2017). These methods are thematic analysis, category analysis, and analysis of narratives. While each aforementioned strategy has its own characteristics, all strategies have a similar basic mechanism. The basic analytical method is a regular ongoing analysis of accumulated knowledge to recognise recurring trends, themes, and categories. By using a thematic analysis technique to view cumulative data through all the methods of data gathering mentioned above, each new piece of knowledge was analysed to provide a preliminary answer for each specific research question. The preliminary answers were then grouped into themes and represented in a summary format or a diagram.

4.7.3. Phase 2: Survey analysis

Phase two was to conduct research on health information systems ideas, concerns and expectations intended for health workers. The questionnaire survey analysed the views of healthcare workers on the use of the health information system. The data collected were analysed using descriptive statistics such as frequency tables, means and standard deviations, which allow the researcher to provide simple summaries and better views of the study.

4.7.4. Integration of quantitative and qualitative data

The two data sets merge in several ways. The first method is termed, section by section comparison. In the article, you can see those similarities, parts of mixed-method studies. Thus, the researcher first reports the statistical quantitative results and then discusses the qualitative findings (e.g. themes) to either confirm or disconfirm the statistical results (see Creamer, 2017). Alternatively, the researcher may begin with the qualitative findings and then compare the findings with the quantitative. Mixed methods writers label this a side-by-side approach, since the researcher, makes the comparison within a discussion, first presenting one set of findings and then the other. Considering the objectives of the study, the researcher first presented the quantitative findings in the fields of characteristics of the respondents (in areas such as age, gender, professional status and departments), their computer skills in relation to their experience of using routine applications such as Microsoft Word, Excel, PowerPoint, among others were gathered. The quantitative data also expounds on the perception of the respondent in relation to the functioning of the health information system and the adequacy of its features. Figure 4.5 below summarises convergent parallel mixed method design processes for the data analysis.

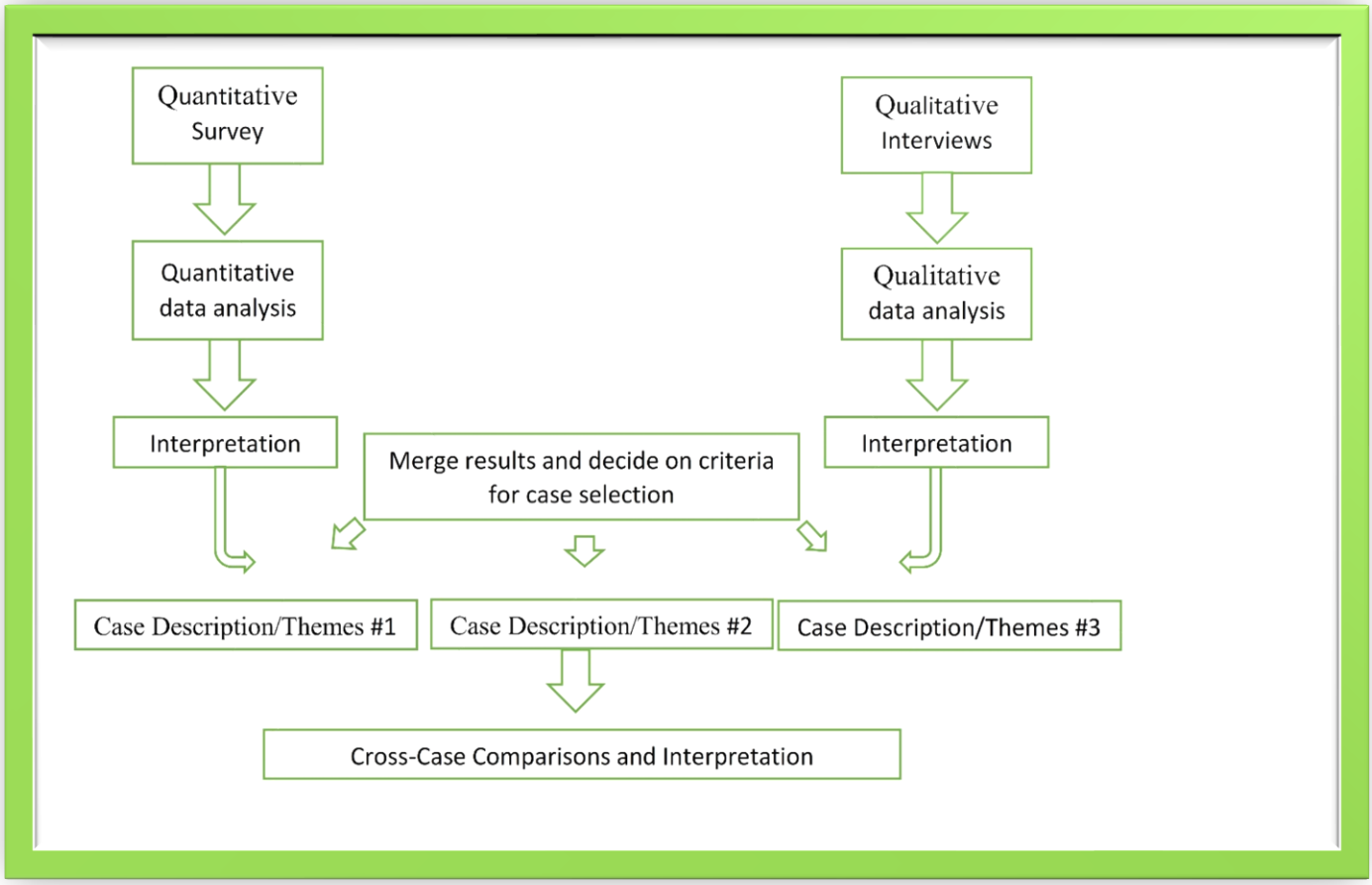

Figure 4. 5: Mixed method case study design analysis
Source:Creswell (2018, p. 300).

4.8. Measures to Ensure Trustworthiness

Items on every research instrument must go through a validation process to ensure that at least the items on the instrument cover the relevant thematic areas of the construct (HIS), and measures the construct. The process does not only pay attention to how the questions are developed but also to how data was collected, managed and analysed (Creswell 2012). On that note, items or content of the questionnaire were developed by using expert advice, knowledge and findings on the construct previously published in peer-reviewed journals and by the expertise of seasoned departmental professors with extensive studies in the area of HIS. To establish reliability and validity with regard to the qualitative features of the research, Lincoln and Guba's (1985) framework for trustworthiness was adopted. This uses four principal criteria to develop a qualitative study's trustworthiness; credibility, reliability, confirmability, and transferability.

The open-ended questions were framed in the English language. The researcher made sure that the grammar was simple and easy to understand which was confirmed when the questions were subjected to the piloting. Post-discussions were also held with participants to clarify some responses that were not clear to the investigator. Since the principal investigator is exposed to sophisticated use of technology, there was the likelihood of bias, hence potential sources of bias were discussed and resolved through discussions with respondents, experts, third parties and the research supervisor.

To deepen reliability and validity, an independent researcher was made aware of the research and followed the processes closely. This study's research supervisor was updated with all the processes used to gather the data from the respondents. In analysing the data, the researcher read through the responses several times that were provided for in the open-ended questions. Initial coding was done and responses that clustered around a particular idea were classified as themes. The independent researcher also followed the same procedure and these findings were compared with the themes developed to establish congruence.

4.9 Ethical Considerations

In research, researchers are obliged to uphold certain ethical principles and values (Willingham 2010). Firstly, the University Research Ethics Review Committee (URERC) from the University of South Africa (see Appendix A) and the Ghana Health Service Ethics Review Committee (see Appendix C) authorised their respective ethical clearance. Permission was also sought from the heads of all ten (10) hospitals across the four (4) regions of Ghana (Greater Accra, Central, Ashanti and Northern).

Secondly, participants for the study were compelled to provide informed consent. Respondents were given a detailed summary of the study areas: (aim(s), problem, significance and expected contribution). With this clarity, the information on the benefits/rewards, duration, the risk involved, privacy, confidentiality and voluntary right of participation were outlined. Therefore, none of the respondents was coerced to be part of the study; rather all participants voluntarily agreed to participate.

4.10. Chapter Conclusion

This chapter discusses the researcher's three philosophical assumptions which underpin all research: the positivistic, interpretive and pragmatic views. This study opts for the pragmatic philosophical assumption given that the research is aimed at generating and designing a standard framework for the HIS to be adopted by the various health centres in Ghana to enhance quality health delivery and patient satisfaction.

Furthermore, the selected research design is a mixed-method design (quantitative and qualitative analysis) that uses both survey and a case study approach to achieve the research objectives.

Moreover, the chapter discusses how participants are purposely selected from the various regions to achieve this study's objectives. Methods of collecting data were from participants who reported through open-ended questionnaires, as well as secondary data from different sources. Also, the chapter explained how the analysis had been done.

Finally, the chapter deals with measures to ensure the credibility of the research and ethical considerations. The next chapter (Chapter 5) addresses the study's conclusions, interpretations and a summary of the discussion of the proposed Health Information Systems framework.

CHAPTER FIVE
RESEARCH FINDINGS AND PROPOSED MODEL

5.1. Introduction

The fourth chapter discussed the study's design and methods. This chapter includes the findings, assessments, interpretations, and recommended model derived from data collecting instruments (specifically, open and closed surveys, as well as individual interviews) and secondary data sources. As a result, Chapter 5 is broken down into four sections namely; description of the selected hospitals and the services offered. This will be followed by the quantitative analysis, qualitative analysis, and finally the proposed model.

The quantitative analysis section is divided into three parts: (i) descriptive statistics of research participants in accordance with the study model in Chapter 3 (staff characteristics; computer literacy and staff health information system exposure), (ii) study goals analysis, and (iii) results overview. Quantitative data was examined and displayed in tables using the Statistical Package for the Social Sciences (SPSS version 24.0). The qualitative analysis presents the developing themes derived from the study questions. The final section which is the proposed model compiled a strategic HIS framework to improve hospital information and technology procedures that affect the daily routines of staff'. Further, the suggested health information framework and implementation guidelines were offered in this section.

5.2 Description of Hospitals in the study

Descriptions of the various hospitals were made using selected metrics. These metrics included the following:

- the name of the hospital
- digital address
- sector/level of care
- region
- district located
- the actual location
- the number of physicians (general and specialised), and
- the population of the district it serves.

In all, data was taken from four (4) teaching hospitals (Korle-Bu, Komfo Anokye, Cape Coast, and Tamale Teaching Hospitals) across Greater Accra, Ashanti, Central and the Northern regions of Ghana, one (1) regional hospital (Greater Accra Regional Hospital), and three (3) district hospitals (includes Dunkwa Municipal, Mamprobi and Agogo Presbyterian District Hospitals) within different regions with two (2) quasi-government hospital (Police Hospitals and The Trust Hospital).

Table 5.2.1 below shows the primary information obtained from hospital administrative managers/staff, Health Information Personnel, hospital websites, and the 2010 Ghana Population Census documents.

Table 5. 1 : Summary table indicating the hospitals studied

Hospital/Digital Address	Sector/Level of Care	Region/District	Location	Physicians	Population
Korle-Bu Teaching Hospital *(Dig. Ad: GA-221-1570)*	Government/ Teaching	Greater Accra/Ablekuma South Sub-Metro	Korle Gonno, Accra-Guggisberg Avenue	Gen-439 Spec-841	257,543
Tamale Teaching Hospital *(Dig. Ad: NT-0101-5331)*	Government/ Teaching	Northern Region/Tamale Metropolitan	Tamale	Gen-286 Spec-65	371,351
Cape Coast Teaching Hospital *(Dig. Ad: CC-070-9967)*	Government/ Teaching Hospital	Central Region/Cape Coast Metropolitan	Cape Coast-Interberten Road	Gen-173 Spec-33	169,894
Komfo Anokye Teaching Hospital *(Dig. Ad: AK-034-9094)*	Government/ Teaching	Ashanti Region/Kumasi Metropolitan	Kumasi	Gen-213 Spec-201	2,035,064
Greater Accra Regional Hospital *(Dig. Ad: GA-052-7021)*	Government/ Regional	Greater Accra/Osu-Klottey-Sub-metropolis	Accra North-Ridge	Gen-54 Spec-40	137,792
Dunkwa Municipal Hospital *(Dig. Ad: CU-002-5197)*	Government/District Hospital	Central Region/Upper Denkyira East	Dunkwa-on-Offin	Gen-4 Spec-0	72,810
Police Teaching Hospital *(Dig. Ad:GL-046-4449)*	Security Service /Teaching Hospital	Greater Accra/La Dade Kotopon Municipal	Cantonment	Gen-20 Spec-15	221,284
Mamprobi Poly Clinic *(Dig. Ad: GA-407-4075)*	District	Greater Accra/Ablekuma South Sub-metro	Mamprobi	Gen-11 Spec-2	257,543
The Trust Hospital Limited *(Dig. Ad: GA-055-5313)*	Regional/ Quasi-government Hospital	Greater Accra/Osu-Klottey Sub-Metro	Osu-Oxford Street	Gen-34 Spec-24	137,792
Agogo Presbyterian Hospital *(Dig. Ad: AN-0005-3355)*	District/Mission (CHAG)	Ashanti region/Ashanti-Akim North District	Asante-Akyem, Agogo	Gen-36 Spec-6	140,694

A brief description of each hospital follows**:**

5.2.1.1 Korle-Bu Teaching Hospital

Established on October 9, 1923, under the administration of Sir Gordon Guggisberg, former Governor of the Gold Coast now Ghana, with an initial capacity of 200 beds to meet the health needs of the indigenous people. However, the hospital has since expanded to more than 1 500 beds. Korle-Bu means 'Valley of Korle lagoon' (Korle-Bu Teaching Hospital 2019).

The hospital now holds an enviable record as the third largest hospital in Africa and is the leading national referral centre in Ghana due to its creativity and efficient administration. The hospital is located at Korle Gonno, Accra along Guggisberg Avenue (digital address: GA-221-1570) within the Ablekuma South Sub-metro with a population of 257 543 (Ghana Population Census, 2010) with a land area of 15.1 sq km. As the main referral hospital in Ghana, it serves not just the population of the Greater Accra Region (over 4,010,054) but the over thirty-one million Ghanaians and others in the West African sub-region.

Figure 5. 1: Korle-Bu Teaching Hospital
Source: Field Data 2020.

Administratively, Korle-Bu Teaching Hospital consists of numerous clinical and diagnostic departments/units and centres including a Medical sub-BMC, Child Health sub-BMC, Department of Child Welfare, Obstetrics and Gynaecology, Central Laboratory Facilities, Department of Radiology, Radiotherapy Department, Department of Anaesthesia, Department of Surgery, Polyclinic, Accident Centre, Psychiatry sub-BMC. The hospital uses both an electronic (E-Health) and Manual (Folders, Medical Ledgers, Receipts and Notebooks) Health Information system for administrative, clinical and management information operations and decision making. E-Health (the computer-based Information System) is used to acquire, process, store and disseminate textual, pictorial and numerical information in the hospital including the name of patients, age, nationality, gender, address, occupation, ethnicity, medical history, billing, medication/dispensing among others. The system also stores reporting and closing times, work done and other welfare information of the main staff of the hospital. The system uses basic technology materials such as monitors, computer mouse (handheld pointing device), printers, operating systems, laptops and other clinical, dental, pharmaceutical and physiotherapeutic equipment.

Since the hospital operates as a teaching facility it, therefore, welcomes internship/attachment students from all academic backgrounds in order to gain practical experience within the facility. Each year the hospital also welcomes National Service Staff with different academic qualifications (Korle-Bu Teaching Hospital, 2019).

Governance is in accordance with the guidelines of the promulgation of the 1996 Act 525, the Hospital was given the powers to operate as a semi-autonomous body. The Hospital is managed by a board of directors whose duty is to provide consistent guidance for its smooth operation. The management of the daily affairs of the Hospital is performed by the Chief Executive, who is assisted by seven (7) Directors. The Managers are responsible for Health, Pharmacy, Nursing, Banking, Administration, Human Resources and General Services. Administrative authority is exercised by the Chief Executive on the Budget Management Centre (BMC) to ensure that the hospital is operating smoothly and efficiently. Administrative power is also assigned to the Departments of Sub-Budget Control Centres (Sub-BMCs). The Sub-BMCs include the Obstetrics & Gynaecology Department, Medical, Dental, Accident & Emergency, Cosmetic Surgery and Burns Centre. The rest are the Psychiatry, Child Care, Polyclinic, Anaesthesia, and Radiology Sub-BMCs.

5.2.1.2 Tamale Teaching Hospital

This hospital has a 400-bed referral capacity, located in northern Ghana. The Hospital, the first of a series of state-of-the-art Regional Hospitals founded by the Ministry of Health, began full operations on August 12, 1998, and was awarded 'Best Regional Hospital' in 2003. With the establishment of the University of Development Studies (UDS) School of Medical Sciences, the hospital was converted into a teaching hospital, one of Ghana's teaching hospitals serving Ghanaians within five regions in the north of Ghana (North East, Savannah, Northern, Upper East, and Upper West). It is located in the Metropolitan Assembly of Tamale with a population of 371 351 (a total of over 4 228 116 in all five regions in northern Ghana (Ghana Population Census Report 2010). It should be remembered that, apart from the people in the northern part of Ghana, the hospital serves all Ghanaians and other individuals within the West African sub-region.

Figure 5. 2 :The Tamale Teaching Hospital
Source: Field Data 2020

Tamale Teaching Hospital has several departments and units; namely, the Intensive Care Unit, Dietherapy Department, Dialysis Department, Physiotherapy Department, Biostatistics Department, Pathology D Obstetrics and Gynaecology, Accidents and Emergency, Nursing Administration, Communication unit, Estate Department, MIS/ICT, Public Health, and General Administration. The hospital has 286 General Practitioners made up of 78 Medical Officers, 208 House Officers and 65 Specialist Practitioners including 24 Consultants, 30

Specialists, 4 Senior Specialists, and 7 Residents. In addition, it was identified that the hospital uses both Electronic and Manual Health Information Systems for their reporting operations that capture patients' biodata, diagnoses, treatments, dispensing of drugs, billing, discharge history, staff records and other welfare information.

Accordingly, the hospital provides the following services to the general public: OPD-General Out-Patient and Out-Patient Specialist, Child Health Surgical Services, Anaesthesia; Accident and Emergency Services; ICU, Obstetrics and Gynaecology, Laboratory, Imaging, Physiotherapy and Occupational Therapy, Pharmacy, Public Health, Art / HIV / TB, Physiotherapy, Support Services I, Support Services I, Support Services I, Mental Health Services.

Governance of the Tamale Teaching Hospital Board falls under the Ghana Health Service and Teaching Hospital Act, Law 525 of 1996 which has the following structure for hospital boards:

- "The Chairman appointed by the President and not an employee of the Hospital
- The Chief Administrator/Chief Executive Officer of the Hospital
- The Dean of the relevant Medical School
- The Medical Director of the Hospital
- The Director of Administration
- The Director of Nursing Services of the Hospital
- The Director of Finance of the Hospital
- The Director of Pharmacy of the Hospital"

5.2.1.3 Cape Coast Teaching Hospital

Formerly known as the Central Regional Hospital, now Cape Coast Teaching Hospital is currently a 400-bed referral capacity hospital situated in the northern part of Cape Coast (digital address: CC CC-070-9967). It is located at Cape Shore, Interberten Road, and is bordered by Abura Township to the north, Pedu Estate/4th Ridge to the south, Nkanfua to the east and Abura/Pedu Estate to the west. It is one of the Ministry of Health's first series of ultra-modern Regional Hospitals that started full operations on 12th August 1998 and was awarded the 'Best Regional Hospital' in 2003.

Figure 5. 3:The Cape Coast Teaching Hospital
Source: Field Data 2020

With the establishment of the Medical Sciences School of the University of Cape Coast, the Central Regional Hospital was transformed into Cape Coast Teaching Hospital. At present, the hospital serves a population of over 169 894 (see Table 5.1) in the Cape Coast Metropolitan Area and over 2 201 863 in the Central Region of Ghana (Ghana Population Census Report 2010). The Cape Coast Teaching Hospital has fourteen (14) departments and divisions, including Out-Patients Department, Intensive Care Units, Department of Dietherapy, Dialysis, Physiotherapy, Biostatistics, Nursing, Accident and Emergency Department, Estate Department, Telephone Exchange/Communication Units, MIS/ICT, and Technical Facilities. Cape Coast Teaching Hospital provides general, clinical, medical and rehabilitation services to out-patients and in-patients using both the Electronic and Manual Health Information System. The services available today are as follows:

Table 5. 2: General Services provided by Cape Coast Teaching Hospital

General Services	Specific Services
"Dental Services	• Dental & Maxillofacial Clinic • Eye Clinic • Ear, Nose and Throat Clinic
Obs & Gynaecological Services	• Obs & Gynae Emergencies Care • Antenatal Clinic • Post-natal Clinic • Gynaecology Clinic
Paediatric Services	• General Paediatrics Clinic • Paedics Asthma • Paedics NEURO • Paedics Renal • Paedics Cardio
Imaging Services	• X-Ray Services • Computerised Tomography Scan (CT Scan) Services • Fluoroscopy Services • Mammography • Ultra sound Services • Echo Cardiograph Services
Laboratory Services	• Haematology Services • Serology and Immunology • Pathology Services • Biochemistry Services
Other Services	• Mortuary Services • Pharmaceutical Services"

Source: Cape Coast Teaching Hospital (2016)

Table 5. 3: Continuation of general services provided by Cape Coast Teaching Hospital

General Services	Specific Services
General Clinic Care Services	• General & Family Medicine Clinic • Accident & Emergency • Wound Care Clinic
Specialised Clinic Care Services	• Diabetic & Hypertension Clinic • Endocrine Clinic • Gastro Intestinal Clinic • Dermatology Clinic • Hepatitis Clinic • Cardiology Clinics • Haemodialysis services • Sickle Cell Clinic
Public Health Services	• Family Planning Clinic • ST/HIV Counselling Clinic • TB Dot Centre • Adolescent Clinics • Child Welfare Clinic
Rehabilitation Services	• Physiotherapy Clinic • Diet Therapy and Nutrition Clinic • Clinical Psychology Clinic • Speech Therapy Clinic
Surgical Services	• General Surgery Clinic • Uro-Surgical Clinic • Burns & Plastics Surgical Clinic • Orthopaedic Surgical Clinic • Paediatric Surgical Clinic • Neuro Surgical Clinic”

Source: Cape Coast Teaching Hospital (2016)

The Cape Coast Teaching Hospital's vision is to be a world-class leader in tertiary care, medical education and research. The following principles aim to provide advanced clinical health service to (i) support primary and secondary healthcare; (ii) serve as a training ground for undergraduate and postgraduate training for medical and other health professionals; and (iii) to conduct research to enhance the health status of individuals. These key principles are described as:

- Customer Focus
- Excellence
- Creativity
- Ethical Behaviour
- Teamwork
- Integrity.

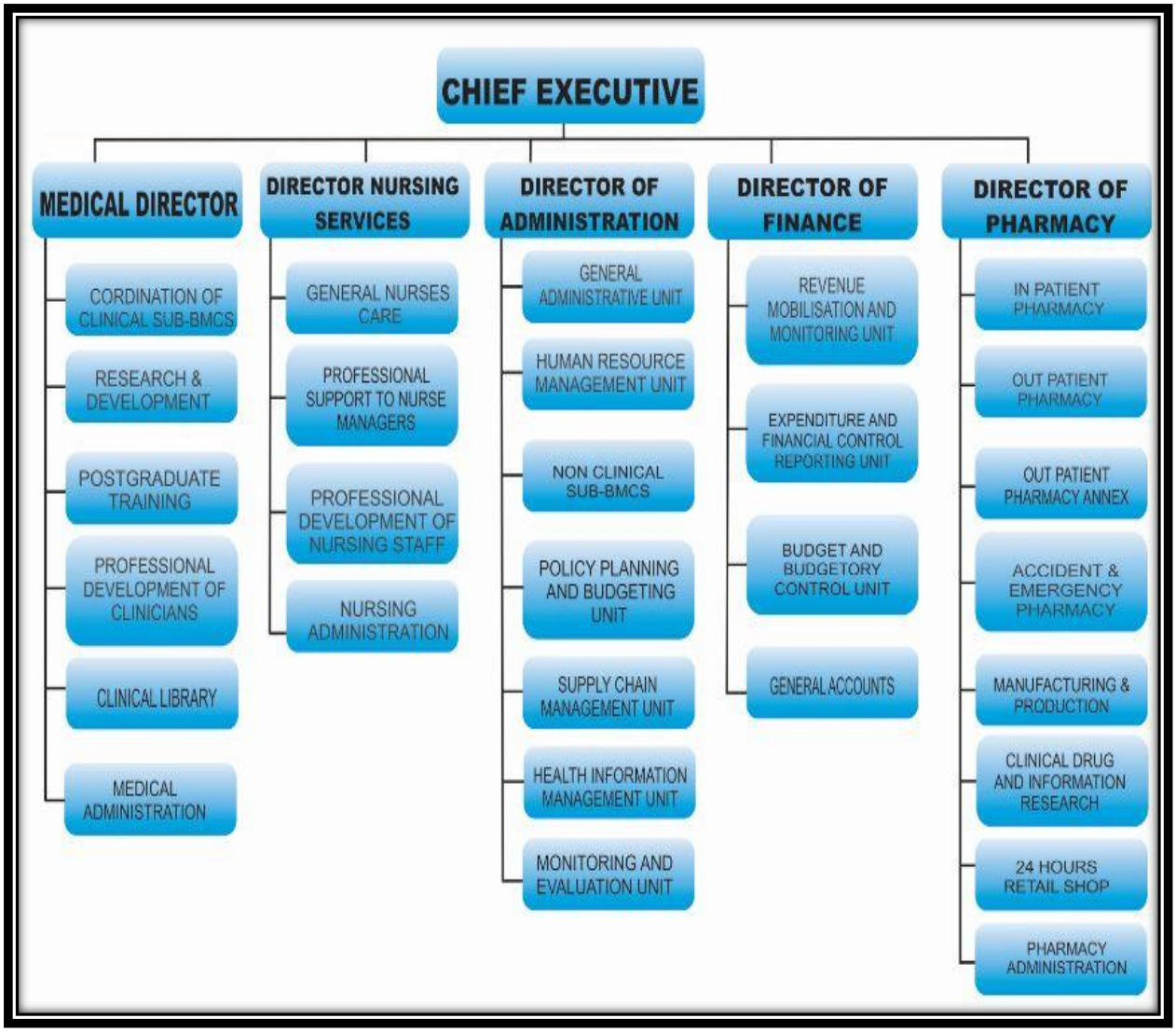

Figure 5. 4: Organisational Structure of Cape Coast Teaching Hospital
Source: Cape Coast Teaching Hospital (2016)

Governance at the Cape Coast Teaching Hospital falls under a Hospital Board which adopted the following structure under the Ghana Health Service and Teaching Hospital Act, Act 525 of 1996:

- 'The Chairman appointed by the President and not an employee of the Hospital
- The Chief Administrator/Chief Executive officer of the Hospital
- The Dean of the relevant Medical School
- The Medical Director of the Hospital
- The Director of Administration'.

5.2.1.4 Komfo Anokye Teaching Hospital (Kumasi)

Komfo Anokye Teaching Hospital (KATH) is situated in the Kumasi metropolitan area (digital address: AK-034-9094), which is the provincial capital of the Ashanti region with a projected total population of 4 780 380 people (Ghana Population Census, 2010). Kumasi's 1 200-bed hospital, country road network, and commercial type of geographic location make the hospital open to all parts of the world. It requires direct referrals from the 16 administrative regions in twelve (12) of Ghana's Region (Ashanti, Bono, Bono East, Ahafo, West North, Savannah, North, North East, Upper West, Upper East and some parts of the Central and Eastern regions of Ghana). Patients are also treated from neighbouring countries like the Ivory Coast and Eastern Burkina Faso.

Figure 5. 5:Komfo Anokye Teaching Hospital.
Source: Field Data 2020

Currently, the hospital has a workforce of around 4 000 staff of diverse professional backgrounds who provide high-quality clinical and non-clinical services and training to people in Ghana and beyond. For ease of administration and specialisation, the hospital was divided into 15 directorates consisting of 13 clinical directorates and two non-clinical directorates. The Emergency Services, Child Health and Family Practice, Surgery, Trauma and Orthopaedics, Nursing, Obstetrics and Gynaecology are the Specialist Directorates. The rest are the Oncology; Eye, Ear, Nose and Throat (EENT); Hospital; Radiology; Oral Health; and the Intensive Care and Anaesthesia Directorates. The non-clinical directorates are the domestic and

technical divisions. Several clinical and non-clinical departments are required as operational support. These are Biostatistics, Chaplaincy, General Administration, Health Services, Human Resources Management, Interior Examination, Planning. Evaluation and control, pharmacy, nursing, quality assurance and public health. The hospital teaches medical students from the School of Medical Sciences (SMS) of the Kwame Nkrumah University of Science and Technology. The delivery of services is both electronic and manual. These Health Information Systems are used to offer a wide range of diagnostic, surgical, and medical care specialist and sub-specialist services resulting in 40 000 in-patient enrolment and 380 000 OPD cases per year.

5.2.1.5 Greater Accra Regional Hospital (Ridge Regional Hospital)

The Greater Accra Regional Hospital (GARH), formerly known as the Ridge Hospital, is located in North Ridge (along Castle Road) in the Osu-Klottey sub-Metro of the Greater Accra Metropolitan Area. It covers a total surface area of 15.65 acres. The GARH's catchment area is the entire Greater Accra District, with an estimated population of more than 4 671 363 (Ghana Statistical Service 2010 census estimate, GSS 2015). However, the following suburbs are in the immediate catchment area: Ridge, Nima, Maamobi, Kanda, Accra New Town, Kotobabi, Osu, La, Adabraka, Achimota, Suburban Area Airport and Central Accra. The hospital has a capacity of 470 beds but growth and development processes are underway to increase bed size into an ultra-modern 620-bed size hospital with a full complement of specialist services that could meet Ghana's increasingly growing capital city's current social needs.

Medical facilities to the general public include Emergency Services, Specialist Dental Services, ENT Services, Family Planning and Cervicare Services, Minimally Invasive Surgical Services, Mortgage Services, Pharmacy Services, Laboratory Services, Radiological Services, Mental Health Services, Spine Health Services, Accident Health Services and Ambulance Services, Maxillofacial Services, Ophthalmology Services, Anaesthesia and Pain Services, Renal Dialysis Services, Endoscopy Services, Child Health Services, Blood Transfusion Services, Physical Therapy and Rehabilitation Services, and Clinical Psychology Services.

The hospital has approximately 54 general practitioners and 40 specialists. The hospital uses both electronic ('Health Pro') and manual systems (e.g. treatment) for clinical, administration and human resources operations to capture medical records, claims, management records and logistics management records as well as financial records for patients. The Health Pro is a

software application that captures clinical information of patients, for example, the treatment sheet is used to record details of patients and drugs that are not in the Health Pro.

Figure 5. 6: The Greater Accra Regional Hospital (Ridge Regional Hospital)
Source: Field Data 2020

Governance of GARH is under the Chief Executive and Administrative Head (the Medical Director) who is responsible for the overall corporate development of the hospital's policies (setting up the hospital's operational plan and enforcing MOH/GHS policies at the hospital). In carrying out his duties, the Medical Director, via the Regional Director of Health Services, is accountable to GHS' Director-General. The exercise of authority and responsibilities by the Medical Director is derived from and in accordance with the GHS and Teaching Hospital Act 1996, Act 525 section 29(1), and the authorities and responsibilities delegated by the immediate superiors.

The heads of the five major Departments of Hospitals, i.e. Heads of Clinical Care, Pharmacy Services, Administration & Support Services, and Finance and Accounting Services are directly under the Medical Director's Office. The Heads of these five divisions serve as line managers but are interlocking with working relationships. Divisional Heads report directly in their daily administration to the Medical Director of the Division. The Heads of Division exercise authority as derived from their duties as well as the authority delegated by and

consistent with their immediate superior (Hospital Medical Director). Division Heads are effectively led, regulated, and accountable to the Medical Director of the hospital.
The Heads of the five Divisions, therefore, form the Core Hospital Management Committee (CHMC) together with the Medical Director and are responsible for the day-to-day administration of the respective groups, with the Medical Director having overall supervisory function over the Hospital Departments.

A Department is the next level of the Division, and a Unit is a component of the Department. Under the current system of hospitals, only one Division, i.e. The Clinical Care Division has Departments and Units under it. The remaining divisions, i.e. (Nursing & Midwifery Services, Pharmacy Services, Administration & Support Services, Divisions of Finance & Accounting Services) have only Units under them. Under the Clinical Care Division, each department is headed by a Departmental Head and reports directly to the Head of Clinical Care. Divisions also exist under the departments. The divisions have heads of responsibility and report directly to Heads of Department. As reported earlier, in addition to the Clinical Care Section, most Divisions have only Unit Heads and report directly to the Divisional Heads. The Administration is independent from the Internal Audit Unit and executes independent audit functions. The unit is accountable directly to the Hospital Building Management Committee, and indirectly to the Medical Director.

5.2.1.6 Brief Description of Police Hospital

In 1976, the Ghana Police Hospital was built primarily to provide quality health services to members of the Ghana Police Force, their families and the general public. It is located at Ring Road East, Cantonment within La Dade Kotopon Municipal District in Ghana's Greater Accra Region, with GL-046-4449 digital address and a projected population of over 221.284 (Ghana Population Census Report 2010).

Figure 5. 7: The Ghana Police Hospital
Source: Field Data 2020

This hospital presently has the following divisions, facilities and units: intensive care unit (ICU); health insurance management centre/health insurance claims office, medical records department. The Out-Patient Department (OPD) is the main reception and consists of a reception desk, four consulting rooms, dressing and injection room; X-ray Laboratory Department, Anesthesia Department; Public Health Department; Physiotherapy Department; and Dialysis Centre. The hospital is composed of six wards: the executive, male, female, maternity, children and OPD wards for patients that require immediate treatment to stabilise or closely monitor the patients. The hospital currently has twenty (20) general practitioners and fifteen (15) specialists. The hospital uses both electronic and manual methods to maintain patient records, hospital management, and logistics processes.

5.2.1.7 Three District Hospitals

Three district hospitals were also assessed. These are Mamprobi Poly Clinic, Dunkwa Municipal Hospital and Agogo Presbyterian Hospital.

Mamprobi PolyClinic is located within the Ablekuma South sub-metro with an estimated population of 257 543 covering a land area of 15.1sq.km. The clinic has eleven (11) General Medical Practitioners and two (2) Specialists. The hospital is organised into Records, Maternity Department, Clinical Department, Pharmacy Department and Public Health and Administration.

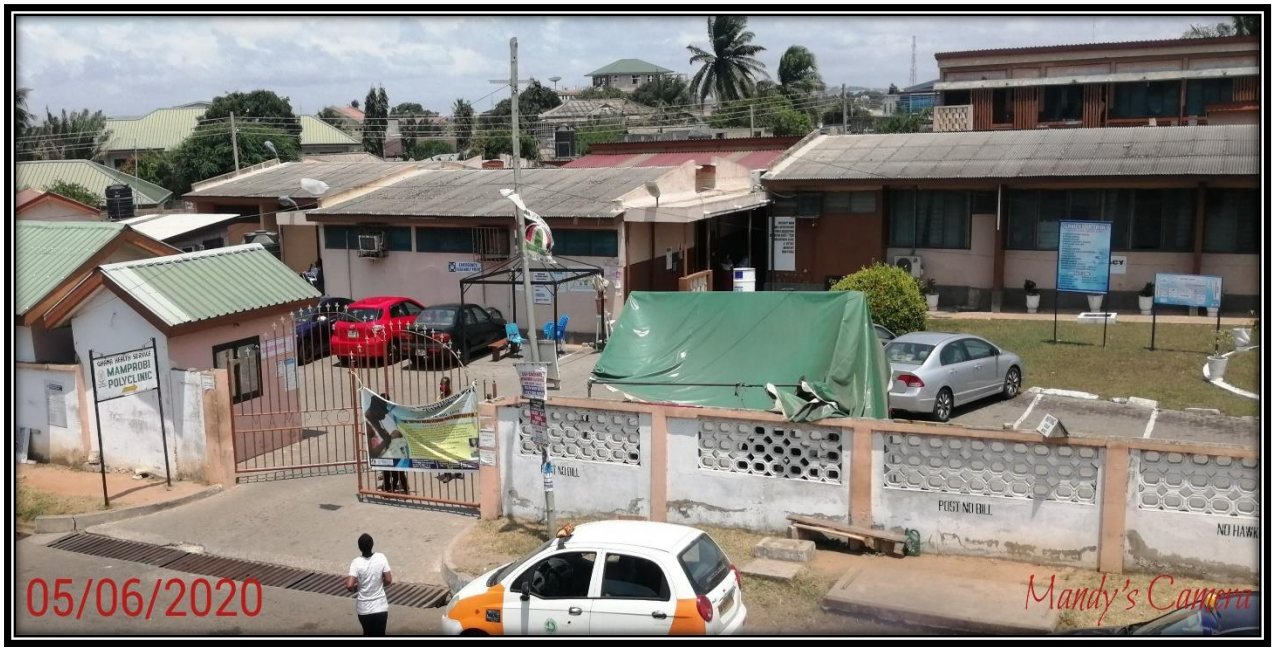

Figure 5. 8: Mamprobi PolyClinic
Source: Field Data 2020.

Dunkwa Municipal Hospital is located at Dunkwa-on-Offin within the Upper Denkyira East sub-metro. The hospital serves a local population of 72 810 with four (4) General Medical Practitioners at the post. The hospital has no Specialists. The activities of the hospital are organised into Outpatient, Dental, Physiotherapy, Otorhinolaryngology (ear, nose and throat) and Administration departments.

Figure 5. 9: Dunkwa Municipal Hospital
Source: Field Data 2020.

Agogo Presbyterian Hospital is a mission hospital in Asante-Akyem Agogo, located within the municipality of Ashanti-Akim North. The hospital serves a population of over 140 694 local people and others from neighbouring countries like Togo, Cote d'Ivoire and Burkina Faso, particularly for ophthalmological treatment. The hospital is designated by the University of Ghana School of Public Health and MOH/WHO as a collaborating centre for the Buruli Ulcer Surgical Management Training Centre. It is also one of two sites in Ghana and among 11 sites in Africa, for malaria vaccine testing. The hospital has the following departments: internal medicine, general surgery, infant health, obstetrics/gynaecology, dentistry, pharmacy, ophthalmology, ultrasound, endoscopy, electrocardiography, physiotherapy, and laboratory facilities. The hospital is made up of six (6) specialists and thirty-six (36) general practitioners, with over 400 other medical and support staff.

Figure 5. 10: Agogo Presbyterian Hospital
Source: Field Data 2020.

5.2.1.8 Brief Description of the Trust Hospital

The Trust Hospital is a quasi-government hospital controlled and managed by Social Security and National Insurance Trust (SSNIT). Trust Hospital was founded in 1992 to provide healthcare to SSNIT workers and their dependents as a non-profit health facility. Subsequently, the facility was expanded to a fully-fledged hospital to extend its services to the public. It has three (3) primary hospital facilities known as the Trust General Hospital, The Specialist Hospital and The Mother and Child Hospital, and six (6) satellite clinics. Data was collected

for the present study from the Trust Specialist Hospital at Kuku Hill (Angola Road; Digital Address: GA-055-5313) within the sub-metro of Osu Osu-Klotey. Ophthalmology**;** Ear, Nose, and Throat (ENT)**;** Dental**;** and Physiotherapy are the main departments with two (2) theatres. There are thirty-four (34) general practitioners and twenty-four (24) specialists in the Specialist Hospital.

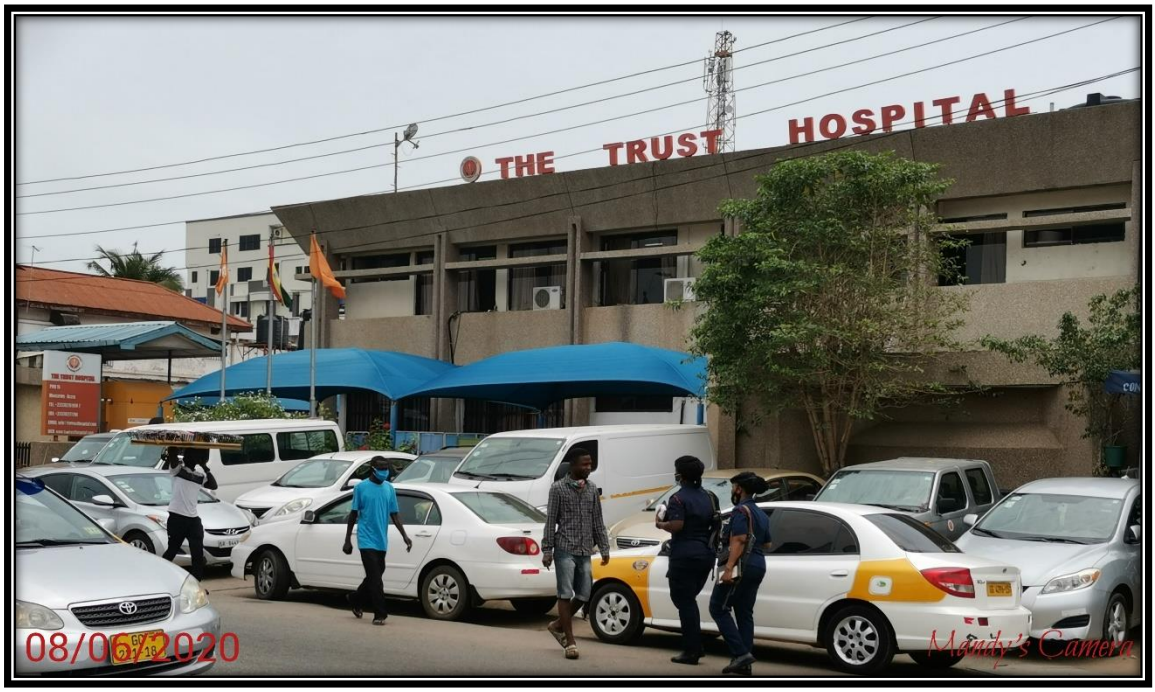

Figure 5. 11: The Trust Hospital
Source: Field Data 2020.

5.3 Quantitative Data analysis

This section provides detailed description of the quantitative data analysis that was used in this study.

5.3.1 Assessment of staff characteristics

The study examines the demographic characteristics of health workers. This was necessary because according to Rogers (1962), the Innovation Diffusion Theory (IDT) states that there are different users of innovation borne out of technology or any other that reacts differently to its adoption due to differences in their characteristics. These differences in characteristics have a great influence on how innovation is diffused and used. Therefore, to properly understand Health Information System adoption and usage by these health workers, there is the need to identify and analyse their characteristics. Nevertheless, it should be understood that the researcher has an interest in developing a HIS framework that is easy to adopt with less or no

signs of user discomfort. It is important to understand the characteristics of the target population to be successful in promoting the HIS framework.

Taking advantage of their background, four categories of participants were selected for the study: medical doctors, nurses, administrative and health information professionals. The descriptive characteristics assessed for medical doctors and nurses were: gender, age, professional status (medical doctors only) and the department of work. For administration and health information professionals, gender, age and professional status were assessed. The results are presented in Tables 5.4 and 5.5 below.

5.3.2.1 Characteristics of medical doctors and nurses

Medical Doctors: Three-quarters of the medical doctors were represented by male gender *(n =15, 75%)* while one quarter were represented by their female counterparts *(n = 5, 25%)*. A greater percentage of the medical doctors were within the 30-39 years age bracket *(n = 7, 35%)*, age brackets 40-49 years and 50 years and above were equally represented by 25% each, while 15% of them were within the ages of 21-29 years. Sixty-five (65%) per cent of the doctors were represented by Junior Medical doctors whilst 35% were Physicians. Fifty per cent (50%) of the doctors work at the Medical Department whilst one (1) each work in three departments (Anesthesia, Outpatients and Accident & Emergency).

Nurses: The greater majority of nurses were women *(n = 17, 85%)* with most indicating that they work at the Medical Department *(n = 8, 40%)*. In terms of age, most fall within the age bracket 30-39 years of age *(n = 12, 60%)*.

Table 5. 4: Descriptive statistics for Doctors and Nurses of the 10 hospitals

Characteristics		Categories	
		Doctors	Nurses
		Frequency *(%)*	Frequency *(%)*
Gender Male		15 *(75.0)*	3 *(15.0)*
	Female	5 *(25.0)*	17 *(85.0)*
Age (yrs.)	21-29	3 *(15.0)*	6 *(30.0)*
	30-39	7 *(35.0)*	12 *(60.0)*
	40-49	5 *(25.0)*	2 *(10.0)*
	≥50	5 *(25.0)*	-
Status	Physician	7 *(35.0)*	-
	Junior Medical Doctor	13 *(65.0)*	-
Department	Medicine	10 *(50.0)*	8 *(40.0)*

Obstetrics/Gynaecology	2 *(10.0)*	-
Anaesthesia	1 *(5.0)*	-
Surgery	3 *(15.0)*	3 *(15.0)*
Dental	2 *(10.0)*	-
Public Health Unit	-	1 *(5.0)*
Outpatient	1 *(5.0)*	6 *(30.0)*
Accident and Emergency	1 *(5.0)*	2 *(10.0)*

Source: Field Data 2020.

These outcomes reflect some reality within the Ghanaian medical field. By conventional wisdom, medical doctor professionals are dominated by the male gender whilst the female gender dominates the nursing profession. However, there has been a steady increase in the number of males in the nursing profession and similarly with the female gender in the medical doctor's field. Also, it was observed that the majority of the medical doctors and nurses were within the age brackets 30-39 years and work at the medical departments of the medical facilities where data was collected.

5.3.2.2 Characteristics of administrative and health information professionals

Most administrative workers represented for the study were identified as female *(n = 11, 55%)* whilst the health information professionals were heavily represented by the male gender *(n = 17, 85%)*. The majority of these professionals fell within the 30-39 years of age bracket *(Administration = 65%; Health Information = 55%).* Administrative Managers were 45% represented whilst Health Information System Managers were 30%. This meant that more of the representation of these two categories were represented by staff and officers.

Table 5. 5: Descriptive statistics for Administrative and Health Information Professionals

Characteristics		Categories	
		Administration	Health Information
		Frequency *(%)*	Frequency *(%)*
Gender Male		9 *(45.0)*	17 *(85.0)*
	Female	11 *(55.0)*	3 *(15.0)*
Age (yrs.)	21-29	3 *(15.0)*	3 *(15.0)*
	30-39	13 *(65.0)*	11 *(55.0)*
	40-49	3*(15.0)*	6 *(30.0)*
	≥50	1 *(5.0)*	-
Status	Manager	9 *(45.0)*	6 *(30.0)*
	Staff/Officer	11 *(55.0)*	14 *(70.0)*

Source: Field Data 2020

5.3.3 Assessment of staff HIS exposure

The first objective of the study assessed doctors, nurses, administrative and health information professionals on health information system exposure and perceptions. This assessment was considered significant because the Actor-Network Theory (ANT) by Callon and Latour (1992) and the Innovation Diffusion Theory (IDT) by Rogers (1962) all point to the familiarity of actors (users) to the innovation in place and their perceptions regarding the use of the innovation. The HIS framework espoused by this researcher is intended to be an improvement in the existing HIS. Therefore, to be able to suggest an appropriate framework that ensures efficient and effective healthcare delivery at these health facilities, there was the need to assess health workers (staff) exposure to HIS so far. There are instances where health workers have been exposed to health information systems only once but do not use it. To resolve that possibility, the researcher assessed health workers for their HIS exposure using three key and critical indicators: HIS usage, Computer Skills and HIS Training. These are further discussed in the sequence below:

5.3.3.1. Health Information System Usage

Respondents for the current study were asked to indicate the type of health information system being used in their day-to-day activities and what facilities they work with. Two major forms of health information systems indicated are manual/electronic HIS and electronic only HIS. Results are presented in Table 5.6 below. In addition, the researcher examined the number of patients each doctor and nurse treat per day using the HIS system and the duration it takes them to record or collect patient health records for a single patient (see Table 5.7).

Table 5. 6: Summary of frequency and percentage of health professionals response to Health Information System usage

HIS System	Frequency	Percentage (%)
Manual/Electronic	57	71.2
Electronic only	23	28.8

Source: Field Data 2020

In all, it was identified that each of the ten (10) hospitals studied have diffused the use of technology in the daily administrative and medical functions of the hospital. Despite this encouraging observation, it was identified that only 23 respondents representing 28.8 per cent did indicate that their operations are fully electronic whilst the greater majority *(n = 57, per cent = 71.2)* used both manual and electronic systems concurrently. Therefore, it could be

understood that innovation in terms of usage of technology in the delivery of healthcare services is widely used by these hospitals but only a few hospitals have fully implemented this sufficiently to discard the old manual system whilst the greater majority of the hospitals still uses both the manual and the electronic system.

Usage of HIS by doctors and nurses

In terms of how many patients are treated per day by medical doctors and nurses in the ten hospitals studied, it was observed that the minimum number reported is 6 patients and the maximum is 40 patients. On average, the doctors and nurses treat about 21 patients per day. The minimum time it takes these professionals to record the health information of each patient is 3 minutes and the maximum reported is 30 minutes. The average time nurses and doctors use in recording each patient information is 15 minutes.

Table 5. 7: Summary mean and standard deviation for a patient treated per day and duration for patient's health records

HIS parameters	N	Minimum	Maximum	Mean	Std. Deviation
Patient Treated per day	40	6	40	21.22	9.612
Duration (*in minutes*)	40	3	30	14.58	7.455
Sample	40				

Source: Field Data 2020

5.3.3.2. Health Information Training

Health information Training was examined using three thematic areas: HIS training (percentage included); adequacy of HIS training; and the areas of HIS training. In terms of HIS training and its adequacy, the majority *(n = 71, 88.8%)* of participants indicated they had training and fewer *(n = 9, 11.2%)* participants indicated no training on health information systems. Among the medical doctors, nurses, administrative and health information professionals who did indicate that they have had training in health information systems ranges from 15 to 100% of staff. Therefore, the nine (9) who did indicate that they have had no training could be among the percentage yet to receive training. Among those who indicated that they have had training on a health information system, one *(n = 1, 1.3%)* person believes that the training is highly adequate, one *(n = 1, 1.3%)* thinks that it is partially adequate and sixty-nine *(n = 69, 86.8%)* believed that the training is adequate (*see* Table 5.8).

Table 5. 8 : Summary of descriptive statistics of HIS training and HIS training adequacy of doctors, nurses, administrative and health information professionals.

HIS Training			HIS Training Adequacy		
Category	Frequency	%	Highly Adequate	Adequate	Partially Adequate
Yes	71	88.8	1*(1.3%)*	1*(1.3%)*	69 *(86.2%)*
No	9	11.2	-	-	-

Source: Field data 2020.

Medical doctors and nurses who received HIS training at the various facilities did indicate that they were given basic training on the use of health technology especially for medical and nursing records/care. The HIS training for the health information managers and officers covers system, updates, security, operations of the system, collecting, managing and transporting patients and staff data. Administrators, on the other hand, received training on using the HIS system for procurement, human resources management and control, and basic administrative processes (such as data entry, retrieval, storage, health information analysis, data trouble shooting and data security).

The reasons provided by those who have not yet received HIS training were: financial challenges, hospital administrators not informing staff, poor organisation and management, poor appreciation of the importance of HIS, lack of staff involvement, limited or inadequate tools, and appropriate logistics.

5.3.3.3. Computer Skill

The participant's computer skills and health information usage were examined by asking them to rate their knowledge of using routine applications such as Microsoft Office, and how often they use a computer. The result is presented in Table 5.9 below. As indicated in Table 5.9 below, 43.8 *per cent* of the participants rated their computer knowledge in using routine applications such as Microsoft Office as excellent, 37.5 *per cent* as good and 18.7 as satisfactory. None rated him or herself as poor. The majority were found to be regular users of a computer with just a few indicating that they are occasional users. Their knowledge and

frequency use of computers do indicate that participants of the study had satisfactory to excellent computer skills.

Table 5. 9: Summary descriptive statistics of computer skills and health information usage of doctors, nurses, administrators and health information professionals.

	Knowledge of Routine Application Usage				*Usage*	
Category	Excellent *(%)*	Good *(%)*	Satisfactory *(%)*	Poor *(%)*	Regular *(%)*	Occasional *(%)*
Doctor	6 *(30.0)*	*10 (50.0)*	4 *(20.0)*	-	17 *(85.0)*	3 *(15.0)*
Nurse	8 *(40.0)*	4 *(20.0)*	8 *(40.0)*	-	17 *(85.0)*	3 *(15.0)*
Administrator	5 *(25.0)*	12 *(60.0)*	3 *(15.0)*	-	19 *(95.0)*	1 *(5.0)*
HIP	16 *(80.0)*	4 *(20.0)*	-	-	20 *(100.0)*	-
Total	*35 (43.8)*	*30 (37.5)*	*15 (18.7)*	-	*73 (91.3)*	*7 (8.7)*

HIS-Health Information Professionals; ICT System use (n = 80; 100%)

Source: Field Data 2020.

On category-specific, half (representing majority) of the medical doctors who took part participated in the study had good computer skills, followed by excellent skills and satisfactory in that order. Nurses on the other hand had equal representation of excellent *(40%)* and satisfactory *(40%)* computer skills with 20 per cent having good computer skills. Hospitals administrators also produced majority with good computer skills, followed by excellent and satisfactory in that order. A greater percentage of health information professionals indicated excellent computer skills as expected and a few indicating good computer skills. These outcomes indicated that staff who were part of the research may not have serious problems with using health information systems at the health facilities.

5.3.4 Perceptions of staff on Health Information System

The study's second aim is to use the TAM (Davis 1989) to assess the adoption of technology in the aspects of utility and ease of use. The objective was to capture users' perceptions of HIS in terms of:

- the easy facility of HIS work functions
- satisfaction with functions of the current HIS system (i.e. storage, process, security, time-saving and confidentiality)
- accurate and complete HIS information
- perceived benefits and usefulness to the hospital.

The analysis was done using seven (7) thematic questions. Detailed results are presented in Table 5.10 below.

Table 5. 10: Summary of descriptive statistics of Health Information System exposure

Health Information System Exposure	Response *(%)*		
	Yes	No	Both
Use ICT System to collect/record patient health information	80 *(100.0)*	-	-
Basic ICT infrastructure for rapid compilation at hospital	80 *(100.0)*	-	-
Satisfied with confidentiality of HIS system at hospital	59 *(73.8)*	21 *(26.2)*	-
HIS system provides accurate and complete information	53 *(66.3)*	26 *(32.5)*	1 *(1.2)*
Perceived secure nature of HIS system	71 *(88.8)*	9 *(11.2)*	-
Quality and effective ease of use of HIS system	66 *(82.5)*	14 *(17.5)*	-
HIS system is beneficial to the hospital	80 *(100.0)*	-	-

Source: Field Data 2020.

Theme Question 1: Do you use an ICT system or application to collect and record patient health information?

Health professionals (doctors, nurses, health information and administration) were asked whether they use basic ICT systems in their everyday activities at the workplace. As seen in Table 5.10 above, all these professionals (100%) indicate that they do. This means that these staff have been exposed in one way or the other to information technology at the workplace.

Theme Question 2: Is there basic ICT infrastructure (computers, telephone and internet access) at the hospital for rapid compilation of data?

All participants (100%) indicated that their health facilities have an ICT system and applications to collect and record patient health information. They all also indicated that their hospitals have basic ICT infrastructure such as computers, telephones and Internet access for rapid data compilation (see Table 5.10).

Theme Question 3: Are you satisfied with the current storage, process, security, time-saving and confidentiality provided by the health information system?

The majority of the participants *(n = 59, 73.8%)* stated their satisfaction with the current storage, process, security, time-saving and confidentiality that is provided by the health information systems whilst 26.2% thought otherwise.

Theme Question 4: Do you think the way in which patient health information is recorded provides accurate and complete information?

A greater percentage of the respondents *(n = 53, % = 66.3)* responded that the way patients health information is recorded provides accurate and complete information. One person *(1% = 1.2)* stated both yes and no; however, 26 (32.5%) underscored that the way patient's health information was recorded does not provide accurate and complete information.

Theme Question 5: Do you perceive that your stored information on your HIS system is secure?

In terms of the HIS system they are exposed to, 71 (88.8%) participants stated that their stored information on the HIS system is secured, whilst 9 representing 11.2% thought otherwise. In effect it could, therefore, be interpreted that the majority of the respondents trust the secured nature of their HIS system within their facility.

Theme Question 6: Do you perceive the quality and format used for sharing information among healthcare professionals to be effective and ease to use?

A greater percentage of the respondents (82.5%) indicated the quality and format used for sharing information among healthcare professionals to be effective and ease to use while 17.5% stated otherwise.

Theme Question 7: Do you perceive the usage of an electronic system for recording, sharing, storing and transferring patient health information to be beneficial and useful to the hospital?

All participants (100%) indicated that the HIS system in their health facilities are beneficial and useful for recording, sharing, storing and transferring patient health information (see Table 5.10).

5.3.5. Assessment of Health Information System Features

The third objective of this study was to assess features of the HIS adopted by health facilities. The health information system is an interactive system of technological and human resources (Actor-Network Theory), the features are best assessed by the human resources (health workers) who use the technology. On that note, health workers were made to assess the features of the HIS alongside nine thematic areas. These are relevance, timeliness, accuracy, availability, accessibility, confidentiality, observability, compatibility and interoperability.

Respondents were asked to rate these features on a 5-point scale ranging from 1 (very good), 2 (good), 3 (satisfactory), 4 (unsatisfactory) to 5 (poor). The results of the respondents' views regarding these features in line with the response scale are presented in Table 5.11 below.

Table 5. 11: Summary of Descriptive Analysis of Health Professionals' Perception on the Features of their Health Information System

Features	Very Good	Good	Satisfactory	Unsatisfactory	Poor
Relevance	28 *(35.0)*	34 *(42.5)*	17 *(21.3)*	1 *(1.2)*	-
Timeliness	17 *(21.3)*	33 *(41.5)*	24 *(30.0)*	3 *(3.6)*	3 *(3.6)*
Accuracy	17 *(21.3)*	36 *(45.0)*	19 *(23.7)*	4 *(5.0)*	4 *(5.0)*
Availability	20 *(25.0)*	31 *(38.8)*	24 *(30.0)*	5 *(6.2)*	-
Accessibility	22 *(27.4)*	33 *(41.5)*	18 *(22.4)*	6 *(7.5)*	1 *(1.2)*
Confidentiality	25 *(31.3)*	29 *(36.3)*	14 *(17.5)*	9 *(11.3)*	3 *(3.6)*
Observability	46 *(57.5)*	24 *(30.0)*	9 *(11.3)*	1 *(1.2)*	-
Compatibility	40 *(50.0)*	30 *(37.7)*	5 *(6.2)*	2 *(2.5)*	3 *(3.6)*
Interoperability	-	-	-	-	80*(100)*

Source: Field Data 2020.

Analysis of the features in Table 5.11 indicated that 42.5% of the respondents (the majority) perceived the relevance of their health information system as good; 35% perceived it to be very good whereas one person perceived it to be unsatisfactory. In terms of timeliness, 41.5% perceived it to be good and 3 each perceived it to be unsatisfactory and poor. In terms of HIS system being accurate, 45% indicated good while 3 each perceived it to be unsatisfactory and poor. However, 38.8% perceived their HIS system to be available. In terms of accessibility, 41.5% perceived HIS as good and 36.3% underscored that the system provides good confidentiality. Assessment of the HIS ability to make data available for easy monitoring revealed that the majority (*57.5%*) of health workers stated it is very good. Also, 50% of the health workers indicated that the HIS is very compatible whilst 100 % stated that the current HIS is poor on interoperability.

5.3.6 Assessment of Health Information System Functions

The fourth goal analysed the roles of the health information system that the health facilities had implemented. The health information system functions were examined along with five themes: data acquisition, data transfer, data processing, data storage, and retrieval. Respondents were asked to rate these characteristics from 1 (very good), 2 (good), 3 (satisfactory), 4

(unsatisfactory) to 5 (poor) on a 5-point scale. The results of the respondent's views on the functions according to the response scale are summarised in Table 5.12 below.

Table 5. 12: Summary of descriptive analysis on perception of health professionals on the functioning of their Health Information System

Functions	Very Good	Good	Satisfactory	Unsatisfactory	Poor
Data Collection	24 *(30.0)*	44 *(55.0)*	8 *(10.0)*	3 *(3.8)*	1 *(1.2)*
Data Transmission	15 *(18.8)*	39 *(48.8)*	19 *(23.7)*	5 *(6.2)*	2 *(2.5)*
Data Processing	11*(13.7)*	39 *(48.8)*	24 *(30.0)*	4 *(5.0)*	2 *(2.5)*
Data Storage	27 *(33.7)*	28 *(35.0)*	16 *(20.0)*	7 *(8.8)*	2 *(2.5)*
Information Retrieval	20 *(25.0)*	27 *(33.8)*	17 *(21.2)*	12 *(15.0)*	4 *(5.0)*

Source: Field data 2020.

The greater percentage of the respondents (55%) indicated that the data collection function of their health information system is good while 5% viewed it to be unsatisfactory and poor. The data transmission function of the health information system was perceived to be good by 48.8% of the respondents, 18.8% perceived it to be very good whereas 8.8% perceived it to be unsatisfactory and poor. The majority of respondents perceived the data processing of their health information system as very good and good whilst 7.5% perceived it to be unsatisfactory and poor. In addition, 68.8% underscored that data storage of their health information system as very good and good although 11.3% perceived it as unsatisfactory and poor. The majority perceived the information retrieval aspect of the health information system as very good and good whilst 20% indicated that it is unsatisfactory and poor. In all, even though the majority perceived their health information system as very good and good, there were pockets of respondents who perceived the functions of their HIS as not being the best.

5.4 Qualitative Data Analysis

The qualitative research tackled two major goals: firstly, to analyse the perspective of healthcare experts on the benefits and limitations of the current health information system. Secondly, to analyse the suggestions of health practitioners to enhance the quality of the current health information system. The subsequent report presents three aspects of the results as follows:

- the first segment summarizes the general understanding and questions about the system of health information

- the results on the strengths and shortcomings of the current system of health information
- finally, the conclusions of these health practitioners in relation to the general policy they have endorsed.

For easy identification of sources of interview quotes, the researcher used certain codes to label the responses. The initials '*LMD*' meaning 'Lead Medical Doctor' is used together with figures ranging from 1 to 4 to represent participants' responses. Other initials meaning, '*LN*' meaning 'Lead Nurse'; 'LAS/LAM' meaning 'Lead Administrative Staff/Lead Administrative Manager'; 'LHIO/LHIM' meaning 'Lead Health Information System Officer/Lead Health Information System Manager'. For example, 'LMD 1' referred to the first lead Medical Doctor in the face-to-face interview conducted by the researcher.

5.4.1 General experience and concerns on the HIS

The main concern shared by the majority of the respondents was that the HIS is a very significant aspect of healthcare in every hospital. Therefore, it should be given more attention to meet the goal of providing the best healthcare. Under this subsection, several other concerns regarding the health information system were provided by health professionals (medical doctors, nurses, hospital administrators and health information officers) to address the fifth objective of the study: the investigation of health workers' expectations of the HIS in their health facilities. The main concerns were about the two aspects of the health information system: computer equipment and human resources. These are detailed below:

5.4.1.1 Health Information Equipment

According to these professionals, the health information system as adopted by their health facilities assists them to effectively deliver their everyday services to the general public. However, there were issues relating to the electronic equipment put in place for the health information system in terms of inadequate logistics, electricity, internet connection and the ICT system. These are further discussed in sequence as follows:

- ***Inadequate Logistics***

While the health workers believe that the HIS has the potential to ease the real-time required to perform every hospital task, they recognised the need for state-of-the-art computers and other health logistics as the present equipment for the HIS adoption is inadequate. Some respondents indicated that the computers and other equipment they use are obsolete which

defeats the good intentions of the hospital management. The following excerpts are from statements that made reflect these comments on inadequate logistics:

> *…Lack of state-of-the-art computers and network challenges make the health information system usage a bit terrible (LAM 1).*
>
> *…Obsolete computers and accessories slowing down work (LAM 2).*
>
> *…The HAMS (Hospital Administration and Management System) system is doing well but inadequate computers at all vantage points coupled with frequent light off and network fluctuation impedes the smooth functioning of the system (LN 1).*
>
> *…There are few computers in every unit but they are inadequate. There are not enough computers to help store and process patient nursing care activities in the unit, hence more computers should be provided (LMD 1).*

While these narratives suggest the fact that the electronic health information system is beneficial and helps to successfully and effectively execute everyday tasks, the general concern is also about the obvious glaring threat and dangers due to inadequate and obsolete health information equipment.

- ***Electricity Power***

A further experience shared was about electrical power. While health workers at the Teaching, Regional and quasi-government hospitals were satisfied with the operation of their equipment, they were also concerned about the unstable electricity supply. Although some health facilities have generators to switch over to when electricity fails, others reported that the unstable power supply is a challenge due to outdated machines operating. Consequently, when there is a power cut, it takes time for their machines to reboot when power is restored. The following excerpts are taken from various comments by health professionals regarding electricity:

> *…The HAMS (Hospital Administration and Management System) system is doing well but inadequate computers at all vantage points coupled with frequent lights-out and network fluctuation impede the smooth functioning of the system (LN 1).*
>
> *…The machines we use are a bit old and take time to reboot. With this computer problem, we usually experience an erratic power supply which makes our work difficult (LHIO 1).*

…We use electronics only for our operations within this facility. With the possible lights-out situation, there is also a generator set/plant fixed by management to support. Anytime there is lights-out, it automatically switches over to the generator and work comes back on track (LHIM 1).

The above narratives by respondents showed the reality of the situation on the ground. Indeed, in most parts of the country, frequent power outages are experienced in the regional hospitals. Those hospitals with limited resources, therefore, have to use manual methods to ensure that work gets done normally. This could also explain why the majority of the hospitals that were studied, use both electronic and manual health information systems to operate. In the same vein, some of these hospitals have found a solution to the electricity shortcomings and have adequate backup systems in place to take over, should such a problem arise.

- ***Internet Connection***

The Internet is a vital component of the health information system to ensure that information is transferred to other units electronically. Those hospitals with fully electronic systems and an internet connection have to be constantly operating for work to be effectively carried out. On that note, the researcher observed two different perspectives. Some think that their internet connection is good but can be improved while those who think their internet is poor needs immediate attention. The following are excerpts from these respondents:

…One big problem I have seen is the internet connection. It is very bad and slow, hence makes work difficult and annoying. Therefore, I think the network or internet should be looked into in order to speed up work (LMD 1).

…The internet we use is one of the best found in health facilities. Even though it is good, I believe that more can be done in order to make it the best in Ghana (LHIM 2).

…Data is important for the work we do. So making data networks available to all constantly will go a long way to help us (LN 4).

…Our internet system is not strong, sometimes in the process of writing a patient's history, the network can go off and you lose all information (LN 3).

As stated earlier, the illustrative quotes show the varying experiences of these health workers. Whilst one group experiences a more comfortable health information system environment,

others face the discomforting side of the system. The call for an improved electronic health information system suggests that there is a need for these workers to get stable internet access. As these respondents clearly stated that a poor connection slows down work and a good connection speeds up work.

- ***ICT System***

The respondents also mentioned the information communication technology system that implements the health information at the workplace. To a sector of respondents, the hospital has a effective ICT system that is used for healthcare delivery within the facility. The system is very efficient to the point that the ICT for health-related work is reliable in giving consistent results at any time. Another group also underscored the challenges the system creates. To them, the system is poor to the point that data capturing and reliability of the information for performance review is a problem. In addition, they think that the system is not up to standard, therefore, the need for a massive improvement. Samples of the varying views are presented below:

> *...Data capturing, reliability of the information for performance review and systems stability are all not up to expectations (LAM 3).*

> *...The system being practised here is not very effective because there are times we have challenges with the intercom and other times too, patients misplace their folders containing this vital information. This is because patient health information is been recorded manually in the patient's folder whilst admissions, discharges and treatment regimens are recorded in the computers provided for the unit (LMD 1).*

> *...There is a strong Information Communication Technology (ICT) system in the facility (LMD 1)*

> *...The system is very reliable (LHIM 2).*

According to health workers, a health information system at one end is reliable while at the other end, it is unreliable. This outcome shows that everything regarding the health information system is not perfect and requires some improvement.

5.4.1.2 Human Resources

Respondents shared their views regarding human resources pertaining to health information systems. According to these respondents, some of the problems that arise from the failure of a health information system is not the system per se, instead, some of our staff do not have the appropriate technological knowledge to operate the system. In addition, the commitment level of health workers to adequately use an electronic system to deal with patients' health needs do play a major role. The issues raised are the upgrade of health workers HIS knowledge, staff appreciation and motivation, poor staffing and support.

- ***Upgrade of health professionals' computer and health technology skills***

According to these professionals, one observation made is the inadequate knowledge level of staff with regards to how to effectively and efficiently use the health information system deployed. They believe that the HIS system makes work easier and they are being encouraged to use it but inadequate knowledge makes the system dysfunctional. For this group, motivating and continuous training of staff on HIS system usage is an ideal plan for the sustainability of the system. The excerpts below reflect the points made above:

> *…As we all know, technology is evolving, many a time there will be new software and upgrade, hence hospital staff have to keep up with such changes. This can be a struggle for the hospital in terms of finance to keep everyone upgraded but staff need this professional upgrade for efficient and effective service delivery (LN 3).*

> *…Information systems help to create, manage and accurately provide information. Though limited in health institutions, very little can be used as a great deal, to promote better healthcare through proper training of health professionals (LAS 1).*

> *…There should be regular in-service training on electronic usage (LMD 1).*

> *…Operational and upgrading of skills of new changes in the software (LHIM 1).*

The views of the above respondents clearly showcased their major concern regarding the need for staff training. They realize the competitiveness and the fast pace of the changing trends of technological knowledge, wisdom and dexterity hence their desire to live up to the standards and expectations of their profession. They believe that the route to achieve this expectation is adequate in-service training of staff on the use of health information systems. At the same time one respondent realized the capital and financial stress it poses to these health facilities.

However, the respondents believe that they have no other choice than to do it because the benefit thereof supersedes the financial drain they may face.

- ***Staff appreciation and motivation***

Respondents addressed the health information system at their health facilities by drawing attention to the non-appreciation by health workers of the system. They argue that the problem of a health information system could also be placed on the pillar of workers' poor appreciation of the importance of such a system. Once these workers fail to appreciate the importance and the need for an electronic system, they are not committed and motivated in seeking proper patient management knowledge and fail to use it consistently.

> *…Commitment of staff to learn and to use the existing health information to properly manage patient's health conditions (LMD 1).*

> *…Poor appreciation of the importance of health information systems and their impact on policy development and patient management. Due to that, some of them prefer using the manual system even though they have the opportunity to use the electronic system (LMD 4).*

> *…Some health workers' knowledge on HIS is not the best and they appear not to appreciate the relevance of health information as well as data security, hence allowing people to have access to their personal space on the portal (LAM 3).*

These narratives, therefore, portray the need for health workers beliefs about a health information system to be corrected. The implication of these behaviours is that money has been spent in making healthcare delivery efficient but despite the little done, the systems are not effectively used by workers, which is essentially money going to waste

- ***Poor staffing***

Staffing as a system had its fair share of the experience of a health information system. These respondents feel that health information could have been better if the staffing process and the staff are competent. They think that the staff employed to run the system are of low quality hence impacting HIS negatively. The issue is that the health information professionals employed to work for the facilities in most cases lack adequate knowledge on advanced ICT and they have either low or no knowledge about health management. The staff in charge for

instance fail to involve other staff in terms of taking decisions on ICT setup to deliver efficient healthcare. To them, this lack of involvement creates a missing link or void for HIS to fail. The relevant excerpts are as follows:

> *...Poor staffing of healthcare workers makes it difficult to adapt to electronic health information systems (LMD 4)*
>
> *...Lack of staff involvement as they do not enjoy linguistic information (LHIO 4).*
>
> *...The way staff are employed within the facility is very poor. In most cases, the staff that get access to work here are based on 'Who knows you'. This is perhaps the basis for the many errors they make. Remember, this is a government hospital and staff here operate it as if it is their family and friends' business. Really! We got to be serious because it is really killing the hospital. Our HIS system is not the best because the one responsible is clueless but who are you to speak, the in-charge is a cousin of a director. So we have to pretend everything is fine and work, hmmm (LAS 3).*

The narratives give a clear association between competent human resources and innovation. Innovation comes about when responsible people are knowledgeable in their field when people do not have adequate knowledge and skills, the outcome will always be absurd. That is what these respondents are alluding to. By implication, respondents believe that their health information system weakness is not the system but rather weak human resource to take that vital and competent innovative decision.

- ***Support***

The health information professionals who are responsible for instituting better and high performing electronic health information systems underscore that support from the top hierarchy of the hospital management is key. Those facilities with weak health information systems stated that their current state of affairs is partly resulting from management. According to them, management failed to act in good conscience. In most cases, they have the innovation and desire to strengthen the health system of the hospital but it appears management also has a different agenda. Sample views are as presented below.

…Lack of support for decision-making tasks [include]: to update existing information, sharing information through decentralised computing and financial support to procure IT tools to innovate the current HIS to suit the present needs (LHIO 4).

…We know that an effective Health Information System requires proper training of the users. There are many times we would like to train staff and also upgrade our knowledge but anytime we put forth such proposal across management they seem not to care. It appears their focus is on something else but not how to operate with efficiency. What I can say is that probably they are okay with the current functioning of the health information system (LHIM 3).

…our management supports us greatly. Anytime, we the health information professionals approach management regarding our intentions and plans capable of making us realise some of the objectives of the policy, they quickly organise a meeting for us to discuss. Also, they encourage us to discuss our strategy with all heads of departments for their input so that our system becomes comprehensive enough for the health facility (LHIM 4).

These narratives suggest that the necessary support is not forthcoming for quality planning, procurement and implementation of the electronic health information system. They believe this is one of the contributing factors that made the total adoption of an electronic health information system an abysmal and difficult venture. Despite this obvious challenge, there is one (1) person who believes that the conditions at his facility are different. In this facility, management responds promptly and goes the extra mile to support the ICT agenda as stipulated in their ICT health policy. This implied that some staff members are determined to achieve greatness in the health sector of Ghana by implementing the appropriate facilities.

5.4.2 HIS Policy

Respondents expressed their views about the HIS policy used by their health facilities. According to those respondents, they are expected and obligated to adhere to the general HIS policy framed by the Ghana Health Service. The National Health Policy (ICT for Accelerated Development-ICT4AD) of the Ghana Health Service has four main objectives. First, the development of information and communication technology infrastructure within the health sector. This is done by networking all health institutions and by providing effective ICT resources to implement and manage services. Secondly, improving access to and control of health information through the implementation of a health information dissemination network

and a health information systems network. Thirdly, by introducing health sector telemedicine technologies and using ICTs to improve referral, emergency and disaster response systems, improving access to quality health services. Fourthly, to increase awareness, capacity and use of ICT among health workers, by offering ICT skills training to prospective and current health workers; by retaining a vital network of ICT specialists in the health sector; and by deploying ICTs to help and improve job functions for health workers. This is a full quote from one health information manager at one of the facilities:

> *…The ICT policy used in this hospital covers two points on the system. They are gathering information or data and prevent the system from hackers. The first part of the policy adheres to the four main objectives stipulated in the Ghana Health ICT for Accelerated Development (GH ICT4AD). With that, we have what we call the Health Pro that is used by all the health professionals in the facilities not exempting the administrative staff and the Navision which is only used by the finance department. The HIS runs on both Intra and the internet and also the server uses a solid-state drive (SSD). The main issues are instability of the internet and sometimes very slow response from the server when there are plenty of queries being entered into the system. To solve this, the hospital has engaged three different internet providers namely; Comsys, Vodafone and Surfline. In terms of telemedicine, the facility has what we call the CarePro which is a doctor and patient interaction system application. With this and a summary of the discussion of the proposed Health Information Systems framework, there is only a few doctors who use the App for consulting and treatment. The idea is to know how best it works, after which we will migrate all significant staff who may be in the position of given instruction the chance of using it. The policy that regulates all these developments are geared towards making the healthcare delivery at the hospital attractive. The second part of the policy is procedures for protecting the system from hackers, the servers are protected with modern efficient firewalls, Sophos and Panda Antivirus. Database/security administrators also restrict access to Facebook/and other social media platforms to all staff during working hours to secure the system. In case a disaster occurs or a problem with the HIS system, there is a Disaster Recovery Site (DRS) which helps with backup. Automatically the system backups at dawn when there is less pressure on the system. It is the responsibility of various departments to request an upgrade of the system from the Health Information System Manager (HISM) to suit their daily routine. The HISM re-educates staff anytime there is a system upgraded. In*

addition, every department has protocols that serve as guidelines on the system. There is a strong existing of audit trails, which are regularly updated by the system administrator and ensure that passwords are changed at least every 6 months. I must reiterate this point, all the policies of the health facilities are in accordance with World Health Organisation, national policies such as the National Data Centre Policies and Ghana Health Service (LHIM 4).

In addition to the above extensive narrative, the other health information managers reiterated this vital policy regulation. That is, their ICT policy corresponds with the Ghana Health Service and this means, they do not do anything outside their ministry's instructions. These policies mentions the ICT implementation and security of the electronic health information system.

5.4.3. Strengths and Weaknesses of the Health Information System

Respondents for the current interview underscored the general logic that there is no system without strength or weakness. Although the adoption of a health information system at their health facilities is welcomed, it is also important to highlight the strengths and weaknesses that make the system unique.

Strengths of HIS

Several strengths were identified and stated by respondents. The strengths covered health information system features and functions concurrently. According to the respondents, these strengths are what make the system an interesting and powerful tool for healthcare delivery in the country. These strengths are organized under three thematic areas namely; accessible and user-friendly, data storage and information retrieval. These are described below by respondents as follows:

- **Strengths theme 1: Accessible and user friendly**

  Selected comments by participants were:

  …Reliable, easy to access, more user-friendly interface, convenient and modern (LMD 2).

  …Good internet system, portable machines and availability of health information personnel to help rectify ICT problems and constant ICT training of staff make our Health Information System one of the best and easy to use (LAS 2).

...It is not difficult to access the system because we have been well trained to use it (LN 3)

Two significant features of every health information system or technology that encourage usage are accessibility and user-friendliness. In terms of accessibility, innovation or technology is expected to be portable and convenient to have access to it as and when needed. The narrative of the Lead Administrative Staff 2 above, clearly shows that the health information system currently used by his or her facility meets such significant features, hence, leading to such an intriguing view. A similar view was shared by several health professionals studied. In addition, some respondents (health professionals) touched on the user-friendliness of their health information system. Whilst some raised concern about the laborious nature of their HIS, others from different hospitals expressed different views on theirs. Some underscored how user-friendly they have made the user interface with modern and state of the art designing of software and hardware for effective usage. These respondents made some significant observations and comments. According to them, Health Information System as the name connotes is a combination of several actors and networks. For HIS to function effectively as a complete system, there is the need for all actors to function effectively. Therefore, the use of modern and state of the art gadgets (e.g., computers/laptops), coupled with an efficient, fast, reliable and effective internet connection, linked by responsible leadership and adequate training of staff make the system complete, accessible and user-friendly.

- **Strengths theme 2: Data storage**

One very important function of an electronic health system is the ability to store more information without crowding the physical space of the facility. It was expected that the HIS used by the hospitals will give proper storage capacity but the responses are divided on this. Whilst some see their health information system to be efficient and effective in terms of storage, others see the storage system to be weak. This means that storage is seen as a benefit or a strength for some of the respondents and at the same time as a weakness for others. The following are what some respondents have to say:

...Records sometimes go missing and hence makes recovery of the medical history of patients inaccessible. In addition, patients also spend longer periods at the records section just to get access to their folders (LN 2).

…Storing information electronically is very good and the way and manner our HIS is structured, health information storage is safe. There is a backup storage capacity where all health information is backed up for any unforeseen eventualities (LHIM 2).

…Data stored is accurate and efficient. In addition, information stored provides adequate privacy and security. Health information is stored at both internal and external servers (LN 3).

…Information is easily lost because patient health information is mostly stored in the patient's folder and little of it is stored using the ICT (LMD 1).

A major concern of many regarding the use of technology in the execution of work and other responsibilities is the safe retention of information or data generated. It is worthy of note that not all respondents were proud and confident about the health information system adopted by their health facilities, others do appreciate and hold in high esteem the efforts made by their hospital management team. Others believe that capturing of data, reliability of stored information for performance review is a concern that should be looked at. In the same vein, some health professionals think otherwise about their health information system. They underscored that their health information system is efficient and they have had adequate training on data entry, retrieval, storage, health information analysis, data troubleshooting, and data security, hence, making it easier for proper data storage and sense of security of stored information.

- **Strengths theme 3: Information retrieval**

Respondents shared their fascinating views on the time-saving nature of their health information system given that retrieval of stored information is not a problem. Most especially, information regarding a patient's health status or history is always available when needed. In some instances and jurisdictions, information stored on patients is difficult to retrieve due to the cumbersome and disorganized nature of health information system implementation. According to these respondents, health information systems used by their facilities provide them with a different and better experience of which they cannot ask for more but could only encourage management to continue the good work done. One medical doctor could not conceal his happiness however, has this to say:

…Can trace back previous health history as far back as 3 years ago (LMD 3).

...the health information system we use in this facility is simple and information retrieval is easy (LHIO 4).

...I do not struggle to retrieve information that I have stored previously. I must say, the system is indeed flexible to the retrieval of information (LN 3).

The comment by this medical professional suggests how easy and well thought out the health information system within his facility was adopted and implemented. Retrieving three (3) years old information speaks volumes in connection with data storage functions, security, confidentiality and proper safe-keeping of records by the health information system.

- **Weaknesses of HIS**

In terms of health information system weaknesses, respondents of the current study identified three main thematic areas. These are time-consuming, confidentiality and patient health information transfer/interoperability. These respondents raised some alarming circumstances they find themselves in as a result of HIS usage. The following are the thoughts and views shared by some selected respondents who took part in the face-to-face interviews conducted by the researcher.

- **Weaknesses Theme 1: Time Consuming**

One experience of a manual system of health information has to do with the longer time it takes to record, retrieve and store information. This experience is different for state-of-the-art electronic system of health information. Aside from reliability and storage respondents touched on the time factor of the health information system. Those health facilities which use both manual and electronic systems complained about the time-consuming nature. Whereas those with the fully electronic system said that the HIS is fast and saves time. The following are excerpts of respondents on time:

... time-consuming in assessing health records (LMD 4).

...Health information system in Ghana is still marking time. We still using the old way of gathering and storing information which is not helping the healthcare system in Ghana. Indeed, the HIS is very slow and takes a lot of our time (LAM 3)

… Time-consuming for patients to easily access past records. In cases of emergency, patients are disadvantaged if their records are unavailable or delay in retrieving them (LN 2).

The respondents raised several reasons about the time-consuming nature of their health information system. They indicated that the existing system is cumbersome to some, not user-friendly, and difficult to navigate when it is in use. The view of the Lead Medical Doctor's 4 sums it all up. In general, a section of respondents perceives their health information system as difficult. The system is so laborious that using it is intimidating because they need to go through a series of processes to complete one clinical and administrative procedure.

- **Weaknesses Theme 2: Confidentiality**

According to some of the respondents, the health system used by their facilities does not provide adequate confidentiality of patients and staff information alike. In addition, respondents said that they experienced a lot of popups in their usage of the system which they perceive serves as a link for the confidentiality of patient's information to be compromised. This is what some respondents had to say:

…At my facility, a different person can just come and pick somebody to access his or her information without her knowledge coupled with the frequent breakdown of HIS, computers do not guarantee confidentiality and data security (LN 1).

…the way patient information is handled here in our hospital, it does not guarantee privacy and confidentiality at all (LMD 4)

…confidentiality of health information in this hospital is a big problem (LHIO 4)

The above view of the nurse *(LN1*) gives a clear indication of the flimsy security nature of the hospital's health information system. In her view, she expects a system where data could be accessed by health professionals but must be restricted to the individuals who have a stake in the data. The present state in which anyone could have access to the health information of patients indicates a threat to information confidentiality.

- **Weaknesses Theme 3: Interoperability/Patients Health Information Transfer.**

Information- orientated integrations where the exchange of information through common databases between direct healthcare systems and supportive systems were not available.

> *…Systems in one specific hospital do not interact to systems in the other hospital (LN 1)*
>
> *…Transferring patient's information from the lab investigation to other units of the hospitals [is] usually delay[ed], hence makes healthcare delivery slow and time-consuming (LN 4).*
>
> *…Currently, not all departments are running on the ICT program. Patients transferred from one department, which uses ICT to another, which does not always create [a] challenge (LMD 1).*
>
> *…As it stands now, our facility uses electronic health records to operate but our system is not in sync with other hospitals in Ghana, so when a patient needs to be referred to a different hospital, we have to use referral notes which make it a bit laborious and time-consuming (LHIM 2)*

The narratives showed that these health professionals above believed that an ideal and efficient health information system should be capable of transferring data from one unit to another, within the same hospital and other hospitals. When they found out that they were going to migrate to the electronic system, they expected that such privilege could be enjoyed, but to their utter shock, the existing health information system did not function effectively, particularly on data transfers from one hospital to another (interoperability). Because of that, when making referrals even though they use their facility's electronic health information system, they have to rely on the manual referral sheets for doing so. With the internal information transfer system from one unit to another, they experience regular breaks in transmission thus most of the time interrupting work.

The above narratives again showed that in some hospitals the existing health information system makes it difficult to capture the information. Equally, these professionals raised general concerns regarding the loss of patient's health information at some of the hospitals because of the unreliable storage component of the health information system. Also, one person mentioned

the waiting time in the records section as time-consuming which must be improved. On a whole, respondents appreciate the feat accomplished by their facilities in the form of health information system adoption. They agree that the system has some interesting and unique features and functions if it operates in the way it should, nonetheless, they also believe that there is a need for feature upgrades and improvement on functions periodically.

5.4.4. HIS Recommendations

Health professionals, who took part in the study, were given the chance to make recommendations for the improvement of the existing health information system. These recommendations are centred on the following:

- the need for adequate and frequent training of ICT officers and other staff
- complete migration to electronic health information system
- telemedicine
- networking with other hospitals
- the need to improve the current health information system to store videos, audios and scan images.

Some excerpts concerning respondents' recommendations for improvement are as follows:

> *…There should be a sensitisation on the need to use an electronic system to store and process patient health information (LMD 1).*

> *…Knowledge of health workers about the relevance of health information as well as data security should be emphasised (LAM 3).*

> *…With trained personnel, the information system must have an adequate power supply, suitable physical space and a secure environment to operate effectively (LAS 1).*

These views, shared by the three health professionals above, were similarly communicated by their colleagues who wanted to witness an improvement of HIS, to bring a proper and efficient relationship between the human resources (users*)* and the health information system (technology). This understanding, therefore, suggests that innovation diffusion, adoption and implementation cannot downplay human-machine synergy: machines and technologies are purposely designed to be used by human beings for fast, efficient and effective use of time and other resources

5.4.5 Conclusion of analysis

In summary, the qualitative study provides the contextual experiences and concerns for health workers of their use on health information system deployed by their health facilities. It also provides health workers views and understanding, regarding the strength and weaknesses they have observed or experienced through the use of the health information system. Finally, this part of the study allowed health workers to come forward with their qualitative suggestions and recommendations to improve the health information system. Overall, health workers have had varying experiences. Whiles some sections of these workers perceived their health information system to be good, others perceived it to be unsatisfactory. However, what was established was that the health workers would like to have a proper synergy between the health information system and staff, hence, propose for elevated training of staff to acquire critical skillsets for efficient usage of HIS. In addition to previous cursory desire, it was established that the health workers would like their health information systems to be interoperable where they can easily communicate with other hospitals. Table 5.13, Table 5.14 as well as Table 5.15 below, provide a summary of findings for the qualitative part of the study.

Table 5. 13: Summary of findings for the general experience and concerns on Health Information System

No	Main Themes	Subthemes	Illustrative interview Quotes
1	HIS equipment	Inadequate logistics	*Lack of state-of-the-art computers and network challenges make the health information system usage a bit terrible.*
		Electricity	*We use electronics only for our operations within this facility. With the possible light[s] out situation, there is also generated set/plant fixed by management to support. Anytime there is light off, it automatically switches over to the generator and work comes back on track.*
		Internet connection	*One big problem I have seen is the internet connection. It is very bad and slow, hence, makes work difficult and annoying. Therefore, I think the network or internet should be looked into in order to speed up work.*

		ICT system	*The system being practised here is not very effective because there are times when we have challenges with the intercom and other times too, patients misplace their folders containing this vital information. This is because patient health information is being recorded manually in the patient's folder whilst admissions, discharges and treatment regimens are recorded in the computers provided for the unit.*

Table 5. 14: Summary of findings for the general experience and concerns on Health Information System (continuation)

No	Main Themes	Subthemes	Illustrative interview Quotes
2	Human Resource	Upgrade of health workers (computer and health technology)	*As we all know, technology is evolving, many a time there will be new software and upgrade[s], hence hospital staff have to keep up with such changes. This can be a struggle for the hospital in terms of finance to keep everyone upgraded but staff need this professional upgrade for efficient and effective service delivery.*
		Staff appreciation and motivation	*Poor appreciation of the importance of health information systems and their impact on policy development and patient management. Due to that, some of them prefer using the manual system even though they have the opportunity to use the electronic system.*
		Poor staff	*Poor staffing of healthcare workers makes it difficult to adapt to electronic health information systems.*
		Support	*We know that effective health information system requires proper training of the users. There are many times we would like to train staff and also upgrade our knowledge but*

anytime we put forth such proposal across management they seem not to care. It appears their focus is on something else but not how to operate with efficiency. What I can say is that probably they are okay with the current functioning of the health information system.

Table 5. 15: Summary of findings on the Strengths and Weaknesses of the HIS

No	Main Themes	Subthemes	Illustrative interview Quotes
1	HIS Strength	Accessible and user friendly	*…Reliable, easy to access, more user-friendly interface, convenient and modern*
		Storage	*Storing information electronically is very good and the way and manner our HIS is structured, health information storage is safe. There is backup storage capacity where all health information are backed up for any unforeseen eventualities*
		Information retrieval	*…Can trace back previous health history as far back as 3 years ago.*
2	HIS Weakness	Time consuming	*…time consuming in assessing health records.*
		Confidentiality	*….At my facility, different person can just come and pick somebody to access his or her information without her knowledge coupled with frequent breakdown of HIS computers do not guarantee confidentiality and data security.*
		Interoperability	*… The system in one specific hospital do not interact to systems in the other hospital.*
			…Information-orientated integrations where exchange of information through common databases between direct healthcare systems and supportive systems were not available.
			…Transferring patient's information from one unit to other units of the hospitals usually delay, hence makes healthcare delivery slow and time consuming.

Source: Field Data 2020.

5.5. Integration of Quantitative and Qualitative Findings

To achieve the purpose of the current study, the study's qualitative aspect was conducted sequentially to confirm (or otherwise) some of the findings obtained in the data analysis resulting from the responses to the quantitative survey tools. From the initial (quantitative) data analysis, the study's respondents had different demographic characteristics in the area of gender, age, occupational health status, and work department. There are also variations regarding health workers' exposure to health information systems. Some health professionals are exposed to electronic and manual health information systems, while others solely operate an electronic system.

There are different levels of computer literacy that make some more efficient than others hence necessitates for the training of which there are varying degrees of percentages of staff training by the hospital management team. Quantitatively, most of the respondents were generally happy about the features and the functions of their health system, with the minority showing discontent. A similar outlook is observed from the qualitative data obtained. Respondents who participate in the face-to-face interviews recount their overall experiences of health information systems. Almost all of them appreciate the innovation and are satisfied with their health information system. Despite their appreciation, they also made some observations worthy of attention. These outcomes clearly suggest that no one specific innovation serves as a panacea to all challenges or problems. Others also despise the same invention that is enjoyed by many. These conflicting feelings and views for a system serve as the engine for improvement.

To conclude, both quantitative and qualitative results suggest that an appropriate health information system is the one that takes into account and establishes a proper synergy between man and machine. From the angle of man (users), HIS implementers must adequately analyse and examine user characteristics (e.g., gender, age, professional status, etc.) and user experience in information technology (e.g., ICT literacy, perceptions of health information, training, among others.). From the angle of the health information system, critical attention must be paid to the features (e.g., relevance, timeliness, accuracy, availability, accessibility, confidentiality, observability, compatibility and interoperability) and HIS functions (e.g., data collection, transmission, processing, storage and information retrieval).

5.6 Introduction: Summary and Proposed Model

The chapter starts with a summary and an overview of the two studies. This section discusses how the study's objectives were achieved using the mixed-methods approach and indicates the integration of the quantitative and qualitative methods. The study also presents the proposed model for adopting a revised framework for the health information system. Lastly, this chapter highlights practice guidelines for implementation.

5.7 Overview of Study and Summary of Findings

The study's aim was twofold: the first was to assess the perception of HIS influence, effectiveness and acceptance by employees, and the second was to identify the strengths and vulnerabilities of HIS in Ghana. The context of this study was Ghana, of which data is collected from the northern (Northern), middle (Ashanti) and southern (Greater Accra and Central) regions.

A two-part study was planned using a mixed-methods design to achieve these two aims mentioned above. For the analysis, the researcher explicitly adopted the convergent mixed parallel approach. At the same time, the researcher gathered quantitative and qualitative data in the form of methodology. The quantitative component using questionnaires explored health workers 'impressions of HIS impact and acceptance. The qualitative one-on-one interview and semi-structured interview guide examined health workers' perspectives about the strengths and limitations of HIS implementation and the way forward. A total of eighty (80) participants were selected specifically for the analysis. The quantitative data was analysed using frequencies and percentages, while the qualitative data was analysed using the thematic approach.

The quantitative investigation revealed that, there were more male doctors but more female nurses represented from different age groups, professional statuses and departments. More males were as health information professionals and more females as administrative professionals from other age groups and professional levels. These health workers are exposed to the electronic health system, with the majority of the health workers indicating that they still use the manual health information system alongside the electronic system. Furthermore, the majority workers trained to use HIS at their health facilities, have satisfactory to excellent computer skills. However, effective and efficient HIS application at health facilities is not entirely achieved. On their perceptions regarding HIS information influence and usage, they all said that they use basic ICT infrastructure to collect/record patients' health information, used for the rapid compilation of data. The

respondents indicated that they were satisfied with the confidentiality of patients' data stored in HIS because staff who obtain access to patients' data do so with a protected password. However, the respondents stated that protecting patients data can be further protected by staff using their password and additional login details. On the grounds of HIS perception and acceptance of the features and functions, most of these health workers stated that the HIS is relevant to the high volume of patients whose data need to be stored. The respondents further indicated that if HIS is adequately utilized, it will save time, provide accurate data, and make its availability and accessibility, at any time assured.

Respondents further stated that their HIS systems in each hospital do not communicate with other HIS systems in the same hospital. Systems in OPD do not interact with systems in the dispensary nor oncology department. This lack of data interoperability hinders the effective operation of HIS in hospitals.

In addition, the respondents indicated that their hospitals are part of the Ghana Health Services system; however, data generated in one hospital cannot be accessed or seen in another hospital. Data is not easily transmitted, processed and stored if such data was generated from a different hospital other than the source where it was developed. In the same vein, someone cannot retrieve patients' data from another facility where it is generated.

The qualitative data analysis reveals the following weaknesses in HIS:

- inadequate logistics
- erratic power supply (electricity)
- interruption in internet connectivity
- ineffective information communication and technology (ICT) system

In addition, the data analysis also shows that health workers need:

- upgrade of their knowledge on computer and health technology
- proper appreciation and strong motivation from staff to use HIS
- better staff and ,more significant support from management.

On HIS policy, it is identified that the health facilities designed their internal HIS policy based on the objective of the Ghana Health Service National Health Policy named as ICT for Accelerated Development (ICT4AD).

The strengths of HIS were identified as:

- accessibility and user-friendliness
- data storage
- information retrieval.

The weaknesses of HIS were identified as:

- time consumption
- confidentiality
- interoperability

The health workers recommended increased sensitization and training, adequate power supply and proper policy to safeguard HIS experience.

Study one (1) and two (2) complement each other. Whiles study 1 provides health workers to rate their perceptions; study 2 offers the opportunity to share their actual experiences, which study 1 did not capture. In all, the two studies show that their health facilities been influenced by some level of the electronic health system and perceive in general that the features and functions are acceptable. Yet HIS share some pertinent challenges that derailed the effectiveness of HIS, such as erratic power supply, internet challenges, poor staffing/lack of skilled personnel (Vo, 2009), poor appreciation and motivation on the part of staff to use HIS technology, lack of management support and inadequate logistics.

These outcomes validate Kuhn et al. (2001) list of problems that impede the management and implementation of health management information systems (HMIS) which are limited financial and infrastructural resources (Simba & Mwangu, 2004; Frazer et al., 2004).
They are:

- development of health IT programs
- incapacitating ambiguity

- morals and authorised deliberations
- absence of mutual interoperability ethics
- lack of skilled personnel (Fadare et al. 2012; Bump & J.B. 2010)
- regional and district incorporation.

While one majority said they had received sufficient training in the study, some of these health workers in Study 2 emphasize that lack of training is a significant issue, so they need computer and health technology technical training (as reported by Piliouras et al. 2011). The findings suggest that lack of training impedes the adoption of HIS technology hence, the need for advanced training for health workers is required to increase HIS impact and adoption/acceptance.

Another contradictory outcome from the two studies has to do with the confidentiality and security of the HIS system. Whilst most of the respondents perceived their HIS to be secured and provide an opportunity for better confidentiality of patient's health information, some still lamented on the same issue as their biggest problem. They stated that their experience with HIS in their facility does not have the capability to ensure:

- patients' privacy
- the trustworthiness of the medical report
- the security standards that a proper HIS demands.

In the same vein, some believe that their HIS is perfect on these same metrics. These divided views show that things are not illustrious at all facilities, but some face significant challenges that need attention. This is important because Standerry (2011) and Cripps and Standing (2011) identified security and confidentiality as major problems for successful HIS implementation and adoption in the USA and Australia.

In study 2, the data in particular, some health workers indicated that steps are taken by their health facilities to address health workers concerns in relation to security and confidentiality by adopting strong data security systems, frequent update of the system, change of password every six months and the adoption of user interface specifics that prohibit an intruder.

In summary, studies 1 and 2 focus attention on the use of health technology within the ten health facilities studied. The quantitative part shows that there are different levels of HIS technology

influence and acceptance, training, varying appropriate levels of HIS features and further appreciation for HIS functions. The same revelation is realised with the qualitative part of the study. The same factors impeding HIS technology usage serve as enhancing characteristics for HIS technology appreciation by some health workers. On the grounds of strengths and weaknesses, there were discriminatory views. Whilst some view accessibility and user-friendliness, data storage and information retrieval as strengths, others view them as weaknesses. Some view time consumption and confidentiality as the weaknesses of their HIS, whereas others see these as their strengths. Regardless, however, the interoperability part received overwhelming or 100% endorsement or agreement by both studies . All the health workers identified that their health systems are not connected hence during referrals, they have to use letters and referral sheets. Respondents, therefore, suggest that there should be some integration of health information system technology where patients' health information can easily be referred to and accessed from one hospital to the other. However, the respondents underscore the apparent security threats and suggest that only the required information by the medical officer must be made available within a stipulated time. The researcher also found that doctor-patient interaction or interface using technology (telemedicine) to be a serious setback.

5.8 Proposed Health Information Framework

The two features of System Interoperability and an electronic doctor-patient interface or interaction were identified to be non-existing. Information-orientated integrations, where the exchange of information through a shared database between direct healthcare systems and supportive systems were unavailable. It was also observed that systems in one specific hospital do not communicate with systems in other hospitals. These two features of health information systems depict the current trends of technology witnessed in any well-structured, developed and organised health information management. Based on these limitations found in the current health information system, the researcher proposed the following Revised Health Information System Framework (R-HIS-F) as shown in Figure 5.12 below.

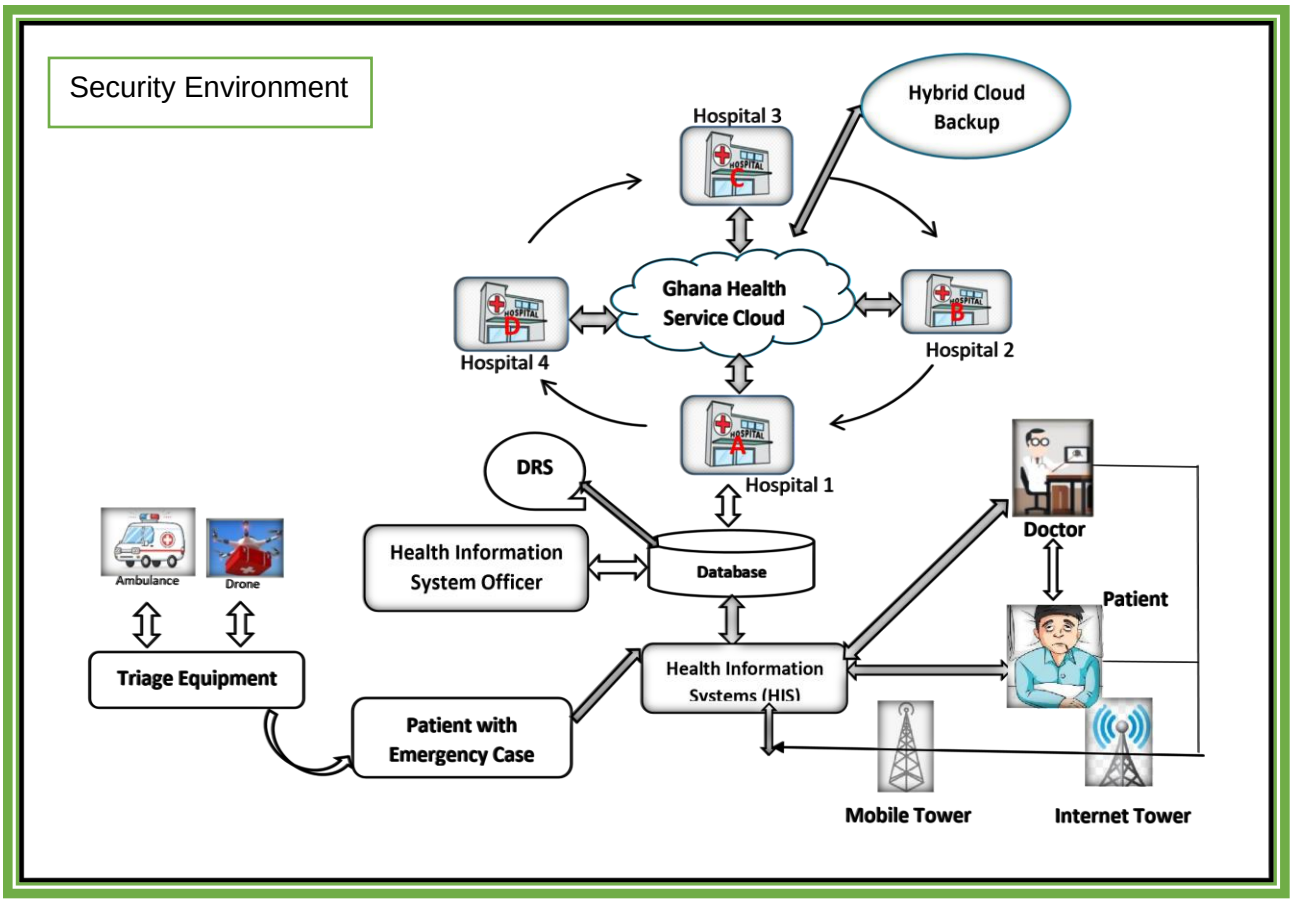

Figure 5. 12: Revised Health Information System Framework (R-HIS-F)

The above-updated structure for the Health Information System established for Ghana's health facilities is proposed.

The system will be used for easier administrative work and controlled by Ghana Health Service. Significantly, the system highlights the interoperability or integration of health services among all health facilities hosting all data on Ghana Health Services Cloud (cloud architecture/computing). The different elements of the system are as follows:

- **Ghana Health Service Cloud.** This applies to computer system resources, particularly data storage (cloud storage) and processing capacity that is not handled directly by the user. That means users will be able to access the data through the internet. The cloud architecture aims to provide users with:
    - high bandwidth
    - unrestricted access to data and applications

- the agile on-demand network that transfers rapidly and securely between servers
- automatic update, and most importantly
- ensured network safety.

According to researcher, this should be hosted by the Ghana Health Service for easy monitoring of health facilities activities in Ghana. The cloud system should be configured in such a way that patients can easily be referred to referral points by the different health facilities, and the referral points would also have prompt referral notification from facilities. This agreement renders the hospital facilities interoperable.

- **Interoperability (Hospitals 1-4).** The four (4) hospitals are only one example of all Ghana's hospitals. That means that all hospitals must feed into one Ghana Health Service-managed consolidated cloud. It allows hospitals the ability to communicate with each other freely and access critical information. The cloud system is either designed online or web-based, making it easy to execute referrals from each hospital because at every point such operation is performed, the system provides notification to the targeted hospital.

- **Hybrid Cloud backup.** The security or protection of cloud data is paramount due to attacks on past clouds and the persistent attempt by illegal and criminal hackers to steal valuable data for their selfish gain. The proposal therefore, is for hybrid cloud backup. This form of backup includes both the on-site or on-site scenario and the cloud. To do this, the Ghana Health Service must have a dedicated on-site storage system, such as networked wired storage appliances, where the data is automatically backed up to these machines. This means that the Ghana Health Service makes data convenient and readily available and that data is often stored in the cloud and simultaneously in the dedicated on-site storage system. This backup system makes it safe and easy to access the data if any devices is compromised. That is, if the cloud is compromised, the dedicated on-site storage system will provide the same need for information, or if the dedicated on-site storage is compromised, the cloud data will be a retrieval or accessible point.
- **Database.** The database is a data set structured to enable data to be accessed, extracted and used. The data stored supports a specific application, and each application managed

by specialised software called application software that enables users to establish access and manage the database.

- **Disaster Recovery System (DRS).** DRS consists of a collection of policies, resources and procedures to allow the recovery and continuation of critical infrastructure and systems of technology when a natural or man-induced disaster occurs. Compared to business continuity as usual, DRS focuses on Information Technology (IT) or technology systems that support vital health functions, which means maintaining all functional elements of a health service working during major disruptive events. This system is critical because aside from natural disasters and human errors/negligence, hackers and ransomware/cyberattacks can inactivate any facility and lead to many losses of sensitive and essential information. The suggestion is for a double-level disaster recovery scheme with this structure, hence one DRS for each hospital and the consolidated Ghana Health Service Cloud. This data storage system is also hybrid as such data is constantly backed up automatically in the Ghana Health Service and the hospital's DRS. As a result, any of them offers a data point that is available and retrievable for services to begin.
- **Health Information System (HIS).** This function of RHISF collects, organises and coordinates all operations at all the hospital's different departments. The HIS is responsible for managing and organising appointments, assessments, prescriptions and distribution at the health facility. The Health Information System also governs the encounter between the doctor and patient, and vice versa.
- **Doctor.** In every hospital department, the doctor represents the medical professional appointed and responsible for patient care. The physician has many ways of attending to the patient in the present setting. There is the patient's intimate face-to-face consultation at the hospitals' acceptance, phone calls, internet messaging and video contacts. The system now offers the ability to assess which patients need to be evaluated and who should receive medical attention through telephone, message and video contact.
- **Patient.** Exemplify the person in need of medical treatment or healthcare. Therefore, there are two types of patients, one which may require regular medical treatment and one which may need emergency care. The system considers all patients so that if the need is identified, the system alerts or notifies the emergency service to treat a patient immediately. This auto warning can be rendered in or out of the hospital. That means the

patients can conveniently access the hospital facilities via the health information system in different ways. It also means that the overall delay in transporting patients is reduced.

- **Health Information Officer.** The officer is in charge of maintaining the hospital database and local DRS. The person is responsible for educating plus developing new ways of improving the HIS at the hospital.
- **Mobile Tower.** This mechanism ensures that patient-medical contact is made possible via text messages and phone calls by any patients who call or message the health facility to book an appointment. Hospital bill payments are also made possible by using the mobile tower through mobile money services at the hospital.
- **Internet Tower.** This second level system provides interaction opportunities between the patient and the hospital. This system uses the internet as a medium or interface to share information across parties (videos, emails and instant chat). Although the intention is between patient-hospital interactions, it also provides an opportunity for hospitals to interact. Medical doctors and nurses, hospital administrators and health information professionals of different hospitals can use this interface to share ideas and knowledge necessary to make their services fruitful, effortless and smooth. 'Webinars' could also be organised for health professionals within different hospitals on topics that serve as a challenge.
- **Triage Equipment.** Equipment used by a Triage Nurse. This equipment plus a triage nurse is made available in an ambulance to ensure that emergency patients receive priority emergency healthcare. These will include a thermometer, pulse oximeter, sphygmomanometer, stethoscope, glucometer and its strips, urinalysis strips, 12 lead electrocardiography, observational chart, South African Triage Score (SATS-Used by Ghanaian hospitals), pain assessment scale etc.
- **Ambulance.** This is a medically fitted vehicle that carries patients to care centres such as hospitals.
- **Medical Delivery Drone.** This is a piece of medical equipment based on artificial intelligence should be used to deliver medical and health vitals such as blood and medication to and from health facilities.

5.9 Guidelines for Implementation

The Revised Health Information System Framework (R-HIS-F) proposed in Figure 6.3 above is expected to be helpful at to the national, regional and district level hospitals in Ghana. The current HIS system is well-coordinated, but used in disjointed fragments rather than as a whole. However, this proposed framework has the potential solution to bring a substantial amount of improvement to these existing e-health structures found in the various hospitals in Ghana. Several revelations made in the current study were that:

- health professionals had varying abilities for computer skills (ranging from those with adequate training on HIS to the less adequate)
- some use the complete e-health system whilst the majority use both manual and electronic systems (although the manual system is being used more, which makes a significant difference to efficiency).

The implementation of the Revised Health Information System Structure (R-HIS-F) is, according to Hodgkin's (2015), a multi-step process which should affect all staff members. This researcher, therefore, deems it vital to give guidelines for the efficient and effective implementation and adoption of R-HIS-F in accordance with the processes for each e-health service to assist in the challenges of its execution. In addition, Hodgkin's guidelines (2015) are modified to make the implementation more concrete for the Ghana Health Service and the healthcare facilities in Ghana. A learning curve involved as in any new project, and getting a good plan will save hours of stress for all team members. The following stages are required and described below:

Stage 1: Build the Revised Health Information System Framework (R-HIS-F) implementation team.

Stage 2: Prepare the software

Stage 3: Determine the hardware needs

Stage 4: Consider the patient treatment room layout

Stage 5: Transfer data

Stage 6: Create workflows

Stage 7: What to do when your R-HIS-F is down

Stage 8: Training programme in place

Stage 9: Decide on the implementation approach

Stage 10: Gather feedback for continued improvement

Stage 1: Build Your Revised Health Information System Framework (R-HIS-F) Implementation Team

Revised Health Information System Framework (R-HIS-F) implementation under stage 1 requires two main issues: team building and assignment of critical roles.

- **R-HIS-F Team**

In order to introduce R-HIS-F, there is a need to assemble a strong team to help the process move as smoothly as possible in the Ghana Health Service and hospitals.

- Health employees, such as healthcare providers, doctors, nurses, physician assistants and administrative staff should be part of the team.
- Team members should be allowed to assist in the process by teaching R-HIS-F skills to colleagues and acting as messengers to the implementation team to identify challenges while proceeding.

- **Critical Roles**

After the team is formed, team members are allocated positions. Three significant roles are important: a Lead Super User, Lead Physician and Project Manager.

- **Lead Super User.** The lead super user is the R-HIS-F specialist, both resident and in-house. It is the person who is responsible for creating templates and designing workflows. This person is also responsible for developing standard operating procedures to fix users' issues while using the system.
- **Lead Physician.** His job is to direct the hospital and Ghana Health Service through R-HIS-F implementation by serving as a link between the system's frontline users and the technical personnel. This type of physician should be a tech-savvy person who accepts the latest technology as a lead physician.

- **Project Manager.** The manager is the principal point of contact with the vendor and staff of R-HIS-F. The person is responsible for ensuring everyone is focused on deadlines for implementation, monitors progress and discusses user concerns.

Stage 2: Prepare the software

- The program must be planned and implemented by ensuring compliance with security regulations, legislative and ethical requirements (human rights, privacy and confidentiality, civil rights, criminal laws, and so on).
- In addition, there is a need to carry out a risk assessment based on the National Health Policy of the Ghana Health Service (ICT for Accelerated Development-ICT4AD) to ensure efficient and successful implementation. At this point, Ghana Health Service and Hospital Management collaborate with the Health IT provider to ensure compliance with the program.

Stage 3: Determine the hardware needs

- The choice of hardware has a vast effect on the time and resources used by the practice. For instance, having a computer, scanner, and printer in each room can save doctors up to one (1) hour a day.
- In some jurisdictions, the hospitals have their tablet or laptop for each staff member to log in and out of each patient encounter to save time.
- To avoid the idea that all of this seems daunting, the Ghana Health Service and the various hospitals should work with IT service companies who might assist in meeting hardware needs and the right equipment at the best price.

Stage 4: Consider the Patient Treatment Room layout

- Since the R-HIS-F software involves electronic data entry, the room configuration may have a major effect on patient engagement and satisfaction or affect it. If staff and physicians face away from the patient when entering patient information/data about their health, these patients may believe they are not being noticed. The hospitals should use the 'trust triangle' to solve this room arrangement where the patient, physician, and computer shape a virtual triangle to allow the patient and physician to interface with each other during consultation and treatment.

- In addition, hospital management can consider installing semi-circular desks in consulting rooms or using mobile carts to make the patient feel at ease at appointment time.

Stage 5: Transfer data

- The hardware and software should be ready to use at this point. Therefore, the next step in the implementation process for R-HIS-F, is to migrate or merge any existing data from the previous record system to the current R-HIS-F. Current workers should be delegated or recruited to upload information into the new R-HIS-F for additional or temporary personnel.
- To direct this upload, a checklist of information to be entered into the R-HIS-F must be prepared, and the procedure should ensure that no vital information is lost.

Stage 6: Create workflows

As part of the process, it is crucial to set up workflows before full implementation of R-HIS-F to minimise the amount of stress that the team is likely to face. Having inefficient workflows and inadequate qualified and ready-to-use R-HIS-F team members would intensify problems throughout the implementation phase. When designing workflow issues, these questions should be asked:

- Is this necessary?
- Does this add value for the patient?
- Does this increase efficiency for the staff?
- Is this the correct order?
- Is the right person doing this step?

Stage 7: What to do when your R-HIS-F is down

The development team is expected to discuss and build a concrete game plan for addressing future issues. For example, what should be done when the power goes out? What if there is a system-wide failure requiring IT support to repair it? When the device is compromised, what needs to be done? Since every type of technology can malfunction, planning for such a day is required. Therefore, the implementation team should establish procedures to offer physicians and staff clear instructions on what to do when the R-HIS-F is unavailable.

These critical questions should be taken into account when designing the procedures:

- How will physicians and staff be notified of downtime?
- How will the patient care flow continue?
- How will patient check-in occur?
- How will physicians and staff document the visit?"

To accomplish this during the implementation process, workers should have electronic and paper procedures available to improve their management of R-HIS-F downtime. Instructions should be in triad-ring binders, and copies should be kept in-house and off-site. The implementation team can also suggest storing PDF copies in a secure cloud (Ghana Health Service Cloud), so staff members have several choices to access the instructions quickly.

Stage 8: Training programme in place

Technological and comprehensive preparation is imperative for the effective implementation of R-HIS-F. During implementation, a training plan should be created to allow all physicists and personnel (current and future) to acquire the knowledge and skills to effectively use the R-HIS-F when the system is ready to launch. The following principles should be considered:

- **Start slow**: As users can find it difficult to fully comprehend the system before using the software, provide basic skills to physicians and personnel before start-up. Once users can navigate for at least one week, they can incorporate additional training to improve their abilities, learn time-saving tricks and become more comfortable with the App.
- **Let colleagues teach colleagues:** The implementing team should train super users in each speciality or department and the first stage for each role as mentioned. For example, nurses teach best to nurses, and surgeons teach best to surgeons. Additionally, if you have a super user in each speciality, they can become a permanent resource for their colleagues.
- **Map out ongoing training needs:** A plan for ongoing training is needed. As time passes, users will find shortcuts and new ways to use the tools and want to share these findings with their colleagues. Moreover, the R-HIS-F will need to be updated with new and improved functionality, requiring additional training.

Approach

Resources could be achieved through R-HIS-F users and the IT vendors.

R-HIS-F User

- Develop a user-friendly system for submitting R-HIS-F recommendations to allow changes.
- Encourage active R-HIS-F users to share input and offer usability-enhancing solutions, either through a formal tracking system or through an online discussion that promotes sharing of ideas.
- Create an ongoing R-HIS-F customisation system. Once doctors and staff can manage the new R-HIS-F, they will identify changes that could improve workflow.

IT vendor

Preserve the R-HIS-F vendor relationship and utilize IT support to:

- Develop or customize data entry templates
- Revise R-HIS-F generated forms and letters
- Look for integration opportunities with other commonly used systems in practice.

Group training should be conducted ahead of time to reduce disruption to the workflow of medical practice. This should be included in the planning so that time with patients are not prevented.

Stage 9: Decide on the implementation approach

When the R-HIS-F implementation plan is ready, it is time to determine how to proceed. There are typically two methods of doing this: with a gradual strategy or all at once (often known as 'the big-bang).

- Some practices follow the big-bang method and introduce the R-HIS-F system for all patients and functions on the same day. This method is simultaneous and usually minimises the time spent handling paper records and the current R-HIS-F system. The downside is that it can be very destructive and can sound very monumental to minor issues. If the launch strategy is determined, doctors and staff can get ready for the new R-HIS-F system.
- Due to the differences in terms of the level of adoption and varying technological savviness of the general public, the researcher recommends an incremental implementation approach to ensure that success and optimum performance are achieved. A gradual process and progressive application of the R-HIS-F is easier to handle for some

practices by introducing R-HIS-F functions one at a time, such as e-prescribing to start and then adding other functionalities later. More extensive activities and organisations can be adapted steadily by first carrying out the R-HIS-F at individual locations or divisions and then expanding the software to the rest of the enterprise.

Stage 10: Gather Feedback for Continual Improvement

If the R-HIS-F had been successfully introduced, there would be a need for input from users to assist in developing the system continuously. The implementers should keep the communication lines open, so that staff members and doctors feel comfortable receiving input. If everybody works together, then the R-HIS-F will grow in Ghana's health delivery.

5.10 Section Conclusion

This section refers to the final aim of assembling a strategic HIS structure to strengthen hospital information and technology processes that affect employees' daily routines The section begins with an outline of the analysis and review of the proposed Updated Health Information System Framework (R-HIS-F) results and ends with R-HIS-F implementation guidance.

CHAPTER SIX

CONCLUSION

6.1 Introduction

This chapter concludes the entire thesis by reflecting on how research questions were answered, the contributions made by the study, the presentation of the research, the limitations of the study, the proposed future research and finally, the study's conclusions.

6.2 Review of the Research Questions

The research analysis was planned and carried out following the literature review in Chapter 2 and the theoretical clarification in Chapter 3, along with the researcher's personal experience. Two key experiments were used to address one of the main research questions (cf. 1.2.1) in the adoption of the HIS in Ghana. Firstly, Health staff in ten hospitals who were classified as physicians, nurses, healthcare technicians and managers were measured for their expectations to accept and use the health information system. The findings offered satisfactory answers to the key research question and the creation of the R-HIS-F in 10 public hospitals researched in Ghana. Two essential methods and sampling techniques were used to collect empirical data that responded to the study's objectives. Firstly, the researcher asked the six related questions below:

1. Was the method chosen appropriate to answer the research question?
2. Why was the convergent parallel mixed-method design of the study relevant to the research but not any other approach?
3. Is the unit of analysis and site most appropriate to the research study?
4. Does the collected data capture the contextual complexity and converge to support the research findings?
5. Do the research findings lead to the development of the Revised Health Information System framework?
6. Is the Revised Health Information System framework acceptable and applicable by health professionals?

The sections 6.2.1 to 6.2.6 provide evidence to clarify answers to each question, starting from 1 to 6.

6.2.1 Were the methods chosen appropriate to answer the research question?

A convergent parallel mixed method approach grounded in pragmatic assumption was considered appropriate for this study. This method was used because the researcher assessed health workers perceptions regarding health information acceptance and usage and their opinions on the strength and weaknesses of the current HIS. An assessment of the current use of the health information system was also done to understand the operations of health delivery services within the Ghanaian territory, and afterwards, the views of the health workers were canvassed regarding solutions to solve the current challenges. Therefore, the Convergent Parallel Mixed method design was appropriate for this research.

Ensuring reliability and validity was vital to this research to ensure that items used to tease out this vital information on Health Information System (HIS) were appropriate. Ensuring validity and reliability is centred on how the questions were developed and how data was collected, managed and analysed (Creswell 2012). The questionnaires content was developed using expert advice, knowledge and findings on the constructs previously published in peer-reviewed journals. In addition, knowledge of extensive studies in health information systems was sought from seasoned professors within the university's department. In the qualitative section of the study, reliability and validity were based on Lincoln and Guba's (1985) framework for trustworthiness. Their approach uses four key criteria for determining the reliability of a qualitative study; integrity, reliability, conformability and transferability.

English was used to draft the open-ended questions. This was checked as soon as the questions were subjected to piloting, and discussions were held with participants to clarify some responses that were not clear to the investigator. Since the principal investigator is exposed to sophisticated usage of technology, there was a likelihood of being bias, hence potential sources of bias were discussed and resolved through discussions with respondents, experts, third parties and this researcher's supervisor.

Attempting to improve reliability and validity of the study was made by referring to an independent researcher (the study's supervisor acquainted with all the procedures used to collect data from respondents) by making careful follow-up processes. In analysing the results, the researcher read the answers given to the open-ended questions multiple times. Initial coding was performed, and responses clustered around a specific concept labelled as 'themes'. The independent researcher

followed the same method and examined this study's results, and compared themes formed to create congruence.

6.2.2 Why was convergent parallel mixed-method design of the study a relevant approach to the research but not any other approach?

The evaluation of health information acceptance, usage and strength and weakness of the health information system needs both quantitative and qualitative data to be taken separately and compared. The most suitable methodology, according to Creswell (2014), is the converging parallel mixed-methods design. This approach allows the researcher to test and collect quantitative and qualitative data, examine them independently or separately, and then compare the results to the findings and validate or disconfirm them. The researcher gathered health workers' perceptions in the ten (10) hospitals on HIS usage and acceptance. Specifically, regarding health workers (staff) issues were staff characteristics, HIS exposure, HIS perception, HIS features and functions, which are discrete data information that demands a quantitative level of analysis.

Also, staff experience and concerns regarding HIS policy, strengths and weaknesses and recommendations by staff were all non-numerical data that demand qualitative method of analysis. These different data sets were analysed separately for a better view of health workers' perceptions and experiences. These perceptions and experiences were further integrated to arrive at a common understanding regarding the average health workers' perspective of the HIS in Ghana.

6.2.3 Is the unit of analysis and site most appropriate to the research study?

The current study placed emphasis on understanding the health information system in place for day-to-day healthcare delivery in Ghana to enable the development of the R-HIS framework for efficient and effective healthcare delivery. With this focus, two key units of analyses are significant, namely, geographical location and the actors. Ghana Health Services has zoned the health sector geographical map into three sections: Northern, Middle and Southern. Therefore, any health system analysis should at least select one hospital or health facility from each zone to provide a fair representation of the healthcare delivery system in Ghana. In addition, the healthcare sector is made up of different actors, including health workers, patients (individuals), students, government agencies and many more. However, the researcher was interested in the administrative, clinical and technological issues that occur at the hospital; therefore, it was expedient to get the actual actors or users of HIS to solicit opinions on their day to day assignments.

The second unit of analysis appropriate to meet this objective is health workers. The technology should serve the clinical functions of medical doctors, nurses and the administration. On this note, the researcher sampled and tested 20 medical doctors, 20 nurses, 20 administration managers and officers and 20 health information managers and officers. These 80 respondent health workers represented all three zones. For fair representation based on population and health facilities, one region (Northern Region) was selected from the Northern zone, One region (Ashanti Region) from the middle zone and two regions (Greater Accra and Central Regions) from the Southern zone. These health workers were selected from Greater Accra, Ashanti, Central and Northern regions in Ghana. The hospitals included teaching, district, quasi-government and district/mission hospitals clustered along Northern, Middle and Southern zones. These sites provided a fair assessment to be done on the health information system in Ghana. These respondents were given questionnaires to complete and were further interviewed using a one-on-one method in their different locations.

6.2.4 Does the collected data capture the contextual complexity and converge to support the research findings?

Hospital data was obtained using six sources, one-on-one interviews, questionnaires, findings, expert reports, a study of documents and photographs. These data collection sources exposed the complexities between Teaching, College, quasi-government and district/Mission or popularly known as CHAG. The reason for using these various sources of information and samples is to collect a broad and in-depth database of information on the health information system in Ghana and to provide a robust plan to build an updated Health Information System structure that could account for the concerns and views of all hospital stakeholders. The data obtained from the six sources converged to support research results that further led to the creation of the R-HIS system. Experts from various jurisdictions also validated the R-HIS-F: to study its effectiveness and applicability to Ghana Health Services and Hospitals in Ghana.

This was important to ensure that this system would bring more value to Ghana's provision of health services. The mere construction of a system lacking verification would indeed be a futile effort.

6.2.5 Do the research findings lead to the development of the revised health information system framework?

A thorough description and analysis of the research results are provided in chapters 5 and 6. It was clear from the observations and analysis that only a few health workers fully use the current electronic health information systems while the rest use manual systems alongside electronic support systems. In addition, it was found that there was no presence of a doctor-patient interface between the electronic system and the interoperability of the health information system. The dysfunctional operations have to do with the existing design of the health information system, which has led to problems such as indiscreet management of patient health records, loss of patient data, difficulties in tracing and monitoring of patient files, overcrowding of hospital facilities, incorrect diagnosis and prescription drug error, and incremental loss.

Data from these results (six separate sources) together with the literature and hypotheses, have guided the study's creation of the Revised Health Information System Framework Structure (R-HIS-F) for Ghana Health Services and Hospitals in general. It is worth noting that a series of reviews of the R-HIS-F occurred during this research until this final product emerged as an effective platform to help Ghana's Health Service and Hospitals Ghana provide better healthcare facilities to the people of Ghana and beyond.

In sum, this study developed the R-HIS-F for Ghana Health Services and hospitals and provided a step-by-step implementation process that ensures the framework provides its intended purposes. The R-HIS-F was framed in a way that ensures that:

- the interoperability among hospitals is seamlessly functional
- the doctor-patient web-based interaction is plausible
- the critical services like the ambulance and drone services are connected to the operations of the hospital electronically
- the patient-hospital consultation is feasible
- a double-stage hybrid security system is assured, and the regulatory
- the supervisory mandate of Ghana Health Services becomes less wearisome.

6.2.6. Is the revised health information system framework acceptable and applicable by health professionals?

- The R-HIS-F has been well received by health information system experts in the health and technology sector in Ghana as a significant step towards transforming healthcare delivery in Ghana. However, the implementation was of general concern due to lack of skills and experience in the field of the health information system and the various levels of literacy and diversity of stakeholders involved. In view of this, a guideline for the implementation of R-HIS-F has been given. In addition, approval letters of this R-HIS-F are attached (Appendix I, Appendix J and Appendix K) to validate their usefulness.
- Having stated this, the panel of experts further recommended that memory sticks be given to patients so that their medical history can also be kept by them so that when the R-HIS-F is implemented, the patient medical history can be scanned and stored on the system.

6.3 Contribution of this research study

The current study had two main contributions, thus practical and theoretical contributions. Therefore, this section is subdivided into practical contribution and theoretical contribution.

6.3.1 Theoretical contribution

The current study underscores that no single theory has the capacity of explaining adequately how health information system must be studied and assessed. Based on this assumption, the study draws on three main theoretical notions to assess the health information systems (HIS) in Ghana. These can be explained as a symbiotic relationship between actors (Actor-Network Theory), explanations on the different levels of actor's knowledge and capability of technology usage (Innovation Diffusion Theory) and the features of technology for adoption (Technology Acceptance Model).

The current study made deductions from these three theories and devised an Integrated Model for Revised Health Information System Framework Assessment. With this model, technology or health information systems can be assessed by placing critical attention on three important variables: staff (human resources); health information system (technology); and symbiotic equilibrium (Staff/HIS or technology bond).

The argument is that the system (Health Information System) and the staff (human resources) are critical actors that consistently interact for symbiotic equilibrium. Meaning, acceptance, usage and adoption of a health information system is possible when there is a bond between users and the

technology. Without this bonding, there will be a symbiotic disequilibrium which will eventually lead to system failure. Hence, an assessment of HIS acceptance, usage and adoption by a particular health facility needs these variables.

Sensitive areas worthy of review by staff are such characteristics comprising gender, age, professional status and department; and HIS work experience consisting of HIS training, computer skills, HIS use, HIS happiness and HIS benefits. Under the Health Information System, two vital aspects are worthy of inquiry and these are HIS characteristics (relevance, timeliness, consistency, accessibility, confidentiality, observability, usability and interoperability) and HIS functions (data collection, data transmission, data processing, data storage and information retrieval). Management leadership and assistance, availability of technical logistics and HIS or ICT policy are part of a symbiotic relationship.

6.3.2 Practical contribution

The present research is helping to manage health services in Ghana. The study was able to identify the current healthcare environment by Ghanaian hospitals across four critical regions in Ghana, thus Northern, Ashanti, Central and Greater Accra regions. What came out of the current study was the slow pace of adoption of the electronic health system and incomplete electronic system usage by all ten Ghanaian hospitals in interoperability and telemedicine. After identifying these significant problems, this researcher proposed a Revised Health Information System Framework (R-HIS-F), which is expected to be adopted by Ghana Health Service and health facilities in Ghana. The R-HIS-F provides key stakeholders within the health services industry in Ghana with a comprehensive framework that has the potential and capacity to ensure that work from the various subsectors of the health industry is integrated. This is to say,the current study has two significant and critical practical contributions described as follows:

- Firstly, the R-HIS framework provides solution and implementation guidelines for health information system ecosystem of hospitals in Ghana. On the angle of a solution, the framework provides a comprehensive electronic health system that takes into account the following sets of interfaces:
    - doctor-patient (both emergency and those with normal medical check-up) interaction;
    - health facility and patient interaction;

- health facility and the ambulance service interaction as well as drone medical services interaction;
- interoperability among health facility to health facility;
- Ghana Health Services interaction.

These interactional interfaces allow suitable applications to be designed that all these actors could use, thus Ghana Health Services, Health Facilities, Health Workers, Individuals, and Electronic Service Providers. The interactional interface dictates and directs how health information services should be communicated and the appropriate personnel needed for the success of R-HIS-F. No matter how comprehensive a framework maybe, the solution may not be plausible if its implementation is not done right.

Based on these, the study contributes to health information management in Ghana by providing a step-by-step method that could be implemented. This begins by building a strong revised health information system implementation team and is carried through to gathering feedback for onward and continual improvement of the system.

- Secondly, the Ghana Health Service (GHS) system offers a solution and implementation plan. Under the Ministry of Health, the Ghana Health Service is responsible for managing and overseeing health facilities operations in Ghana. The system suggests that the Service should acquire Cloud in its name and operated by GHS in order to assist GHS work. The Service will host the databases of all healthcare facilities in Ghana with this cloud. This approach would ensure that they get regular information about their activities, problems and complaints (health facilities).

6.5 Research Presentation

This section intends to help the readers recapture the keynote discussions chapter by chapter: from Chapter 1 to Chapter 6.

Chapter 1 initiated the research study by setting out the issues and problems as evidenced by the health sector's delivery of healthcare in Ghana. The rationale and significance of the study are defined by the research problem and formulated in its associated research issue. The importance of the study is rooted in the possibility that the research findings would lead to the creation of a revamped health information system structure consisting of the following:

- an interactional doctor-patient interface
- interactional patient-hospital interface
- e-health records system
- electronic prescribing system
- electronic training system.

Chapter 2 presents an in-depth collection of literature and lays the foundations of the thesis. The basis for the research is set out by carefully examining the existing literature to assess the evaluation of the information system in hospitals.

Chapter 3 discusses related hypotheses that provided the basis for creating models and structures for the health information system that would support the hospitals. The chapter further stressed a conceptual model focused on the architecture of the World Health Organisation.

Chapter 4 gives a detailed account of the different methodological methods used for conducting the research. In this chapter, the researcher offers ample rationale for the approach and methodology chosen for this study.

The findings from the quantitative and qualitative research are discussed in depth in Chapter 5. The descriptions and explanations for the two studies were performed separately and were combined in order to provide a detailed understanding. The results of the findings, and the literature review, informed the creation of the Updated Structure for Health Information System (Revised Health Information System Framework) described in Chapter 5.

Chapter 6 mirrors the study and concludes by reviewing the study's input, recommendations and limitations.

Having mentioned these, the researcher further focuses on these chapters and poses a question: Was this research study written in a format that healthcare practitioners and academics would understand?

To make the study reader-friendly, an overview is presented to direct the reader on what to expect in each chapter in terms of a table of contents, list of tables and figures. Thereafter, each chapter starts with a brief introduction to give the reader an idea of its contents. At the end, each chapter concludes with a short introductory description followed by a brief explanation of the next chapter.

6.6 Limitations of the Study

The study sought to assess and identify the strengths and weaknesses of the health information system currently operating in the hospitals of Ghana. Then propose a revised health information system framework capable of handling the healthcare challenges and providing the platform for better healthcare delivery. However, the first limitation of this research is that patients were not involved in this research and their contribution to this research which might be necessary to craft a policy for patient privacy and confidentiality. However, the users of the HIS in various hospitals attested to the high level of patient privacy and information confidentiality which is built into the HIS system in the hospitals.

Again, the research was confined to Ghana, and the results could not be generalized to other developing nations. Instead, this research study aims to provide a comprehensive viewpoint on what was needed as a solution for Health Information Systems to assist in providing quality healthcare services only in Ghana because it would have been a challenge to undertake such a thorough study in two separate countries with a large number of citizens. However, the findings can be easily repeated in other African countries and other developing countries worldwide.

Another restriction must be the study's depth. The research analysed the health information system and suggested a revised health information system framework (R-HIS-F) structure for Ghana Health Service and Ghanaian hospitals. In other words, the analysis did not cover the framework's functional and environmental testing to ensure that it functions and identifies areas for change and the real benefit it brings to Ghana's health information system.

The enormous financial consequences associated with introducing a revised health information system framework (R-HIS-F) restricts the analysis to this area. Thus, time, preparation and careful financial budgeting are required to incorporate this updated structure for the health information system fully. To address this limitation, especially about the value to health information system and its workability, the researcher subjected the framework (R-HIS-F) to three expert reviews: by Ghana Health Service, expert review; by the hospital; and a private health information system company, expert review. The comments from all three expert reviews validated that the R-HIS-F was well developed to alleviate the difficulties related to healthcare delivery in Ghana, most importantly the easy way to make health records accessible to clinicians and professionals. Therefore, the experts have recommended implementing R-HIS-F to the Ghana Health Service by

including Local Area Network (LAN) health facilities in areas with limited and poor internet connectivity.

Notwithstanding these two limitations, the current study has made very important and insightful admissions, which are worthy of sharing.

6.7 Recommendations for Future Research

This study, as presented, makes a significant contribution to HIS literature by identifying peculiar weaknesses and strengths of Ghana's health system. The research focus of the study was not tied to one particular hospital but instead covered ten (10) hospitals. The general weaknesses and strengths have been identified, and a workable framework R-HIS-F has been proposed and validated by a team of experts for implementation within the health sector. However, this researcher recommends that future studies would take one particular hospital in Ghana and examine the financial resource plausible for its implementation within the hospital. This would go a long way to aid the successful implementation of the R-HIS-F.

In addition, the R-HIS-F was proposed by the researcher based on the assessment of the strengths and weaknesses of hospitals within the three geographical health zones in Ghana. This is a significant contribution because such a framework is carefully designed to cater to Ghana's health facilities. Notwithstanding this progress, the researcher recommends that future studies could examine the health information system architecture among the rural areas and propose particular workable health information systems that could be linked or incorporated into the current R-HIS-F.

Additionally, future research can be conducted on patient satisfaction on HIS as a service system. This will help understand how patients understand and feel about the HIS system they experience within the hospitals they attend.

6.8 General Conclusion

This chapter concludes the entire thesis by paying attention to practical and theoretical contributions made by the current study, followed by recommendations for practice and future research, the limitations of the study, and a general conclusion. The study aims at assessing the strength and weakness of the HIS found in Ghana and how employee perception of HIS influences its acceptance in hospitals.

The key findings are that hospitals in Ghana have incorporated some level of the electronic health system, it and the manual health information system such that only a few hospitals in the country use electronic health information systems entirely. In addition, the study shows that respondents are largely pleased with the functionality and functions of the health information system. However despite their overall satisfaction with HIS, the biggest setback is the lack of interoperability, confidentiality and time consumption. In terms of the strengths, respondents considered the accessibility and friendliness, data storage and information retrieval as the most favoured aspects of the Health Information System.

The study reveals that the installation of an electronic system of the health information systems is the way to go; hence every health facility is encouraged to ensure that they have HIS in place for a complete total migration as soon as possible.

In conclusion, the results are expected to lead to the successful adoption and implementation of the Updated Health Information System Structure for the efficient and effective delivery of healthcare services in Ghana and beyond.

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Appendix A: UNISA Ethical Clearance Certificate

UNISA university of south africa

UNISA-CAES HEALTH RESEARCH ETHICS COMMITTEE

Date: 02/08/2019

NHREC Registration # : REC-170616-051
REC Reference # : 2019/CAES_HREC/117
Name : Ms A Quist
Student #: 66099129

Dear Ms Quist

Decision: Ethics Approval from 01/08/2019 to completion

Researcher(s): Ms A Quist
amandaquist@yahoo.com

Supervisor (s): Prof A Coleman
colema@unisa.ac.za; 071-137-0859

Working title of research:

Assessment of health information system adoption: A case study of Ghana health service

Qualification: PhD Information Systems

Thank you for the application for research ethics clearance by the Unisa-CAES Health Research Ethics Committee for the above mentioned research. Ethics approval is granted until the completion of the project, **subject to submission of yearly progress reports and the clarification required below. Failure to submit the progress report will lead to withdrawal of the ethics clearance until the report has been submitted.**

Due date for progress report: 31 July 2020

Please note the points below for further action:

1. The sampling procedure needs further clarification – how will the two participants in each field be selected?
2. The supervisor is requested to confirm in writing that he is confident that the research will deliver a PhD in the field of computing.

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*The **low risk application** was **reviewed** by the UNISA-CAES Health Research Ethics Committee on 01 August 2019 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No field work activities may continue after the expiry date. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:
*The reference number **2019/CAES_HREC/117** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

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Appendix B: Application for Ethical Clearance from Ghana Health Service

The Chair,
Ghana Health Service Ethical Review Commitee
Private Mail Bag, Ministres
Accra, Ghana
West Africa.

August 19, 2019.

Dear Chair,

APPLICATION FOR ETHICAL CLEARANCE

Amanda Quist Okronipa is my name, a PhD in Information Systems candidate at the University of South Africa (UNISA) and I am doing a research titled **Assessment of Health Information System Adoption, A Case Study of Ghana Health Service.**

I seek ethical clearance to collect data from your facilities for my doctoral studies. The data obtained from this exercise will be used for academic purposes only.

If given the opportunity, I will deem it a great privilege and an obligation to work hard to complete my doctoral studies. You may contact me via mobile on +233209286540/ +233557507788 and by at email 66099129@mylife.unisa.ac.za if have any questions or need further clarifications.

I look forward to your kind cooperation. Thank you in advance.

Attached to this application letter are:

- Cover letter from head of the PI's Institution
- Cover letter and CV supervisor
- Covering letter from school confirming student status
- Covering letter and CV from local supervisor
- Permission letter to the study sites
- Statement to comply with ethical principles
- Completed GHS-ERC administrative information form
- Completed GHS-ERC checklist
- Ethical Approval letter from the student's university
- Executive Summary
- Full Protocols
- All data collection forms to be used in the research (Interview questions, Questionnaires, Scheduled document questions)

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- Participants information sheet for (Health Information Officers, Doctors, Nurses, and Hospital administrative officers)
- Consent form for (Health Information Officers, Doctors, Nurses, and Hospital administrative officers)
- Abridged CV f principal researcher

Yours sincerely,

Amanda Quist Okronipa

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Appendix C: Permission from Ghana Health Service

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
GPS Address: GA-050-3303
Tel: +233-302-681109
Fax + 233-302-685424
Mob + 233- 050-3539896
Email: ethics.research@ghsmail.com

MyRef. GHS/RDD/ERC/Admin/App
Your Ref. No. 19593

24th October, 2019

Amanda Quist Okronipa
Ghana Technology University College
Private Mail Bag 100
Accra-North

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC 003/09/19**
Project Title	Assessment of Health Information System Adoption: A Case study of Ghana Health Service
Approval Date	24th October, 2019
Expiry Date	23rd October, 2020
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.
- Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
Dr. Cynthia Bannerman
(GHS-ERC Chairperson)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

Appendix D: Participant Information Sheet for Health Information Officers, Doctors, Nurses and Hospital Administrative officers

UNISA university of south africa

APPENDIX A: PARTICIPANT INFORMATION SHEET FOR HEALTH INFORMATION SYSTEMS OFFICERS

Ethics clearance reference number: 2019/CAES_HREC/117
Research permission reference number: 10/07/2019

Title: Assessment of Health Information System Adoption: A Case Study of Ghana Health Service.

Dear Prospective Participant

My name is Amanda Quist and I am doing research with Prof. Alfred Coleman, Chair of Department (COD) Computer Science School of Computing, in the Department of College of Science, Engineering and Technology (School of Computing) towards a PhD in Information Systems, at the University of South Africa. We are inviting you to participate in a study entitled Assessment of health information system adoption: A case study of Ghana health service.

WHAT IS THE PURPOSE OF THE STUDY?

The study is about investigating the strength and weakness of health information systems found in Ghana and how employee perception of health information systems influences its acceptance and the perceive use. Based on the findings from the assessment of health information systems in Ghana, a proposed framework will be developed to assist doctors, nurses and hospital administrators to execute their professional work effectively and efficiently. Additional, the assessment of the health information systems will provide the underpinnings for decision making by the health care profession in functions like data generation, compilation, analysis and synthesis as well as communication and use of health information systems.

WHY AM I BEING INVITED TO PARTICIPATE?

Why did you choose this particular person/group as participants?

I will obtain information and permissions from Ghana Health Service through selected hospitals in Ghana. This group of people were selected because they are the actual ended uses of Heath Information System. In the health space, there are different categories of professionals (doctors, nurse, administrative officers and health information systems officers). The interaction of these people is paramount to effective delivery of health services, due to the fact that knowledge on

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APPENDIX A: PARTICIPANT INFORMATION SHEET FOR DOCTORS

Ethics clearance reference number: 2019/CAES_HREC/117
Research permission reference number: 10/07/2019

Title: Assessment of Health Information System Adoption: A Case Study of Ghana Health Service.

Dear Prospective Participant

My name is Amanda Quist and I am doing research with Prof. Alfred Coleman, Chair of Department (COD) Computer Science School of Computing, in the Department of College of Science, Engineering and Technology (School of Computing) towards a PhD in Information Systems, at the University of South Africa. We are inviting you to participate in a study entitled Assessment of health information system adoption: A case study of Ghana health service.

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This is to Certify that this Study's Inform Consent Form Has Been Approved by GHS-ERC for the Period 24.10.19 to 23.10.2020
Sign ..... Date 24/10/19
Name Nana Abena Apatu
GHC-ERC Administrator

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APPENDIX A: PARTICIPANT INFORMATION SHEET FOR NURSES

Ethics clearance reference number: 2019/CAES_HREC/117

Research permission reference number: 10/07/2019

Title: Assessment of Health Information System Adoption: A Case Study of Ghana Health Service.

Dear Prospective Participant

My name is Amanda Quist and I am doing research with Prof. Alfred Coleman, Chair of Department (COD) Computer Science School of Computing, in the Department of College of Science, Engineering and Technology (School of Computing) towards a PhD in Information Systems, at the University of South Africa. We are inviting you to participate in a study entitled Assessment of health information system adoption: A case study of Ghana health service.

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WHY AM I BEING INVITED TO PARTICIPATE?

Why did you choose this particular person/group as participants?

I will obtain information and permissions from Ghana Health Service through selected hospitals in Ghana. This group of people were selected because they are the actual ended uses of Heath Information System. In the health space, there are different categories of professionals (doctors, nurse, administrative officers and health information systems officers). The interaction of these people is paramount to effective delivery of health services, due to the fact that knowledge on health care practices can be shared among the various parties. In addition, the participants will

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APPENDIX A: PARTICIPANT INFORMATION SHEET FOR HOSPITAL ADMINISTRATIVE OFFICERS

Ethics clearance reference number: 2019/CAES_HREC/117
Research permission reference number: 10/07/2019

Title: Assessment of Health Information System Adoption: A Case Study of Ghana Health Service.

Dear Prospective Participant

My name is Amanda Quist and I am doing research with Prof. Alfred Coleman, Chair of Department (COD) Computer Science School of Computing, in the Department of College of Science, Engineering and Technology (School of Computing) towards a PhD in Information Systems, at the University of South Africa. We are inviting you to participate in a study entitled Assessment of health information system adoption: A case study of Ghana health service.

WHAT IS THE PURPOSE OF THE STUDY?

The study is about investigating the strength and weakness of health information systems found in Ghana and how employee perception of health information systems influences its acceptance and the perceive use. Based on the findings from the assessment of health information systems in Ghana, a proposed framework will be developed to assist doctors, nurses and hospital administrators to execute their professional work effectively and efficiently. Additional, the assessment of the health information systems will provide the underpinnings for decision making by the health care profession in functions like data generation, compilation, analysis and synthesis as well as communication and use of health information systems.

WHY AM I BEING INVITED TO PARTICIPATE?

Why did you choose this particular person/group as participants?

I will obtain information and permissions from Ghana Health Service through selected hospitals in Ghana. This group of people were selected because they are the actual ended uses of Heath Information System. In the health space, there are different categories of professionals (doctors, nurse, administrative officers and health information systems officers). The interaction of these

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people is paramount to effective delivery of health services, due to the fact that knowledge on health care practices can be shared among the various parties. In addition, the participants will be recruited through the recommendation of the hospital directors. Your participation in the interview will go a long way to achieve the aim of the research. Your participation is voluntary. You have the right to be a part of the study, choose not to participate or to stop participating at any time without penalty. There are no right or wrong answers. The information you will provide will strictly remain confidential and anonymous and will only be used for research purposes. You will not directly benefit by participating in the study, however this study will indirectly benefit you as a participant in the form of providing information that can be used to improve Health Information Systems policies and support.

[The Protection of Personal Information Act, nr 4 of 2013, necessitates the disclosure of how access was gained to the personal information of prospective participants]. Indicate the approximate number of participants *[this is useful information to assist the participant to make an informed choice whether to participate in the proposed study – potential breaches of confidentiality increase with a small sample size].*

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

Describe the participant's actual role in the study.

The study involves the use of interviews, questionnaires, scheduled documents interviews and expert review will be the main methods. The sort of questions you will be asked relates solely to Health Information Systems and nothing else. The expected duration of your participation in completing the questionnaire will not exceed 45 minutes.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Yes, your participation in this study is voluntary and anonymous. You have the right to withdraw at any stage without any penalty or future disadvantage whatsoever. You do not even have to provide the any reason(s) for your decision. Your withdrawal will in no way influence your continued relationship with the researcher. Note that you are not waiving any legal claims, rights or remedies because of your participation in this research study. All information obtained from the questionnaire is strictly confidential.

- The completed study will be reported in aggregate. Confidentiality will be maintained, only the researchers will have access to the study data and information. All data collected will be stored in a secure place (locked cabinet) and will be destroyed in minimum of five years and maximum of seven years. This study has no potential risks because of the

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participants and environment selected for the study but in case of any challenges, the researcher will be available to resolve any challenges that may arise. Time duration for the interview will take 45 minutes.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

It will improve healthcare service delivery and patient in the communities will have access to better health care service. It will also ease the work routine or activities of the healthcare practitioners (doctors, nurses, hospital administrative officers and health information officers).

ARE THEIR ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

Participation in the study will not cause any potential level of inconvenience and/or discomfort to you.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

Very high level of confidentiality will be ensured regarding any information provided by you. No identity or name or contact will be recorded. The researcher will store hard copies of the collected data from the study for a minimum period of five years in a locked cupboard in the Supervisor's office at UNISA Science Campus office no: 04-061, for future research or academic purposes. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Data collected will be destroyed after five years of completion of research. Information collected will be used only for this research. Till the completion of the research, the data will be kept in a locked cabinet. Your answers will be given a code number or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings. Password will be used on captured data on computer.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers will not be stored. However, electronic information will be stored on a password protected computer till completion of this research. All information and data will be destroyed after completion of the study. Hard copies will be shredded and/or electronic copies will be permanently deleted from the hard drive of the computer through the use of a relevant software programme. The researcher will store hard copies of the collected data from the study

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for a minimum period of five years in a locked cupboard in the Supervisor's office at UNISA Science Campus office no: 04-061, for future research or academic purposes. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

You will not receive payment or any incentives. Also you will not directly benefit by participating in the study, however this study will indirectly benefit you as a participant in the form of providing information that can be used to improve Health Information Systems policies and support.

HAS THE STUDY RECEIVED ETHICS APPROVAL

This study has received approval from the Research Ethics Review Committee of the College of Agriculture and Environmental Sciences, Unisa.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Amanda Quist on +233209286540 or fax 66099129@mylife.unisa.ac.za or the supervisor at colema@unisa.ac.za or + 27116709108. The findings are accessible for December 2021. *Please do not use home telephone numbers. Departmental and/or mobile phone numbers are acceptable.*

Should you have concerns about the way in which the research has been conducted, you may contact <insert supervisor's contact details here, including email, internal phone number and fax number>. Contact the research ethics chairperson of the CAES General Ethics Review Committee, Prof EL Kempen on 011-471-2241 or kempeel@unisa.ac.za if you have any ethical concerns or Contact the Ghana Health Service Ethics Review Committee Administrator's, Nana Abena Kwaa Ansah Apatu, 0503539896, ethics.reasearch@ghsmail.org if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study.
Thank you.

Amanda Quist

This is to Certify that this Study's Inform Consent Form Has Been Approved by GHS-ERC for the Period 24.10.19 to 23.10.2020
Sign ..... Date 24.10.19
Name ... GHC-ERC Administrator

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Appendix E: Consent Form for All Participants

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CONSENT TO PARTICIPATE IN THIS STUDY

Title: Assessment of Health Information System Adoption: A Case Study of Ghana Health Service.

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname..... (Please print)

Participant Signature.....Date.....

Researcher's Name & Surname AMANDA QUIST (Please print)

Researcher's signature Date November 11, 2019.

This is to Certify that this Study's Inform Consent Form Has Been Approved by GHS-ERC for the Period 24.10.19 to 23.10.2020
Sign ..... Date 24.10.19
Name Nana Abena Apata
GHC-ERC Administrator

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Appendix F: Interview Questions for Chief Information Manager and Health Information System Officers (CIO/HIS)

APPENDIX B: INTERVIEW QUESTIONS

INTERVIEW QUESTIONS FOR CHIEF INFORMATION MANAGER AND HEALTH INFORMATION SYSTEM OFFICERS (CIO/HISO)

The objective of this interview schedule is to access the strength and weakness of health information systems in Ghana in terms of its accessibility, timelessness, availability, accuracy and the degree of utilization of health information systems from the point of view of the health information system officers

- Your participation in this research study is voluntary and you may withdraw at any time if so desired
- Your interview will take 45 minutes
- Your responses will remain confidential

Section A: Biographical Details

Age

☐ 21-29

☐ 30-39

☐ 40-49

☐ 50 and above

Gender

☐ Male

☐ Female

Professional Status

☐ Chief Information Manger

☐ Health Information System Officer

1

Section B:

1. What types of Health Information Systems are used in your hospital?

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   .....

   .....

   .....

2. What are they used for?

   .....

   .....

   .....

   .....

3. Are the system interoperable?

   .....

   .....

   .....

   .....

4. How do you rate the existing Health Information System in your Hospital?

	Very Good	Good	Satisfactory	Unsatisfactory	Poor
Relevance					
Timeliness					
Accuracy					
Availability					
Accessibility					
Confidentiality					

5. How do you rate the current application of Health Information System in your Hospital?

	Very Good	Good	Satisfactory	Unsatisfactory	Poor
Data Collection					

Data transmission					
Data processing					
Data storage					
Information Retrieval					

6. Do health information staff and other health workers in the hospital receive regular in-service training in health information system?

a. If Yes,

- What percentage of health workers has received such training?

  .....

  .....

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  .....

- Please explain the kind of training provided?

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b. If No, please discuss the reasons for the lack of regular training sessions

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7. Is there a functional central administrative unit for Health Information Systems?

   a. If Yes, does that unit have adequate resources and undertake Health Information Systems strengthening activities regularly.

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b. If No, have you had such a functional unit in the past or are there plans to establish such a unit in the future.

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8. Do you receive assistance in designing, managing and supporting database and software?

   a. If Yes, please rate the degree of assistance as:

   Excellent ☐ Adequate ☐ Limited ☐

   b. If No, could you share with me your opinion as to why such assistance is not available?

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9. Are there adequate personnal trained in Health Information System?
   - If yes, can you rate it according to adequacy?

   a. Highly adequate ☐ b. Adequate ☐ c. Partially adequate ☐

   - If No, can you identify specific area that do not have adequate capacity?

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10. In your opinion, what are the three most prominent strengths if any, in the existing Health Information System in your hospital?
    1. .....
    .....
    2. .....
    .....
    3. .....
    .....

11. In your opinion, what are the three most prominent weakness if any, in the existing Health Information System in your hospital?
    1. .....
    .....
    2. .....
    .....
    3. .....
    .....

12. What type of ICT equipment does the hospital have?
    .....
    .....
    .....
    .....

13. What are the equipment used for?

    .....
    .....
    .....
    .....

14. Is there basic ICT infrastructure (Computers, telephone, network and internet access) at the hospital for rapid compilation of data?
    a. Yes ☐ b. No ☐

15. Is there support for ICT equipment maintenance at all levels on regular basis?
    a. Yes ☐ b. No ☐

16. How does the hospital communicate with other hospitals and other departments within the hospital?
    ……
    ……
    ……
    ……

17. What e-health system is commonly used for communicate between the health care professionals?
    ……
    ……
    ……
    ……

18. Who has access to patient health records in you hospital?
    ……
    ……
    ……
    ……

19. How are patient health record captured and by who?
    ……
    ……
    ……
    ……

20. How long does it take to capture one patient's health records?

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21. How is a patient record transferred within the hospital and outside the hospital?

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22. What type of ICT equipment or infrastructure is needed by the hospital? Why?

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23. What ICT Plans does the hospital have for the future?

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24. Is there anything new you would like to recommend or add?

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25. What are your general concern regarding Health Information Systems in your hospital.

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26. Out of your experience, what new ideas of Health Information Systems do you recommend?

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THE END

Thank you for your time and participation

Appendix G: Questionnaire for Doctors And Nurses

APPENDIX C: QUESTIONNAIRE FOR DOCTORS AND NURSES

The purpose is to establish the ideas, concerns, expectations and satisfaction of healthcare professionals in using health information systems in Ghana.

- All information will be treated confidentially. The completion of this questionnaire is voluntary and your participation will be highly appreciated
- Your interview will take 45 minutes

Section A: Biographical Details

Age

☐ 21-29

☐ 30-39

☐ 40-49

☐ 50 and above

Gender

☐ Male

☐ Female

Healthcare Professional Status

☐ Physician

☐ Nurse

☐ Junior Medical Doctor

Department

Indicate your department……

1

Section B

1. How do you rate your computer skills in relation to the knowledge of using routine applications such as Microsoft, etc.?

   a. Excellent ☐ b. Good ☐ c. Satisfactory ☐ d. Poor ☐

2. How often do you apply Information Technology and its tools in you daily routine at the hospital?

   a. Regular user ☐ b. Occasional user ☐ c. Never use ☐

3. How many patients do you treat per day? ☐

4. How do you assess patient health records?

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   .....

   .....

   .....

5. How do you record patient health information?

   a. Manual and Electronic .....

   .....

   .....

   b. Electronic.....

   .....

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6. How long do you spend recording/collecting patient health records for a single patient?

   .....

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7. Do you use an ICT system or application to collect and record patient health information?

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8. Where is patient health information stored?

.....

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.....

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9. Do you perceived that your stored information is secure?
If Yes,.....

.....

.....

If No,.....

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.....

10. Who stores patient health information?

a. Doctor ☐ b. Nurse ☐ c. Both Doctors and Nurses ☐

d. Others, please specify ☐

11. Are you satisfied with the current storage, process, security, time saving and confidentiality provided by the health information systems?

a. Yes ☐ b .No ☐

If no can an alternative be provided to improve the usage of health information systems?

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.....

12. Is there basic ICT infrastructure (Computers, telephone and internet access) at the hospital for rapid compilation of data?

a. Yes ☐ b. No ☐

13. Do you think the way in which patient health information is recorded provide accurate and complete information?

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14. How often are patients refer to the other hospitals due to failure in Health Information Systems in the hospital?

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15. Which process do you use when referring patients to other hospitals or departments?

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16. Do you share patient health information with other healthcare professionals within the hospital and outside the hospitals?

a. Yes ☐ b. No ☐

17. How do you share patient health information?

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18. Do you perceive the quality and format used for sharing information among healthcare professionals to be effective and ease to use?

If Yes, kindly provide a reason.....

.....

.....

If No, kindly provide a reason .....

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.....

19. Do you perceive usage of electronic system for recording, sharing, storing and transferring patient health information will be beneficial and useful to the hospital?

If Yes, kindly provide a reason.....

.....

.....

If No, kindly provide a reason .....

……

……

20. How do you describe the existing Health Information System in your Hospital?

	Very Good	Good	Satisfactory	Unsatisfactory	Poor
Relevance					
Timeliness					
Accuracy					
Availability					
Accessibility					
Confidentiality					

21. How do you respond to the statement "Health Information systems in Ghana hospitals are poorly organized and need urgent reform measures"

a. Strongly agree ☐ b. Agree ☐ c. Disagree ☐ d. Strongly disagree ☐

Kindly provide a reason……

……

……

……

22. How do you describe the current application of Health Information system in your Hospital

	Very Good	Good	Satisfactory	Unsatisfactory	Poor
Data Collection					
Data transmission					
Data processing					
Data storage					
Information Retrieval					

23. How do you describe your overall satisfaction towards the existing Health Information System in your hospital?

a. Highly satisfied ☐ b. Satisfied ☐ c. Unhappy ☐ d. Dissatisfied ☐

24. How do you describe your overall dissatisfaction towards the existing Health Information System in your hospital?

a. Highly dissatisfied ☐ b. Dissatisfied ☐

25. In your opinion, if there are any changes to be integrated into the existing health information systems what will that be?

1. .....

.....

2. .....

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3. .....

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26. In your opinion, what are the three most prominent strengths if any, in the existing Health Information System in your hospital?

1. .....

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2. .....

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3. .....

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27. In your opinion, what are the three most prominent weakness if any, in the existing Health Information System in your hospital?

1. .....

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2. .....

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3. .....

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28. Do health information staff and other health workers in the hospital receive regular in-service training in health information systems?

a. If Yes,

- What percentage of health workers has received such training?

  .....

  .....

- Please explain the kind of training provided?

  .....

  .....

b. If No, please discuss the reasons for the lack of regular training sessions

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29. Are computers available at all levels for Health Information Management?

a. Yes ☐ b. No ☐

30. What are your general concerns regarding Health Information Systems in your Hospital?

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31. Is there anything new you would like to recommend to improve the content of the current Health Information System?

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THE END

Thank you for your time and participation

Appendix H: Interview Questions for Administrative Manager and Administrative Staff

APPENDIX D: GROUP INTERVIEW QUESTIONS

INTERVIEW QUESTIONS FOR ADMINISTRATIVE MANAGER AND ADMINISTRATIVE STAFF

The aim of this interview is to investigate hospital information systems use and management processes at Ghana hospitals (Ghana Health Service).

- Your participation in this research study is voluntary and you may withdraw at any time if so desired
- Your interview will take 15-45 minutes
- Your responses will remain confidential

Section A: Biographical Details

Age

☐ 21-29

☐ 30-39

☐ 40-49

☐ 50 and above

Gender

☐ Male

☐ Female

Professional Status

☐ Administrative Manager

☐ Administrative Staff

1

Section B

1. Briefly describe the geographical location and setting of your hospital by responding to the items below.

Name of hospital	…… …… ……
Sector	1. Government Hospital ☐ 2. Private Hospital ☐ 3. Security Service Hospital ☐
Level of care	1. District Hospital ☐ 2. Regional Hospital ☐ 3. Teaching Hospital ☐
Digital Address	…… ……
Region / District	…… ……
Location	…… ……

2. What is the population size of the area, which your hospital serves?

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3. What is the size of your hospital? Kindly breakdown to department.

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4. How many doctors does your hospital? Indicate the number of general practitioners and specialist practitioners below.

Physicians	**Number**
General practitioners	
Specialist practitioners	

5. What processes are involved when a patient first arrives in the hospital and how long do these processes take?

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6. What Health Information Systems are used by the hospital?

a. Manual and Electronic .....

.....

.....

b. Electronic.....

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.....

7. What are they used for?

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.....

.....

8. How do you describe the existing Health Information System in your Hospital?

	Very Good	Good	Satisfactory	Unsatisfactory	Poor
Relevance					
Timeliness					
Accuracy					
Availability					
Accessibility					
Confidentiality					

9. Are these systems used to capture any type of information? If so, what type of information does Hospital Information Systems capture?

.....

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.....

10. Is there an automated Hospital Information System used for capturing, sharing or storing patient health information?

a. Yes ☐ b .No ☐

11. How do you describe the current application of Health Information Management in your Hospital

	Very Good	Good	Satisfactory	Unsatisfactory	Poor
Data Collection					
Data transmission					
Data processing					
Data storage					
Information Retrieval					

12. Do Hospital Information Systems communicate with other systems within the hospital or with other hospitals?

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13. How is patient health information stored by the hospital, is there a standard format followed?

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14. What processes are used when a patient is transferred from one hospital department to another department and hospital?

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15. How often do you apply Information Technology and its tools in your daily routine in the hospital?

a. Regular user ☐ b. Occasional user ☐ c. Never use ☐

16. What is your experience of working with Hospital Information Systems?

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17. Does the use of Hospital Information Systems meet healthcare needs of the hospital?
    a. Yes ☐ b. No ☐

18. Are there adequate personal trained in Health Information System?

    - If yes, can you rate it according to adequacy?

    a. Highly adequate ☐ b. Adequate ☐ c. Partially adequate ☐

    - If No, can you identify specific area that do not have adequate capacity?

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19. Is there a functional central administrative unit for Health Information Systems?
    - If Yes, does that unit have adequate resources.

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    - If No, have you had such a functional unit in the past?
    - Are there plans to establish such a unit in the future?

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20. Do health information staff and other health workers in the hospital receive regular in-service training in health information?

    a. If Yes,

    - What percentage of health workers has received such training?

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- Please explain the kind of training provided?

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b. If No, please discuss the reasons for the lack of regular training sessions

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21. Are computers available at all levels for Health Information Management?
    - Do you think that the computers are sufficiently available?

Yes ☐ No ☐

- If No, according to your opinion what are the reasons for the lack of computers in the hospital for health information management?

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22. What are your gnaral concerns regarding Health Information Systems in your hospitals.

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23. Is there anything else you would like to recommend or add?

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THE END

Thank you for your time and participation

Appendix I: Expert Review: Ghana Health Service, Department Of Health Information Management Systems

OUR CORE VALUES
- People-Centered
- Professionalism
- Team work
- Innovation
- Discipline
- Integrity

My Ref No. GHS/PPMED/20/L062

GHANA HEALTH SERVICE
Your Health - Our Concern

Ghana Health Services
Private Mail Bag
Ministries
Accra, GHANA
Tel: (0302)-662014
Fax: (0302)-666-808
E-mail: dg@ghsmail.org

2nd September, 2020

AMANDA QUIST
UPSA
ACCRA

EXPERT REVIEW

I have read/examined the Revised Health Information System Framework (RHIS-F) proposed and find it relevant for Ghana Health Service.

The framework is also suitable for the various health facilities in the country. If implemented, it will enhance the essential linkages between the various public and private hospitals.

I have recommended that due to limited or no internet connectivity in some part of the country, the framework should include a LAN for health facilities with such challenges.

Thank you.

MR. DOMINIC K. ATWEAM
HEALTH SYSTEMS ANALYST
HEAD DISTRICT HEALTH INFORMATION MGT. SYSTEM

Appendix J: Expert Review: The Trust Hospital, Department OF Health Information Systems.

THE TRUST HOSPITAL COMPANY LIMITED

PMB 16
MINISTRIES, ACCRA
TEL: 0302761974-9

Fax: 0302777790
Loc. Oxford Street: Osu, Accra, Ghana

HOSPITALS & CLINICS
CONTACTS & LOCATIONS

HOSPITALS
Trust Hospital - Osu
Oxford Street
Osu.
Tel: 0302761974-9

Trust Specialist Hospital
Angola Road
Osu Kukuhill
Osu.
Tel:

Trust Mother and Child Hospital
Troas Crescent
Osu.
Tel:

CLINICS
Trust Clinic - Tema
SSNIT Building
Community 2
Tema.
Tel: 0303212292

Trust Clinic - Sakumono
Opposite Tennis Court
Sakumono.
Tel: 0303403861-2

Trust Clinic - Adenta
Adenta Shopping Mall
Adenta.
Tel: 0302949600

Trust Clinic - Dome
Dome SSNIT Flats
Dome.
Tel: 03022433133
0302433111

Trust Clinic - Dansoman
Housing Estates
Dansoman.
Tel:

Trust Clinic
Pension House
Pension House
Car Park.
Tel:

TO : Amanda Quist

Cc : Prof. Alfred Coleman

FROM : Kenneth K. Azumah

DATE : September 7, 2020

SUBJECT : **Expert Review**

The proposed Revised Health Information System Framework(R-HIS-F) for creating and managing a national EHR appears to be well-reasoned and supported by initial analyses of surveyed environment. The work laying out a framework for a national database hosted in the cloud is a significant contribution to efforts of Ghana Health Service to make health records conveniently available to clinicians and specialists. Adding a financing model will make the framework generally stronger, acceptable and more useful to similar developing economies.

Kenneth K. Azumah
Hospital Information Systems Manager

Appendix K: Expert Review: A Private Health Information System Practitioner

SIDRID
simple driven ideas

P.O. Box GP 2095, Accra-Ghana
t: +233 507 974 848, +233 243 104 909
e: info@sidrid.com

To **Amanda Quist**

From **Mr Jibril M. Bashiru**

Date 02 September, 2020

Subject: **Subject Review on Revised Health Information Systems Framework (R-HIS-F)**

The Revised Health Information System Framework you proposed provides a good foundation for the implementation of a robust and effective health information interoperability in Ghana.

The central health information repository architecture connected with all the relevant stakeholders in the health delivery sector of Ghana, when implemented, will among others not only ensure a comprehensive health information about patients but also allow for introspection of those data by relevant stakeholders such as Ghana Health Service to guide policy directions and feedback to practitioners.

Sincerely,

Jibril M. Bashiru
Director / CTO

OPSOMMING

Internasionaal het gesondheidsinligtingstelsels (GIS) die lewering van gesondheidsorg in ontwikkelde lande bevorder, maar ten spyte van bewese voordele, bly hul implementering in ontwikkelende lande gefragmenteer en neem nie die bestaande infrastruktuur of menslike en logistieke hulpbronne in ag nie. Dit het daartoe gelei dat die navorser die voordele van GIS's in staatshospitale in Ghana ondersoek het.

Deur die gemengde ontwerpmetode van samelopende parallelle te gebruik, het die studie gepoog om die GIS's wat in Ghana se onderrig-, distrik- en kwasi-staatshospitale gebruik word om die lewering van gesondheidsdienste in hulpbronarm-omgewings te bevorder, te ondersoek.

Data is deur vraelyste, onderhoude en waarnemingtegnieke versamel. Tagtig gesondheidsorgwerkers (dokters, verpleegsters, gesondheidsinligtingbeamtpes en administratiewe personeel) van 10 hospitale in die land se noordelike, middel en suidelike geografiese sones is doelbewus en geriefshalwe gekies. Die data van die kwantitatiewe studie is deur frekwensies en persentasies ontleed terwyl tematiese ontleding vir die kwalitatiewe komponent gebruik is.

Die bevindings het getoon dat alhoewel al tien gesondheidsfasiliteite verskillende vorme van GIS-toepassings het, het gesondheidsorgwerkers minimale verwante opleiding (hoofsaaklik gefokus op rekenaarvaardighede) ontvang. 'n Belangrike voordeel was die vertroulikheid van pasiëntdata wat met 'n wagwoord beskerm is. Alhoewel dit as veilig beskou is, het die respondente erken dat daar strenger gebruikerverifikasie moet wees. Nog 'n geïdentifiseerde kwessie was dat een GIS nie met 'n ander GIS in dieselfde hospitaal gekommunikeer het nie: die afdeling vir buitepasiënte was nie aan die apteek of onkologie-afdeling verbind nie, wat operasies vertraag het. Alhoewel die Ghana Health Service (GHS) al die hospitale in Ghana reguleer, het een hospitaal nie toegang tot die data wat in 'n ander hospitaal gegenereer is nie. Inligting word dus nie maklik oorgedra, verwerk of êrens anders gestoor as waar dit vasgelê is nie. Swak internetverbindings en elektrisiteitsvoorsiening word ook gesien as dat dit die hospitaalwye-gebruik van GIS's beperk.

Die navorsers het 'n hersiene raamwerk vir die gesondheidsinligtingstelsel (R-HIS-F) voorgestel vir die samewerking en integrasie van gesondheiddata en -dienste vir alle hospitale in Ghana, deur die GIS-wolkdiens. GIS-kundiges het die voorgestelde R-HIS-F geldig verklaar en gesertifiseer as voordelig vir gesondheidsorgwerkers en bevorderend vir die lewering van gesondheidsorg in Ghana.

SLEUTELWOORDE: Elektroniese gesondheid; Raamwerk vir gesondheidsorg in Ghana; Gesondheidsinligtingstelsels; Gesondheidsorgwerkers; Hospitale; Samewerking; Simbiotiese ekwilibrium

OKUCASHUNIWE

Emhlabeni wonke, izinhlelo zolwazi lwezempilo (lwama-HIS) zithuthukise ukulethwa kokunakekelwa kwezempilo emazweni athuthukile, nokho naphezu kwezinzuzo ezifakazelwe, ukuqaliswa kwazo emazweni amaningi asathuthuka kusalokhu kuyizicucu, zehluleka ukucabangela ingqalasizinda ekhona noma izinsiza zabantu nezokusebenza. Lokhu kwenze umcwaningi ahlole izinzuzo zokusebenzisa ama-HIS ezibhedlela zikahulumeni eGhana.

Kusetshenziswa ukwakheka kwezindlela ezixubile ezihambisanayo, ucwaningo luhlose ukuhlola ama-HIS asetshenziswa ezibhedlela zaseGhana zokufundisa, zesifunda, zesigodi kanye nezingaphansi kukahulumeni, ukuze kuthuthukiswe izinsizakalo zokunakekelwa kwezempilo ezindaweni ezicindezelayo.

Imininingwane yaqoqwa kusetshenziswa uhlu lwemibuzo, izingxoxo kanye namasu okubheka. Sebebonke, abasebenzi bezempilo abangama-80 (odokotela, abahlengikazi, izikhulu zolwazi lwezempilo kanye nabasebenzi bokuphatha) abavela ezibhedlela eziyishumi kuzo zonke izindawo zezwe ezisenyakatho, maphakathi neningizimu, bakhethwe ngendlela efanelekile nenenhloso. Imininingwane yocwaningo lokuqoqa nokuhlaziya imininingwane yezinombolo yahlaziywa kusetshenziswa amaza namaphesenti, kanti ukuhlaziya indikimba kuqondise ingxenye yekhwalithi.

Imiphumela ibonise ukuthi nakuba zonke izikhungo zezempilo eziyishumi zinezinhlobo ezahlukene zezicelo ze-HIS, ukuqeqeshwa okuncane okuhlobene (ikakhulukazi okugxile kumakhono ayisisekelo ekhompyutha) kwakunikezwa abasebenzi bezempilo. Inzuzo ephawulekayo kwaba ukugcinwa kuyimfihlo kweminingwane yesiguli, eyayivikelwe yigama eliyimfihlo okumele lisetshenziswe ukuze ungene endaweni. Nakuba kuthathwa njengokuphephile, abaphenduli bavume isidingo sokuqinisekisa okuqinile komsebenzisi.

Okunye okukhonjiwe ukuthi i-HIS eyodwa ayizange ixhumane namanye ama-HIS angaphakathi esibhedlela esifanayo: umnyango weziguli ezilaliswa ngaphandle, isibonelo, awuzange uxhumane nezinhlelo egumbini lapho kulungiswa khona futhi kuhlinzekwa imithi, noma ukucwaninga nokwelashwa kwamathumba, ngaleyo ndlela iphazamise ukusebenza. Nakuba zonke izibhedlela zaseGhana zilawulwa Insizakalo Yezempilo YaseGhana (GHS), imininingwane ekhiqizwa kwesinye isibhedlela ayinakufinyelelwa kwesinye, okusho ukuthi ulwazi aludluliswa kalula, alucutshungulwa noma lugcinwe kwenye indawo ngaphandle kwalapho luthathwe khona.

Ukungaxhunywa kahle kwe-inthanethi nokuhlinzekwa kukagesi nakho kwathathwa njengokunciphisa ukusetshenziswa esibhedlela sonke kanye nokwamukelwa kwama-HIS.

Umcwaningi uphakamise Uhlaka Olubuyekeziwe Lohlelo Lolwazi Lwezempilo (R-HIS-F) ukuze kusebenze ukusebenzisana nokuhlanganiswa kweminingwane yezempilo nezinsizakalo kuzo zonke izibhedlela zaseGhana, ngenhlobonhlobo yezinsizakalo ezilethwa ngokufunwa ezinkampanini nakumakhasimende nge-inthanethi ye-GHS. I-R-HIS-F ehlongozwayo yaqinisekiswa ochwepheshe be-GHS, futhi yaqinisekiswa njengezuzisa abasebenzi bezokunakekelwa kwempilo kanye nokuthuthukisa ukulethwa kokunakekelwa kwezempilo eGhana.

AMAGAMA ASEMQOKA:

Electronic Health

Umbhalo wezempilo womuntu ngamunye owabelwa izikhungo nezinhlangano eziningi.

Ghana Health Service Framework

Uhlaka Lohlelo Lolwazi Lwezempilo Ghana

Health Information Systems

Izinhlelo Zolwazi Lwezempilo

Healthcare Workers

Abasebenzi bezempilo

Hospitals

Izibhedlela

Interoperability

Ukusebenzisana

Symbiotic Equilibrium

Ukulingana kobudlelwano obuzuzisanayo phakathi kwabantu abahlukene noma amaqembu.