Cape Peninsula University of Technology

Healthcare information systems implementation for public healthcare service delivery in resource-constrained environments: a critical realist perspective

by

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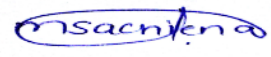
DECLARATION

I, Mourine Sarah Achieng, declare that the contents of **Healthcare information systems implementation for public healthcare service delivery in resource-constrained environments: a critical realist perspective** represents my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.



Signed

10th March 2021

Date

ABSTRACT

Integrated healthcare service delivery has been sought after in healthcare systems worldwide. The integration of healthcare services involves adequate organisation and management of healthcare services, enabling the population to gain access to quality healthcare. Subsequent to the need for integrated healthcare services, there has been an increase in the implementation of technological solutions to manage and organise healthcare services. Technology interventions have long been perceived as operational efficiency enablers in an organisational environment, including in healthcare. Consequently, technology has become integral to healthcare service delivery. The global demand for better public healthcare services, especially in developing countries with constrained resources, has encouraged healthcare systems to turn to technology for innovative ways of delivery. Many healthcare systems in developing countries have implemented some form of technological intervention to facilitate their healthcare processes, such as data capturing and storage in healthcare facilities.

In the healthcare sector, these technological interventions are often expected to improve the quality of the healthcare services delivered and also increase the safety of patients. These outcomes are usually attributed to the ability of these technological interventions to reduce documentation in the manual paper-based process, increase the efficiency of workflow and collaboration in the healthcare delivery process, facilitate better integration across the functional silos, provide real-time access to patient medical information, reduce costs, and increase turnaround times. Based on these reasons and other factors, the drive to implement technological interventions has experience a significant impetus. Regrettably, the implementation of technological interventions across most healthcare systems in developing countries has not yielded the desired outcomes, since healthcare systems have yet to realise the benefits that technological interventions present. Scholarly articles show that the implementation of technological interventions has often resulted in poorly coordinated systems, and implementation done in a silo ad hoc manner, resulting in fragmented systems with limited interoperability and software re-use, and a plethora of small pilots that are not scalable.

Instead of technological interventions being enablers, in some instances they have resulted in inefficiencies attributed to the manner in which they are implemented and used in healthcare facilities. The inefficiencies include, among others, poor data quality and bottlenecks in workflow which impact the turnaround times in the healthcare service delivery process. Literature reports a variety of causes of these inefficiencies. This raises questions about causal mechanisms that have powers that may trigger enabling or inhibiting conditions for the

implementation of technology interventions in the healthcare sector. While many studies on the implementation of technological interventions have focused on providing an understanding of factors that enable or inhibit the implementation process, little attention has been paid to discovering causal mechanisms that generate those outcomes. The current study sought to address this gap within the context of a resource-constrained environment. It argues that the implementation activities of technological interventions have causal effects on frontline users' (healthcare practitioners) ability to use these systems optimally to deliver improved healthcare services. A further argument is that of generative causation, where recognition is given to underlying factors in implementation variances of similar technological solutions in different contexts.

The study employs a case-study strategy using a critical realist qualitative methodology. Semi-structured interviews and document review were used as data-collection methods. Analysis was done using a thematic analysis technique through narrative and explanatory analyses. The study employs the Activity Analysis and Development (ActAD) model as an operational tool to identify, analyse and understand contextual mediators (such as goals/motives, procedures, actions, interactions and relationships between actors, tools) that could enable or inhibit public healthcare service delivery in a resource-constrained environment. Subsequently, the study draws on normalization process theory (NPT) as an explanatory framework to gain insight into the technology intervention implementation process and the extent to which these technologies become 'normalised' within a specific context. NPT helped identify and analyse generative mechanisms within the implementation process of technology that would evoke the mediators/outcomes in the healthcare service delivery process.

The findings in the study highlight context-based mediators such as leadership and management, availability of adequate ICT infrastructure, healthcare policies and strategies, maldistribution of resources, and skills and competency, among others, to have enabling or inhibiting effects on healthcare service delivery in public hospitals. Further, the findings also highlight generative mechanisms such as the degree of coherence, cognitive participation, collective action and reflexive monitoring that have causal effects on the implementation process of technology interventions in a particular setting such public healthcare facilities in resource-constrained environments. The study contributes to the body of knowledge by illustrating the use of critical realism methodology to identify causal mechanisms in the implementation of technology interventions within a healthcare setting.

Keywords*: Healthcare information systems, Implementation, Technology interventions, Healthcare service delivery, Critical realism, Resource-constrained environment.*

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DEDICATION

I dedicate this thesis to two special women in my life: Firstly, to my dear mother, Ms Jenipher Otieno, for her great sacrifices and continued prayers, which are greatly appreciated. Secondly, to my aunt, Prof Emily, for your motivations, tireless efforts and sacrifices in the realisation of this study. This thesis is dedicated to you.

ABBREVIATIONS AND ACRONYMS

Abbreviation	Description
3D	Three Dimensional
ActAD	Activity Analysis and Development
ANT	Actor Network Theory
ART	Anti-retroviral treatment
AT	Activity Theory
CDC	Centers for Disease Control and Prevention
CPOE	Computerised physician order entry
CPUT	Cape Peninsula University of Technology
CR	Critical Realism
CSIR	Council for Scientific and Industrial Research
DHIS	District Health Information System
DHMIS	District Health Management Information System
DHS	District Healthcare System
DICOM®	Digital Communications in Medicine
DoH	Department of Health
DREI	Describe, Retroduce, Eliminate, Identify
DSS	Decision Support System
DWR	Developmental Work Research
e-health/eHealth	Electronic Health
ECDoH	Eastern Cape Department of Health
ECHD	Eastern Cape Health Department
EDRMS	Integrated Document and Records Management System
EGK	Electronic Gate Keeping
EHR	Electronic Health Record
eHR.ZA	Electronic Health Record for South Africa

EMR	Electronic Medical Record
ESS	Executive Support System
GOe	Global Observatory for eHealth
HC	Healthcare
HIS	Healthcare Information System
HISP	Health Information Systems Program
HIT	Health Information Technology
HIV/AIDS	Human immunodeficiency virus, acquired immunodeficiency syndrome
ICT	Information and Communications Technology
IS	Information Systems
IT	Information Technology
LIMS	Laboratory Information Management System
LMICs	Low- and medium-income countries
MDGs	Millennium Development Goals
mHealth	Mobile Health
MIS	Management Information Systems
NDGs	National development goals
NDHS	National Digital Health Strategy
NDP	National Development Plan
NHI	National Health Insurance
NHIS	National Healthcare Information System
NHISSA	National Health Information System of South Africa
NHLS	National Health Laboratory Service
NPT	Normalization Process Theory
OECD	Organisation for Economic Co-operation and Development
OpenHIE	Open Health Information Exchange

OpenMRS	Open Medical Record System
PACS	Picture archiving and communication systems
PDAs	Personal digital assistants
PHC	Primary Health Care
PHCIS	Primary Health Care Information System
PMI	Patient Master Index
PREHMIS	Patient Record and Health Management Information System
ROI	Return on Investment
SAHR	South African Health Review
SDGs	Sustainable Development Goals
SMS	Short message service
SRA	Strategic relational approach
ST	Structuration Theory
TB	Tuberculosis
TMSA	Transformational Model of Social Activity
TOGAF	The Open Group Architecture Framework®
TPS	Transaction Processing System
UHC	Universal Health Coverage
UN	United Nations
USD	United States Dollar
WHO	World Health Organization

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1. Achieng, M. & Tambovceva, T. 2017. Emerging trends of health information systems implementation in low-medium income countries. In Gaile-Sarkane, E. (ed.). *Proceedings of 58th International Riga Technical University Scientific Conference on Economics and Entrepreneurship (SCEE 2017), Riga, Latvia, 13–14 October*: 6062. Riga: Riga Technical University.
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1 CHAPTER 1 – INTRODUCTION

"Know from whence you came. If you know whence you came, there are absolutely no limitations to where you can go."

James Baldwin

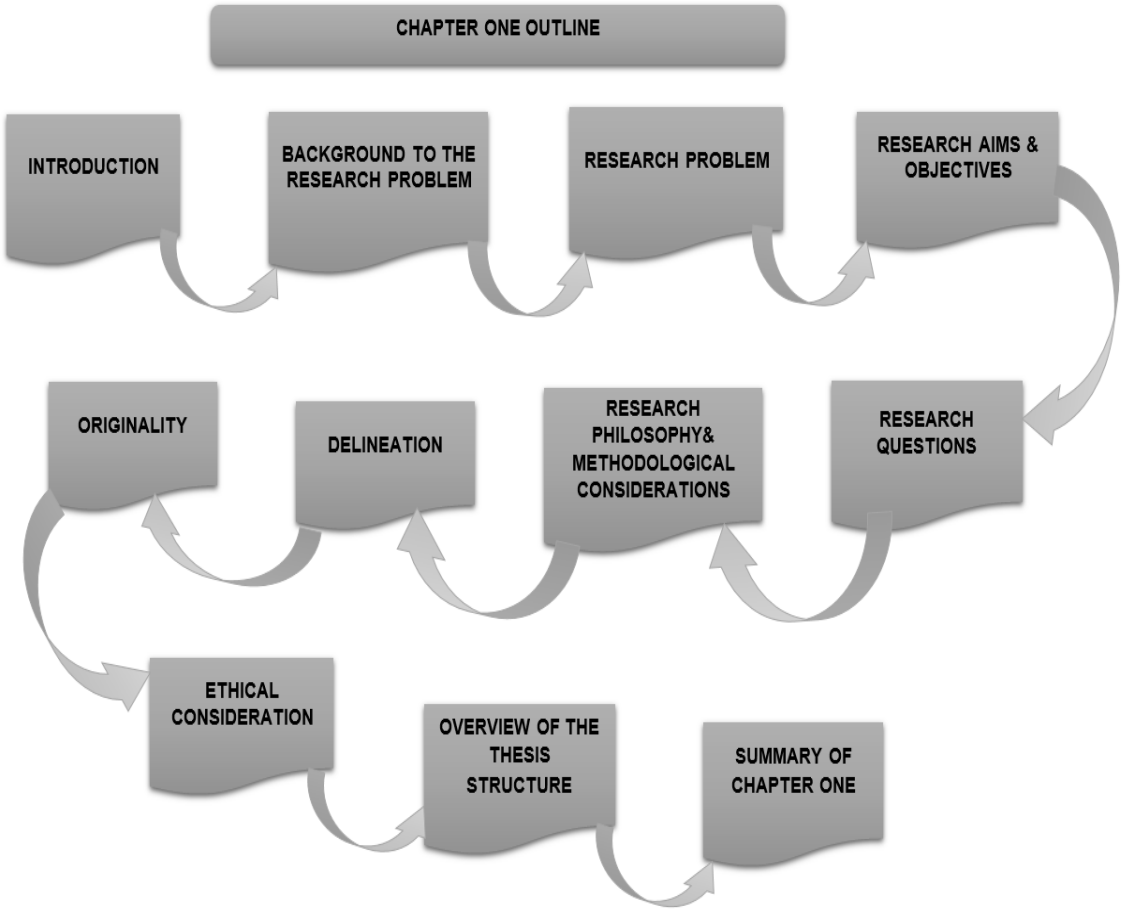

Figure 1-1: Chapter 1 outline

1.1 Introduction

One of the most significant aspect of human existence is healthcare (Nolte et al., 2008; Fichman et al., 2011). Built from a descriptive noun – 'health', and a verb –'care', healthcare is a defining characteristic of what it means to be alive (Fichman et al., 2011). Healthcare however, cannot be adequately understood outside 'health' as the underlying construct. As a construct of both the 'health' and the 'care' concepts, 'healthcare' is often referred to as a form of both a service and a process (including procedures) to diagnose, treat and maintain an individual's physical or mental (including the spiritual and the emotional) condition. In effect, Akuoko (2015) adds the "prevention of disease, illness, injury, and sickness" to this description.

The service aspect, in particular, features more prominently in most scientific definitions of 'healthcare'. For example, the World Health Organization (2004:28) refers to healthcare as "services provided to individuals or communities by health service providers for the purpose of promoting, maintaining, monitoring or restoring health". To emphasise the services aspect, Slee et al. (2008:245) define healthcare as "services that promote health, prevent health problems, diagnose and treat health problems to cure them, and improve quality of life". Similarly, Tien and Goldschmidt-Clermont (2009:257) refer to healthcare as "the treatment and management of illness and the preservation of health through services offered by the medical, dental, pharmaceutical, clinical laboratory sciences, nursing and allied health professions." The mention of a 'healthcare provider' and the 'care of human beings' in the definitions further highlights the essence of actors such as a practitioner and a recipient in the healthcare service phenomenon. Alongside the service and stakeholders (a service provider and recipient), also emerge the aspect of a 'process' in the definition of healthcare.

Healthcare service providers within a particular healthcare system differ considerably in terms of size and structure, ranging from large hospitals to primary care units or community healthcare centres (McKee & Healy, 2002; Grol et al., 2007). Providing a different perspective on this, Mans et al. (2015) note that although healthcare is typically associated with hospitals and clinics, there are many other forms of care processes provided in other organisations. These usually include various professionals involved in the care processes, such as general practitioners, diverse health specialists, dentists, midwives, and physiotherapists (Mans et al., 2015). In effect, a care need and a provision process are embedded in almost all references to healthcare services. In Akuoko's (2015) definition of healthcare as the "organized provision of medical care to individuals or a community", for example, a healthcare need, an 'organized provision' and the access phenomena are

implied. Reference to the ‘organization’ of healthcare service then, tends to articulate healthcare as a deliberate form and structure, with systems, tools and specific procedures of care service provision to the public, by service providers such as healthcare institutions, with specific sought quality implications.

Section 27 (1) of the South African Constitution states that “everyone has the right to have access to health care services, including reproductive health care” (South Africa, 1996:13). For this mandate to be realised, availability of adequate resources has a fundamental role in achieving the delivery of quality healthcare services. Obure et al. (2016) argue when there is constraint on resources (material or human), the quality of healthcare services is often compromised.

1.1.1 Urgency of adequacy in healthcare systems

Many healthcare facilities in resource-constrained settings face a wide-ranging combination of health challenges (Meara et al., 2015; Musa, Nankat et al., 2016), the majority of which are linked to inefficiencies in their healthcare systems. The study conceptualises the term ‘resource constraints’ as those effects that limit the delivery of quality healthcare services in public healthcare facilities, whether human or material, tangible or intangible. As such, healthcare facilities with inadequate leadership and governance, shortage of skilled healthcare workforce, shortage of medical supplies, inadequate funding schemes, and many other inhibiting qualities are considered to operate in a resource-constrained environment (Brinkerhoff & Bossert, 2008; Kirigia & Barry, 2008; Currie, 2009; Musa, Mwangi et al., 2016). Many healthcare systems in developing countries demonstrate considerable inhibiting qualities, therefore are often seen as operating under resource constraints.

This coupled with the high levels of infectious disease burdens and a growing population living in extreme poverty has resulted in inadequately run healthcare systems which further exacerbate the burden of resource constraints. The issue is aggravated by maldistribution of resources, the brain drain phenomenon, and a rapidly growing population. As such, the delivery of healthcare services to the majority of the population in developing countries living in under-served contexts is compromised. Inadequate healthcare infrastructure has also played a critical role in inhibiting access to essential healthcare services (Kirigia et al., 2007; WHO, 2010). Insufficient health regulations and inadequately enforced practices, lack of stakeholder involvement in the planning, management, monitoring and evaluation of healthcare services (McIntyre & Mooney, 2007), as well as inadequate allocation and use of resources, are also cited as key limitations that further exacerbate the challenges. Other mentioned limitations across literature include inadequate training of healthcare personnel

and inadequate building infrastructure; the acquisition and implementation of relevant healthcare technologies to enhance the healthcare system are also cited as challenges commonly associated with healthcare systems of many developing countries, mostly owing to poor economic conditions (Mphande, 2016).

Subsequent to these aforementioned challenges and limitations, Information and Communications Technologies (ICTs) and Information Systems (IS) are often perceived to offer quality enhancing efficiencies to operational processes in organisational contexts, including the healthcare sector. This is of particularly importance for healthcare systems in resource-constrained environments where advances in information technology (IT) have the potential to change radically how healthcare service delivery is carried out and accessed by the general population. For this reason, the study sought to explore the implementation of technological interventions in public healthcare facilities for service delivery in resource-constrained environments of South Africa.

1.1.2 Information systems and the public healthcare sector

Integrated healthcare service delivery has been a sought-after aspect in healthcare systems worldwide for a period of time. The integration of healthcare services involves adequate organisation and management of healthcare data and information that enable a population to gain access to quality healthcare services they need. Subsequent to this need, many healthcare systems have turned to information systems as an enabling tool for the management and organisation of such services. This can be attributed to the perception that the use of IS in a resource-constrained healthcare setting may improve care delivery, by enabling facilities to do more with fewer resources, in a timely and cost effective manner (Smedley, 2005; Liu et al., 2014). The provision of healthcare services is regarded as an information-centric type of service, where efficient information management and sharing tools make a world of difference. In effect, there is a wealth of anecdotal and scientific evidence of the application of technological solutions to manage healthcare information for better decision making. In addition, IS can help improve efficiencies in the collective use of all healthcare resources, with arguments suggesting that if a healthcare system uses its resources fully (optimally) in the allocative and technical sense, it tends to achieve total efficiency. This is seen in cases such as the success of the Singapore and Italian healthcare systems, and substantiates the argument for healthcare information systems' associated successes.

The Singapore healthcare system is one of the many systems known for efficiency and wide network coverage (Bai et al., 2012). The success is attributed to a combination of technical and allocative efficiency enablers, including the ability of the Singaporean

government to upgrade healthcare infrastructure, and invest in modern equipment, networked systems and sophisticated specialties (Lim, 1998; Haseltine, 2013; Blank et al., 2017). As suggested by Smith (2012), the management of healthcare information and its provision are key components to healthcare governance (for accountability). The argument therefore is that since the delivery of healthcare services to patients is highly dependent on information (Bose, 2003), information management, and ultimately efficient use of IS-based enablers are of paramount importance (Chassin & Galvin, 1998). The logic here is that the healthcare sector depends heavily on timely, relevant, and accurate information that is patient centred to provide well-coordinated, and integrated healthcare services (Rezazadeh et al., 2014).

Therefore, timely access to accurate, relevant, integrated and comprehensive healthcare information is critical to the effective delivery of quality healthcare services (Olsen et al., 2007), and the efficient and effective management and usage of healthcare information play a significant role in the outcome of patient care (Bouamrane et al., 2012). The converse is also indicated, with emerging research closely associating poor transfer of information and the disintegration of processes in the delivery of care – with inefficiencies in healthcare systems (OECD, 2010). In resource-constrained environments, accurate and timely medical information can enable hospital managers to identify which aspects of a healthcare system are underperforming. This is in order to offer targets for improvement and identify best practice to redress the occurring issues. It also has a central role in guiding patient choice of care. In seeking quality care and efficiency improvements therefore, successful healthcare organisations have increasingly turned to new information technologies for solutions (Raghupathi & Tan, 1999; Bose, 2003).

A practical example of this is the Italian healthcare system, which has implemented healthcare information systems (HIS) to establish a universal electronic medical records system that connects every level of care across all healthcare facilities (Mossialos et al., 2015). The information system provides relevant authorities with timely information on the care given, resources used, and cost for informed decision making. The Italian healthcare system also has administrative information on care delivered. Speaking of the Italian system, Mossialos et al. (2015:104) state that “a core component of the New Health Information System is the nationwide clinical coding program known as ‘bricks’, one of the most mature elements of Italy’s developing electronic health program. It aims at defining a common language to classify and codify concepts; at sharing methodologies for measuring quality, efficiency, and appropriateness of care; and at allowing an efficient exchange of information between the national level and regional authorities”.

Despite a growing acceptance of technology interventions as efficiency enablers, there has been a debate around the meanings and use of the terminologies, which remain inconsistent within the scholarly and academic fields. For example, in many quarters, the terms ‘health information technologies’ and ‘health information systems’ are often used interchangeably.

Scholars like Furukawa et al. (2008), Korpela (2011), and Mostert-Phipps et al. (2013) use the term ‘health information technology’ (HIT) to describe technology interventions in healthcare settings, whereas scholars like Haux et al. (2002) and Chiasson and Davidson (2004), use ‘information technology’ (IT) in healthcare applications. Other scholars refer to technology interventions in healthcare as healthcare information systems (HISs) (Parry, 2010; Johnson, 2011; Teixeira et al., 2012). Parry (2010) describes HISs as powerful ICT-based tools that are able to make healthcare service delivery more effective and efficient. This draws on the World Health Organization proclamation that HISs are “a prerequisite for coordinated and evidence-informed healthcare” (WHO, 2002:37). Reichertz (2006) and Häyrinen et al. (2008) suggest that the focus on the use HIS is on optimising healthcare information in an attempt to have a more integrated healthcare service. It is believed that efficiency and effectiveness would be achieved in the healthcare service delivery process. The development and design of HIS should take into consideration the need for integrated management of healthcare data at all levels of the healthcare system (Paul et al., 2012). For purposes of this study, the term ‘healthcare information systems’ (HIS) is used to incorporate an all-inclusive range of ICTs spread across a healthcare system.

Given the widespread healthcare challenges experienced by the majority of the South African population and the reality of inadequacies in the national public healthcare sector, the use of HIS as enablers is seen as crucial. This is evident in the efforts or measures the government has taken in an attempt to address the challenges and problems in the public healthcare sector. This is all in a bid to improve access to quality healthcare services to the majority of the population that needs it the most. The background to the research problem, together with the research problem, research question and research objective is presented in subsequent sections.

1.2 Background to the Research Problem

The statements in Section 27 (1) of the South African Constitution (South Africa, 1996), declaring it a right for everyone to have access to healthcare services, has been the guiding principle for initiatives within the healthcare system undertaken by the government after 1994 when it came to power. Even though this section of the Constitution mandates the government to work progressively towards the realisation of this right, it is evident that the

country still experiences challenges with inequities and disparities in the delivery of healthcare services to the majority of its populace (Eyles et al., 2015).

According to Pillay (2001), the post-apartheid government inherited a disjointed healthcare system that was characterised by great disparities in healthcare funding provision, and maldistribution of health resources. In addition, the existing health infrastructure was in a poor condition (Hirschowitz & Orkin, 1995; Coovadia et al., 2009). Further, there was widespread disproportion in terms of access to quality healthcare services among the various racial groups in the country (Goudge et al., 2009). In the wake of 2003, there were several transformations in the healthcare sector with the establishment of the National Health Act, 61 of 2003. South Africa until then did not have an integrated national health framework covering all segments of the population, further complicating the sector transformation initiatives (Kinfu, 2013). As a result, a three-tier structure advocating structural, legislative and policy changes at national, provincial, and district level of healthcare services administration was instituted in the post-apartheid order (Goudge et al., 2009; Kinfu, 2013).

Despite the national government's resolve to make progress in the delivery of healthcare services, major disparities still remain (Booysen et al., 2018). The implications are that the "health and well-being of most South Africans remain plagued by a relentless burden of infectious and non-communicable diseases, persisting social disparities and inadequate human resources to provide care for a growing population" (Mayosi & Benatar, 2014:1344). The continuous strain on the healthcare system, with challenges such as the increasing numbers of reported cases of communicable diseases such as HIV/AIDS and tuberculosis (TB), weak information surveillance capacity in most public healthcare facilities, and difficulties in coordinating the healthcare work activities, militates against the national healthcare system (Cooper et al., 2004; London et al., 2006; Gilson & Daire, 2011). In addition to all these challenges, the major obstacle to the healthcare system in South Africa is its inability to address the shortage of a skilled healthcare workforce, exacerbated by the unequal distribution of required medical resources and funding between the private and public healthcare facilities (Van Rensburg, 2014).

The argument therefore is that the South African healthcare system is under performing, given the resources the country has (Vambe, 2014). Challenges include an inadequate and deteriorating infrastructure in healthcare facilities in under-served communities (Ogundaini, 2016), limited human resources (in terms of numbers, management and clinical care expertise), poor staff attitudes towards service provision (Mchunu, 2013), inequalities in funding, and weak coordination of national health information (Amado et al., 2012). As a

result, the majority of the population who utilise public healthcare facilities do not have access to quality care services (Ogundaini, 2016). Contrary to the objectives of the transformation agenda, South Africa has a dual healthcare service delivery system. It is divided into the private and public sector, where healthcare services vary between the costly high-quality private services on the one hand, and the free, basic primary care services offered to about 80 percent of the population by the state on the other hand (Amado et al., 2012; Bayda, 2013; Vambe, 2014). The public healthcare sector serves a large percentage of the population mainly owing to the level of poverty, especially in rural communities (Kagee, 2004), where the majority cannot afford health insurance and medical aid plans (Coovadia et al., 2009) and therefore do not have access to the sophisticated and often expensive private healthcare (Grobler & Stuart, 2007; Manicom, 2011). As a result, the largely under-resourced public health sector is over-stretched (Vambe, 2014) in comparison to the over-resourced but smaller and underutilised private sector. The reality therefore is that while healthcare access has improved over the years in South Africa, the quality of healthcare that the majority receives seems to have fallen (Bayda, 2013).

Given the national government's efforts to improve healthcare service delivery, the argument this study makes is neither on the availability nor accessibility, but on the efficiency and effectiveness of the delivery of healthcare services in public healthcare facilities, especially those in resource-constrained environments. The study critiques the public healthcare service delivery process as well as the implementation of healthcare information systems that are supposed to facilitate the process. The study argues that for the quality of the healthcare service delivery process to be improved, the public healthcare system has to first achieve an integrated management of healthcare information. One possible effective measure for information management is the implementation of IS in healthcare facilities, which offers countless benefits such as efficiencies in the facilitation of healthcare services delivery (Reichertz, 2006; Häyrinen et al., 2008; Schonfeldt et al, 2011; Ogundaini, 2016). One of the countless benefits of healthcare information systems is that the systems enable the integration of data collection, processing, storage, reporting and use at various levels of the healthcare system.

In many healthcare systems around the world, technology interventions such as HIS have become an integral part of the delivery of healthcare services employed to pursue strategic improvements (Blumenthal & Tavenner, 2010; Hsiao et al., 2014). The majority of the public healthcare facilities in South Africa have implemented HIS to enable their healthcare service delivery processes in one form or the other. However, what is lacking or rather what the country has failed to realise as result of the implementation of these systems, is not only the return on investment (ROI) but also the positive impact of these systems on health

outcomes (DoH, 2011; Cresswell et al., 2016). The argument scholars in the information systems field make is that the mere adoption and implementation of these systems do not automatically translate to an improved situation. The fundamental aspect in the implementation of these technology interventions is for decision makers and leaders in the healthcare system to be aware of the context-based factors. These factors have causal powers that may enable or impede first the implementation process and second the infusion of these systems into the work activities of healthcare practitioners for effective and optimal use in the delivery of healthcare services.

As is evident throughout this document, the implications of these context-based issues have brought forth the many challenges associated with the inadequate HIS implementation in many public healthcare facilities that are said not to be integrated into the broader National Health Framework (Weeks, 2013). For example, four of the nine provinces in South Africa are using more than one information system on a similar operational function (Katuu, 2015), and none of these systems are integrated with one another in a broader national context. The existing status of HIS implementation in public healthcare facilities highlights the urgent need for constant evaluation of the benefits or values of these systems in the delivery process in a specific context (Rahimi et al., 2009). Other visible implications of the inadequacies in the public healthcare system are reports of long queues in many rural public healthcare facilities, with patients having to wait in vain for up to eight hours to receive care; these stress the point of inadequacies in the public healthcare system. As a result, public healthcare facilities are often overcrowded, with long waiting times to receive care (Sokhela et al., 2013). The authors attribute the long queues in hospitals to the increased workload of healthcare practitioners in an environment with a limited workforce. In a similar report, Mahlangu and Nemalale (2014) wrote a review on long waiting times at Daveyton clinic (outside Johannesburg) and at Thengwe clinic in Limpopo. Furlong (in June 2015) also report similar frustrations in two health facilities in Khayelitsha (Western Cape) and Ekurhuleni in Gauteng (GroundUp).

Both reports highlight complaints by patients who have experienced long waiting periods at healthcare facilities. Such experiences have in some cases been attributed to possible causes such as shortages of healthcare workers in those facilities. What the study deduces here is that the initiatives taken in the public healthcare system are not yielding the desired results, and this is further exacerbated by the lack of alternative measures to mitigate the challenges. While recognising this reality, the then Minister of Health, Dr Aaron Motsoaledi, conceded that this was not due to a lack of innovative clinical solutions, but to deficiencies in the delivery systems. In his address, Dr Motsoaledi (2014) committed to addressing the challenge, stating that while innovation “has occurred in drugs, diagnostics, therapeutics,

and devices, but now more than ever, innovation is required in healthcare delivery systems", which he cited as a factor that has "prolonged patient waiting times". From this admission, it is evident that the challenge is no longer based on logistics but lies in the maturity of the healthcare service delivery system. With many public health facilities boasting the latest information systems (IS), the question raised in this thesis is how the existing HIS are implemented in the South African public healthcare sector.

On these points, scholars cite inadequate implementation and continuous monitoring and evaluation of systems as a problem. In line with this, Moullin et al. (2015) in their study on healthcare innovations, argue that the selection of implementation strategies should be inclusive of all aspects in respect to the setting where the systems will be used. This includes the capability of the intended users of the system to utilise the technologies optimally, and the degree to which relevant stakeholders are involved in the implementation process. This, the authors argue, would be an ideal situation as opposed to solely focusing on the technology interventions. As such, the broader perspective would provide decision makers, policy makers and healthcare managers with a clearer overview on how the implementation process should be carried out. The public healthcare system in South Africa for a very long time has been making use of the District Health Information System (DHIS) established in the late 1990s as a routine check type of system that tracked healthcare service delivery. Co-developed by the Health Information Systems Program (HISP), the DHIS was first implemented as a pilot study in certain healthcare facilities in the country and played a pivotal role in the routine collection, storage, analysis and reporting of healthcare data (Venter, 2007; Calligaro et al., 2017).

In its early use, the DHIS system accomplished great achievements for the public healthcare sector and was rolled out in most healthcare facilities around the country. However, with the increase in demand for continuous routine healthcare information due to population growth, gaps in the system, such as flaws in capturing of data that led to poor quality data, bottlenecks in the flow of data, and reporting discrepancies in lower levels of the healthcare system were exposed. To address some of these challenges, the web-based DHIS2 was launched; however this was only piloted in one province. From the experience with the DHIS system, it is evident that the existing technology interventions in the public healthcare system are largely fragmented, with a plethora of pilots that are often not scalable, poorly coordinated, lack interoperability among existing systems, and a haphazard procurement process (Mars & Seebregts, 2008; DoH, 2012).

Another challenge is that many of these systems are often implemented in a silo[1] ad hoc manner that further exacerbates the problem of fragmentation and interoperability (Stansfield et al., 2008). The implications have been the increase in the duplication of healthcare data and information in the healthcare system (Bakar et al., 2012), as well as the high dependency on technical support from external vendors which drives the cost of healthcare in the country.

The implications of these challenges are more evident in healthcare facilities in under-served contexts where resources are often constrained and the burden of data collection and storage is a massive challenge (Lucas, 2008). This in most cases results in inadequate analysis of the situation in those healthcare facilities, with inadequate decisions such as those concerning the distribution of healthcare resources. Although there are logistical failures that inhibit implementation and subsequent use in public healthcare facilities (Bhagwandin, 2011), what is not clear is whether the problem lies only here or with the adequacy and relevance (fit for purpose) of the technology interventions in the healthcare sector. Poor quality of data and inadequate flow and management of information are often attributed to incomplete, inconsistent and incorrect data (Mayosi, Lawn et al., 2012; Mphatswe et al., 2012; Naidoo et al., 2013; Katuu, 2016). Inadequate records management in public healthcare facilities also constitute some of the core challenges the healthcare system faces (Keenan et al., 2013; Adler-Milstein et al., 2015; Mathai et al., 2017). In addition, inadequate feedback mechanisms between the provincial and district healthcare facilities are a common challenge (Braa et al., 2001; Garrib et al., 2008; Coleman & Garten, 2009; Gimbel et al., 2011).

Although the South African healthcare system is rich in data (at all levels), data systems that do not provide timely nationally representative data clearly compromise the quality of healthcare and health outcomes (Mayosi, Lawn et al., 2012). This study takes the stance that unless the quality of the healthcare service delivery process in public healthcare facilities in resource-constrained environments is addressed, the national government will not be in a position to achieve universal coverage of healthcare services to all its citizens. The devastating implication of this is the inability of the majority of the most vulnerable members of the population in under-served communities to gain access to quality healthcare services.

[1] "Organizational silos describe the isolation that occurs when employees or entire departments within an organization do not want to, or do not have the adequate means to share information or knowledge with each other. Siloed teams often end up working in isolation from the rest of the company, leading to a plethora of internal and external problems for employees, executives, partners and customers" (Ismael, 2018)

It is on the basis of these arguments that the study's research problem is formulated in the next section.

1.3 Research Problem

While the South African public healthcare system has achieved major advances in its medical capabilities, it still faces major disparities and inequities in the delivery of healthcare services to the majority of the population living in under-served contexts. It is based on these challenges that the national government has placed access to quality healthcare higher on its transformational agenda. As noted in previous sections, most technology interventions in the public healthcare sector are marred by challenges, such as fragmentation that have led to a lack of coordination and interoperability among the existing systems. There is also evidence of haphazard procurement processes of systems owing to a lack of analysis of the context and fit for purpose of these systems in the healthcare system. As such, the management of healthcare data and information across all levels of the healthcare system is a major challenge. The causes of these challenges are therefore not purely logistical, but also linked to the gaps in implementation and subsequent use of these technology interventions to facilitate the delivery of healthcare adequately.

The implications of such outcomes have been that much of the healthcare information in public hospitals is either never captured, or is captured incorrectly or inefficiently. Consequently, the retrieval of information for decision-making purposes at different levels of a health system has been a challenge for relevant stakeholders. Unless the national government addresses challenges around the implementation and use of technology interventions in public healthcare facilities, it will remain impossible from a strategic point of view to realise the ROI of the interventions. At the same time the sector will not achieve its objectives of universal coverage of quality healthcare services, with dire consequences for the vulnerable members of the population, and for the economy and overall democratic stability.

1.4 Research Aims and Objectives

Given the research problem, the aim of the study is twofold: firstly, the study explored the landscape of public healthcare service delivery in South Africa. Secondly, the study took an explanatory stance to determine why the existing HIS implementation does not facilitate the delivery process of healthcare service in public healthcare facilities adequately.

1.5 Research Questions

This sub-section presents the research questions and their objectives that guides the study. The study has two main primary research questions, the central question is *Why is the existing HIS implementation not adequately facilitating public healthcare service delivery*? In order to answer this question, it is decomposed in to a sub-question that addresses the factors enable or inhibit the implementation process in public healthcare sector. To complement this, the second primary research question is also decomposed into 3 sub-questions. The sub-questions are the empirical questions that eventually used to answer the two primary questions.

Table 1-1: Summary of research questions, sub-questions and objectives

Title: Healthcare information systems implementation for public healthcare service delivery in resource-constrained environments: a critical realist perspective		
Research Problem	Existing HISs in the public healthcare sector in South Africa are marred by challenges such as inadequate coordinated systems, leading to fragmentation and lack of interoperability. Many implementations are done in a silo ad hoc manner with limited interoperability and software re-use, and a plethora of small pilots that are not scalable. This has resulted in inefficiencies in the public healthcare system such as poor data quality, dataflow bottlenecks and reporting discrepancies at different levels of the healthcare system which impact the quality of healthcare service delivery in the country negatively.	
Research Question 1	**Why is the existing HIS implementation not adequately facilitating public healthcare service delivery?**	
Research sub-questions	**Research Method(s)**	**Objectives**
RSQ 1.1 What are the factors that affect HIS implementation in the public healthcare sector?	Literature analysis Semi-structured interviews	To identify and determine how these factors inhibit or enable the implementation of HIS in public healthcare facilities, especially those in resource-constrained environments
Research Question 2	**How can HIS implementation adequately facilitate public healthcare service delivery in resource-constrained environments?**	
Research sub-questions	**Research Method(s)**	**Objectives**
RSQ 2.1	Literature analysis Semi-structured interviews	To establish and examine the status quo of HIS implementation and use in public hospitals within resource- constrained environments

How does the existing HIS implementation enable/inhibit healthcare service delivery?		To determine the use of HIS in public hospitals within resource-constrained environments
RSQ 2.2 What are the existing HIS implementation strategies in the public healthcare sector?	Document analysis Semi-structured interviews	To identify policies, strategies or guidelines that inform the HIS implementation process in public healthcare facilities

1.6 Research Philosophy and Methodology Considerations

The philosophical and methodological underpinnings of this study were aligned with the critical realism (CR) paradigm. The researcher understood research methods to be "all those methods [that are used to] conduct research or perform research operations" (Kothari, 2004:20). On the other hand, research methodology was perceived as how a researcher "systematically solve[s] the research problem" (Kothari, 2004:20). In other words, a research methodology that a study employs should describe in detail the gradual process the researcher makes in their investigations. The research methods employed as sources of primary data included semi-structured interviews and document analysis. For secondary sources of data, the researcher consulted literature sources (journal articles, books, etc.). Thematic data analysis was employed as the analytical method and the study utilised ATLAS.ti software for document analysis. A single case study strategy was employed, using qualitative critical realist methodology. To achieve the first aim of the study, the activity analysis and development (ActAD) framework was used as a theoretical and analytical lens within the critical realist paradigm. For the second aim, which was explanatory in nature, the study also employed the normalization process theory (NPT) as an explanatory theoretical framework in the identification and explanation of generative mechanisms.

The critical realist perspective allows a study to view empirical knowledge as one that is socially constructed. Through the application of the critical realist methodology, the study adopts the retroduction approach to identify and characterise generative mechanisms in the implementation process of HIS. These mechanisms may provide possible explanations for the current outcomes in the public healthcare service delivery. The critical realist stratified ontology provided the depth of understanding of and explanation for events/effects in the implementation of HIS activities through generative mechanisms, structures and realities of entities (Vandenberghe, 2007). A key aspect of critical realism that motivated the use of this paradigm is its position that both positivist and interpretivist paradigms suffer from epistemic fallacy. This essentially means that advocates for both paradigms have a tendency to minimise the weight of statements about human knowledge to just mere

statements about human knowledge of the reality. In addition, positivists and interpretivists make assumptions that what exists is only what is observed and experienced. However, critical realists believe that to understand social contexts fully, researchers should look beyond what is observed and experienced. It is on the basis of these arguments that the critical realism philosophical paradigm is adopted in this study to achieve the objectives of the second aim of the study. The study looks beyond the outcomes of healthcare service delivery and the implementation of HIS; it also looks beyond the context-based factors that may influence the implementation of HIS and the delivery of healthcare services. In as much as the two issues were important, the study highlights the generative mechanisms that have causal powers that can produce those observable or unobservable events and experiences.

1.6.1 Unit of analysis and observation

The unit of analysis in this study is the healthcare service delivery process in public healthcare facilities in resource-constrained environments of South Africa. The unit of observation therefore is the stakeholders in the delivery of healthcare, which included the participants purposively selected for their involvement and knowledge in the delivery of healthcare services and the implementation of HIS in the public healthcare sector. The participants included senior managers in the healthcare facility (as they oversee the healthcare service delivery process at the hospital); technical support administrators (as they offer technical support on implemented technologies); clinical and medical staff, including nurses (as they are the users of these systems for clinical work to provide services); administrators and clerks (as they use the systems for administrative activities to support the clinical activities); provincial ICT directors (representatives from the Department of Health, as they oversee the adoption and implementation of various technology projects in public healthcare facilities within the province). The empirical home for the case study is the Eastern Cape province, the geographical area where the empirical case is situated. The province's economic status also fits the under-served context.

1.7 Delineation

The study conceptualised the term 'resource-constrained environment' as those factors that limit the operational process of healthcare services in a healthcare facility. For example, a constraint could be in terms of resources or time, where a time constraint could refer to the overall turnaround time of a healthcare process. The resource constraint could refer to the more controllable and tangible elements, such as staffing and materials or equipment required for successful delivery of service.

The study adopts Nilsen's (2015:2) description of the term 'implementation' as a "process of putting to use or integrating new interventions within a setting". As such, the study views

the implementation of HIS in public healthcare settings as more than just installing and configuring procedures, but also as the act of training healthcare practitioners on how the new intervention works in their context so that they are capable of making use of the intervention effectively to deliver healthcare services. This involves the activities of defining how an information system should ideally be designed and developed to fit its purpose for use, and the context in which it is implemented – this while ensuring that the information system is operational and optimally utilised.

1.8 Originality and Contribution

The study contributes to the body of knowledge by illustrating the use of critical realism methodology to identify causal mechanisms in the implementation of HIS that have causal powers that may trigger outcomes that are observed or unobserved and experienced in the healthcare service delivery system. The practicable contribution of the study is for decision and policy makers in terms of providing implementation considerations that may be used for HIS implementation in resource-constrained environments. The study contributes to the planning, design and development of future strategies to sustain initiatives for HIS implementation for public healthcare service delivery. The researcher deduces that the study also contributes significantly to the body of knowledge in implementation science in the healthcare informatics domain.

1.9 Ethical Considerations

Ethical consideration is a crucial aspect when conducting research, as it ensures confidentiality and anonymity of participants during and after conducting research (Babbie, 2011). Similarly, Zikmund et al. (2010) posit that researchers that employ a case study strategy to carry out their investigation must obtain ethical clearance before starting the research. To this effect, the researcher, prior to commencing the investigation, obtained ethics clearance from the Cape Peninsula University of Technology's (CPUT) Faculty of Informatics and Design research ethics committee, and as the research was health related, ethics clearance was also obtained from the research ethics committee of the Faculty of Health and Wellness Studies. Further clearance was solicited and obtained from the Eastern Cape Department of Health (ECDoH) and from the hospital where the study was to be conducted. An informed consent letter requesting individual permission to collect data was also given to willing participants (see Appendices A–E). To protect their confidentiality, the participants' names or any other pseudonyms that could identify them are not disclosed in this report.

1.10 Overview of the Thesis Structure

The thesis is structured into nine chapters as outlined. **Chapter 1** introduces the study, outlining the South African public healthcare background. The chapter describes the healthcare systems integration of technology interventions in the public healthcare service delivery process as efficiency-enabling tools. The first chapter also outlines the research problem and research questions, as well the aims and objectives of the study. The **second chapter** is concerned with positioning this study within the existing scientific body of knowledge of healthcare information systems implementation. It therefore addresses issues on the existing status of healthcare service delivery in South Africa; health strategies and policies that inform healthcare information systems application; healthcare information systems implementation; as well as related research developments and innovation. The chapter also presents the theoretical/analytical frameworks aligned to the study. The **third chapter** provides discussions on the philosophical underpinnings and the research approach adopted for the study. In the **fourth chapter,** the research design and methodology of the study are discussed. The chapter provides a description of the data-collection and analysis techniques employed in the study. Chapter 4 also gives a description of the document-management approach the study employed as well as the ethical considerations the researcher complied with before and after the investigations.

The study involves a multi-layered analysis process, the first of which is document analysis and interpretations of data, as presented in **Chapter 5**. The analysis and interpretation of interviews is presented in **Chapter 6.** A discussion from a critical realist perspective on the findings from both the analyses is presented in **Chapter 7**. Chapter 7 also presents discussions on the identification of emerging themes from the data-analysis process. The findings from the two analyses are discussed from a critical realist perspective in relation to literature and the research questions that guide the study. In those discussions, the answers to the research questions are provided. These findings are then contextualised within the study's theoretical analytical frameworks and literature. It is from these new findings that the study's conceptual framework is designed. In **Chapter 8**, a retroductive approach is taken with the aid of the NPT theoretical explanatory theory to identify, characterise and explain generative mechanisms that produce outcomes in the implementation of HIS in public healthcare facilities. Finally, **Chapter 9** concludes the study by summarising the research process, and by reflecting on the research problem and how it is addressed throughout the study. Chapter 9 of the study also provides recommendations, research contributions and limitations.

1.11 Summary of Chapter 1

The focal argument of the introductory chapter of this thesis is that the public healthcare system in South Africa has a clear mandate to provide access to quality healthcare services to the majority of its populace living in under-served contexts. To be able to carry out the mandate successfully, the challenges associated with the implementation of technology interventions in the public healthcare sector have to be addressed adequately. Without better insight into these problems, the public healthcare sector in South Africa will continue to experience challenges associated with inadequate implementation of technology interventions.

In the next chapter, the study draws on literature sources to clarify the context of public healthcare service delivery and the implementation of healthcare information systems in public healthcare sectors in resource-constrained environments.

2 CHAPTER 2 – LITERATURE REVIEW

"We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely."

Edward O. Wilson, Consilience: The Unity of Knowledge

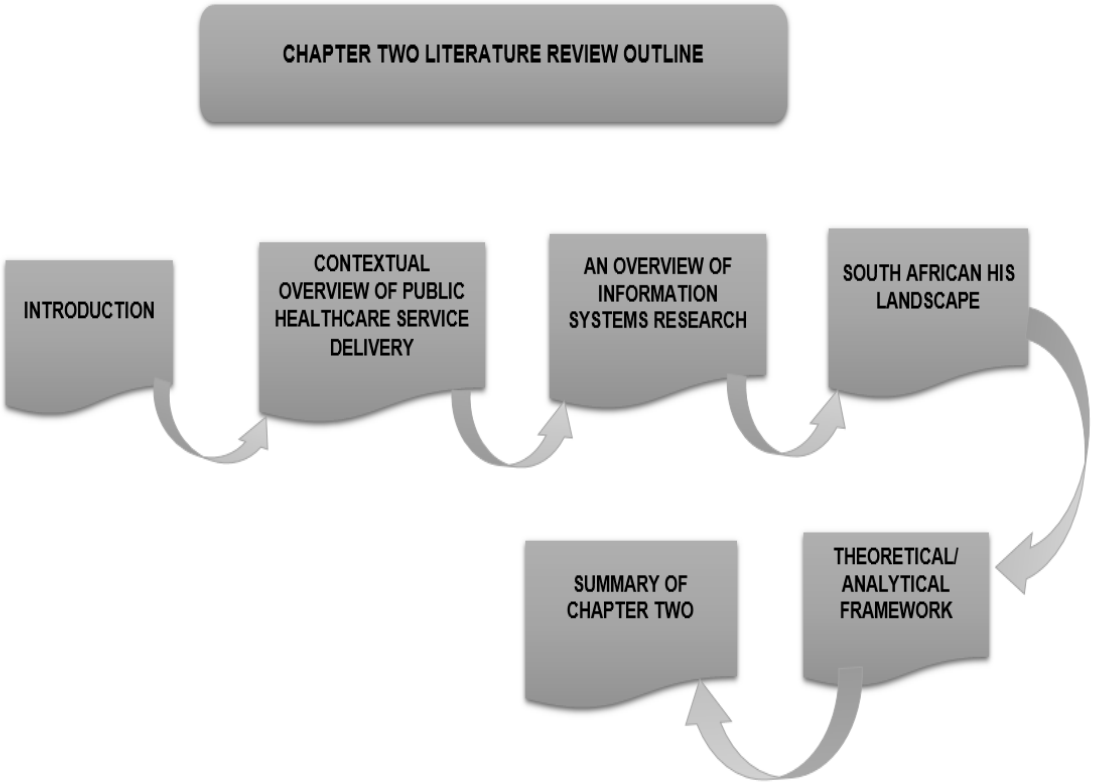

Figure 2-1: Chapter 2 outline

2.1 Introduction

The aim of this study was twofold, firstly to explore the status of public healthcare service delivery within a South African context. The objectives of this aim, firstly, were to establish the outcomes of the existing healthcare services in public healthcare facilities, and secondly, to establish how healthcare information systems were utilised in the delivery process of healthcare services. Here the focus was to highlight the outcomes that affect healthcare facilities in resource-constrained contexts and also in those that serve communities in under-served contexts. The second aim sought to provide an explanation for the happenings or outcomes of the first aim. To achieve the second aim, the following question guided the investigation: “Why is the existing HIS implementation and use not adequately facilitating healthcare service delivery in public hospitals?” The rationale was not only to establish the contextual factors that enable or inhibit HIS implementation in healthcare facilities, but also to determine the generative mechanisms that have causal powers to influence the implementation of HIS and its subsequent efficacy in healthcare service delivery.

In an attempt to address the aims and objectives of this study, Chapter 2 positions it within the existing body of knowledge. The rest of this chapter is therefore structured to address the following areas that the researcher deems necessary. The chapter begins with Section 2.2 that presents the background to healthcare service delivery before exploring the history of public healthcare services in South Africa. The chapter then gives an overview of information systems and their application in various organisational contexts in Section 2.3. Section 2.4 presents an overview of information systems implementation and subsequently narrows the focus to the implementation of information systems in the healthcare sector. In section 2.5, the study narrows its focus and examines the historical background of healthcare information systems, and their application, implementation and use in the public healthcare sector of South Africa. Section 2.6 presents the theoretical or analytical frameworks within the IS field in which the study is situated and the rationale for the selected frameworks. The chapter concludes with a summary in Section 2.7.

2.2 An Overview of Public Healthcare Service Delivery

One of the many guiding principles in the World Health Organization (WHO) Constitution recognises the enjoyment of “the highest attainable standard of health as a fundamental right of every human being without distinction of race, religion, political belief, economic or social condition” (WHO, 1946:1). Studies have shown that despite this declaration, that essentially mandates almost all healthcare systems worldwide to provide universal healthcare coverage, many are struggling to attain this as a basic right for the majority of

the population. The majority of healthcare systems that struggle to attain this mandate are in developing countries. The realities of inadequate healthcare service delivery for many are prevalent in public healthcare systems that vulnerable individuals of society rely upon (Meara et al., 2015; Musa, Mwangi et al., 2016). Such realities have elicited the need for constant monitoring and evaluation of public healthcare service delivery processes, especially in developing countries, to establish innovative ways of enhancing the quality of healthcare services as well as health outcomes in under-served contexts.

To gain a better understanding of the phrase 'healthcare service delivery', the study decided to problematize the two concepts, 'healthcare' and 'service delivery'. The first concept, 'healthcare', is explored in section 1.1 of Chapter 1. Healthcare comprises services that either promote health, or prevent or treat health problems. Based on the descriptions given, the word 'services' features frequently in definitions of healthcare. That brings us to the second construct, 'service delivery'. In a general sense, a service is often viewed as a set of activities carried out by an individual or a group of people to accomplish a certain task for somebody else. In a more scientific context, a service is described by scholars like Solomon et al. (1985) and Zeithaml and Bitner (2000) as an integration of several activities and processes that interact to produce an outcome. From a business point of view, emphasis is on the interactions between the activities and the processes. The *Business Dictionary* adds the concept of providers and clients to the description of service, referring to it as "a component of business that defines the interaction between providers and clients where the provider offers a service … and the client either finds value or loses value as result".

In addition to this description, Axelsson and Wynstra (2002) suggest that in order to understand the concept of service (s), four alternative methods must be considered when defining a service or services in an organizational context. These include (i) input oriented definitions that focus on the supplier's or provider's resource capability; (ii) process oriented approaches that emphasises on how the service is produced (including service activities and processes); (iii) function oriented descriptions of service should stress on service functionality and output and lastly, (iv) outcome oriented approaches that focus on the service's economic value. From these statements, the researcher gathers that service includes the act of delivering something. As such, service delivery is a phrase commonly used in many contexts. For Harber (2009), the use of a phrase or term can sometimes capture the time and issues referred to. He contends that one needs to dissect a phrase such as 'service delivery' to gain a better understanding of its underlying meaning. Haber (2009) suggests that a phrase like 'service delivery' "contains a host of assumptions, policies, attitudes and promises". In his exposition of the term 'service delivery', he

perceives it as part of a “technocratic” interrelationship governments have with their citizens. It is thus governments’ responsibility to provide services, as citizens are on the receiving end of these services. Concurring, the World Bank (2004), in its report, uses the phrase ‘service delivery’ to place a sense of duty and responsibility on governments for “making services work for poor people”. Drawing on this exposition, the researcher deduces that service delivery in any context encapsulates three things: supporting infrastructure, the artefacts (product or service) offered, and the activities carried out. The interaction and interrelations among these three aspects determine the value of service delivery. To evaluate the value of service delivery, the inputs in the delivery process determine the outputs. This to large extent will determine the extent to which the inputs have a desired output or values.

In healthcare, service delivery is viewed in the context of activities that involve caring for a patient. These usually range from activities that healthcare practitioners carry out in healthcare facilities, to policies and strategies decision makers put in place for the purpose of promoting, maintaining or restoring health (WHO, 2004). The argument seems to capture Harber’s (2009) interpretations of the phrase ‘service delivery’. Service delivery in the context of healthcare becomes one of the key aspects of a country’s healthcare system (D’Souza & Sequeira, 2012; Fitzsimmons et al., 2014). Activities within the service delivery process require inputs such as adequate availability of a skilled healthcare workforce, medical equipment, and funding of the healthcare sector. An increase in these inputs should ideally be expected to improve the quality of service delivery and enhance health outcomes (WHO, 2010). A desired output in a healthcare system depends largely on the availability of resources and their optimal use.

Important aspects in the issue of value and quality in the delivery of healthcare services are the various perspectives, depending on who defines it. According to WHO (2004), from a provider point of view, quality of healthcare services should mean devising innovative ways of providing services in the best possible way. This could translate to implementing interventions that enable an effective and efficient environment that is cost conscious. Al-Assaf, cited in WHO (2004), postulates that the value of delivering healthcare services can only be realised when the integration and alignment of activities within healthcare processed are met. In addition to this, the design and implementation of healthcare interventions should aim to meet the needs and expectations of patients. This implies that interventions in healthcare service delivery should seek to address the needs of those patients intended to receive those services (Dyck, cited in Clapper & De Jager, 2004).

There has been a growing demand from various quarters of the world for healthcare systems to strengthen and enhance their provision of healthcare services. WHO (2010) highlight areas they consider require the most attention: mother–child mortality, the management and control of communicable diseases such as tuberculosis (TB), HIV/AIDS, and malaria. There is also a need to manage chronic diseases such as cancer. However, despite this call, many healthcare systems are faced with challenges associated with managing health issues (Meara et al., 2015; Musa, Nankat et al., 2016). The challenges are further exacerbated by the inadequacies of these systems, such as poor leadership and management capabilities, inadequate funding mechanisms, shortage of resources and many more (Kirigia et al., 2007; WHO, 2007; Brinkerhoff & Bossert, 2008; Currie, 2009; Musa, Mwangi et al., 2016). Figure 2-2 depicts the dynamics that shape the delivery of healthcare services in a healthcare system (Van Olmen et al., 2010:21).

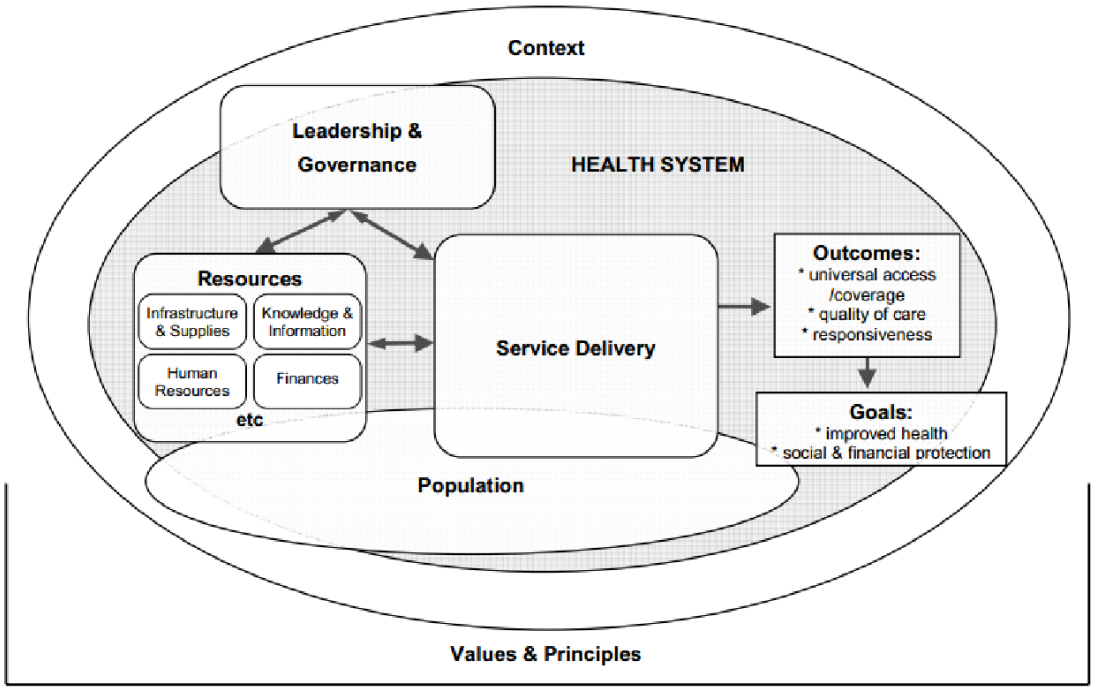

Figure 2-2: Healthcare systems dynamics' influence on healthcare delivery framework (Van Olmen et al., 2010:21).

Figure 2-2 shows the interrelationships of the context in which a healthcare system is situated and other specific features, and how they inform one another to produce an outcome that is desired or of value, or the opposite. The features in the diagram, such as leadership and governance, play a vital role in any healthcare system in areas such as resource distribution and supervision. The argument could be that good governance and strong leadership, while taking into considerations the needs and demands of a particular population, are drivers of desired outcomes. All these activities are embedded in a particular

context which also has causal powers (from external or internal sources) that may influence the manner in which a healthcare system operates in order to achieve its goals. In this study, the focus is on healthcare service delivery as a work activity system, where possible effects on the transformation of activities may produce outcomes (desired or undesired).

The different aspects within a healthcare system such as that in South Africa influence the manner in which healthcare services are delivered. For example, the two-tier healthcare system in South Africa impacts how resources are distributed, depending on the availability of funding. The next sub-section provides a discussion on healthcare service delivery in South Africa.

2.2.1 An overview of public healthcare service delivery in South Africa

The history of South Africa is rich, although complicated, and is engraved in almost all aspects of the country: education, healthcare, transportation, etc. This complicated history is infused with disparities based on demographics such as race and gender, urban and rural habitats, poverty and wealth (Coovadia et al., 2009). The implications of such disparities can be felt in all aspects of life, and the healthcare sector is no different. The healthcare system is fragmented, owing to resources being mismanaged at all levels. Schneider et al. (2007) suggest that as a result of fragmentation, the healthcare sector operates two parallel healthcare systems that differ in terms of resources and funding. The private healthcare system, on the one hand, is highly funded and well-resourced, and services the few privileged to afford it, as opposed to the public healthcare system, funded by taxes and inadequately resourced, servicing the majority of the population.

In the early 1990s, significant steps were taken by the South African government to redress the inequities in access to public services for the majority of the population that for a very long time accessed weak and dysfunctional public systems (Versteeg et al., 2013). These changes were in the form of legislation, policies and changes to public organisations. The healthcare sector was no exception. For example, in the healthcare sector, legislative changes were embodied in Sections 27 and 28 of the South African Constitution in respect of rights to access to health for all. In addition, rights to basic nutrition, social services and shelter to all children in South Africa were addressed (South Africa, 1996). This ongoing reform in the healthcare sector also provided for the development of strategies for managing issues of chronic and communicable diseases that burdened the system. The transformation of the public healthcare sector is, however, hampered by several challenges, such as a shortage of human resources, inadequate leadership, and poor management in healthcare facilities, among other issues which militate against the delivery of quality healthcare (Scott et al., 2012).

The Constitution mandates the government of South Africa to deliver quality healthcare services to its populace (Stuckler et al., 2011). Subsequent to this mandate, the government has proposed various initiatives to improve access to efficient and quality healthcare to ensure the safety of the majority of its citizens (Mogashoa & Pelser, 2014). The initiatives include healthcare policies and legislation to ensure compliance with the delivery of quality healthcare (Moyakhe, 2014). The private and public sectors vary immensely in respect of the quality of their care services (Chida, 2008; Wale, 2013). The public healthcare system delivers healthcare service to the majority of South Africans; therefore the initiatives tend to focus on it. The basic primary healthcare services include diagnosis, treatment and care (this includes managing ongoing long-term health conditions). The healthcare services go beyond just these three, but also focus on the prevention of health problems by promoting early interventions. These primary healthcare services are often offered at little to no cost to the patient in comparison with specialised services in private healthcare facilities or public tertiary healthcare hospitals (Ataguba & McIntyre, 2012).

In the public healthcare system, care services are offered on three levels: primary healthcare that includes community and home-based care, and secondary and tertiary levels. In most instances, the primary healthcare level is the first point of care that a patient access. In the second level of healthcare provision, in most instances patients are referred for specialist medical attention such as cardiology, urology and oncology. The third and highest level of healthcare service provision in the public healthcare system involves more advanced medical investigations and treatment when all efforts fail in the other two levels. The second and third tier of the healthcare system rely heavily on the strong foundation of primary healthcare. Failure at the primary healthcare level results in challenges that filter across all levels. For example, inconsistency in data capturing, storage and dissemination in the lower level influences how data is utilised across the healthcare system, and eventually impacts health outcomes (Bailey et al., 2016).

Over the years, there has been considerable improvement in the public healthcare system. However, there have been doubts about the extent to which the changes have impacted under-served communities (Visagie & Schneider, 2014), despite the national government's strategic initiatives to strengthen the public healthcare system. Healthcare continues to be hampered by diverse inequities, resulting in many people not being able to access quality healthcare services (Wale, 2013; Marten et al., 2014).

2.2.1.1 Healthcare challenges in the South African context

For the majority of people who rely on public healthcare, their experience has been that of persistent and prolonged inefficiency. The challenges associated with the public healthcare system include the persistent disparities in the provision of healthcare services (Coovadia et al., 2009; Schaay et al., 2011; Ataguba & McIntyre, 2012). This challenge is deeply rooted in the history of the country and still persists in the present healthcare system. Yet another challenge is the growing burden of communicable and chronic diseases (Schaay et al., 2011; Holtz & Elsawy, 2013; Deloitte, 2014). To manage such challenges, the healthcare system requires an adequately skilled healthcare workforce; however that is a persistent challenge that the system has yet to address. The inadequate human resource capacity in the country has a great effect on the delivery of healthcare services, especially in under-served contexts. What exacerbates the challenge is also the inability of healthcare management and leadership to handle transformation in the healthcare sector as well as to effectively manage human resources (Coovadia et al., 2009).

To address the shortcomings in the public healthcare system, the national government has initiated various reforms over the years. For example, the development of the National Health Act, 61 of 2003, moved the healthcare system in the right direction. Despite the promulgation of this Act, its impact on addressing the issues around access to quality healthcare services by the majority of the population depends largely on the adequacy of its implementation and evaluation. The majority of South Africans living in under-served communities rely on primary healthcare clinics which form the foundation of the healthcare system and that provide free services. The challenge for the national government is not only to increase accessibility to healthcare in terms of physical infrastructure, but also to ensure that the quality of healthcare services is not compromised (Jobson, 2015).

2.2.2 Health reforms in the public healthcare sector of South Africa

Many of the challenges facing the public healthcare delivery system have their roots pre-1994, when the system was fragmented and characterised by discrimination (Baker, 2010; Bheekie & Bradley, 2016). By 2009, the South African government had put in place significant health reform strategies in a bid to enhance the delivery of public healthcare services. Among other policies and strategies discussed in this section, the most recent and notable White Paper policy is the National Health Insurance (NHI) programme. The Bill was devised with the purpose of achieving universal access to healthcare by 2025 (DoH, 2011; Weeks, 2012). The intention of the publication of the NHI Bill was to facilitate the government's aim of achieving universal and more equitable healthcare coverage for the majority of the public. If successfully implemented, the programme should enable the

decentralisation of governance and management structures. The central tenet of the NHI programme is full integration of services with far-reaching community outreach services. The formulation of such policies is often aimed at centralising primary healthcare (PHC) services in order to redirect the allocation of resources in the public healthcare sector. This kind of strategy curbs the existing situation of resource-intensive, hospicentric and curative care service focus. Another issue that has plagued the public healthcare system is the shortage of a healthcare workforce. The NHI Bill promises to increase throughput in medical schools. How exactly the implementation of the Bill will achieve this is not yet clear.

The argument is that a policy such as the NHI policy will transform the public healthcare system by enabling resources to be pooled and directed at primary healthcare and at the same time facilitate tracking the impact of primary healthcare outcomes. This allows for some sort of accountability in the public healthcare system. Other reforms aimed at improving public primary healthcare is the national government's primary healthcare approach that centres on the promotion of health and disease prevention and the district healthcare system (DHS).

These reforms in the public healthcare sector are part of the national government's aim of achieving universal health coverage and are underscored in other government policies like the National Development Plan (NDP) 2030. The District Health Management Information System (DHMIS) policy is a strategy developed by the national government to form part of a legal framework for the implementation and use of technology interventions in the healthcare system. The DoH (2011) argues that the benefits of such a policy include its ability to harmonise health information across the healthcare system in the country. Along with this benefit, the DHMIS strategy enhances the public healthcare system to formalise those resources necessary for a functioning healthcare information system such as the DHIS. The latest healthcare reform strategy in the healthcare system is the National Digital Health Strategy (NDHS) for South Africa, 2019 – 2024. The strategy was developed to enhance the digital healthcare platform in the public healthcare system. This includes enhancing governance structures, creating robust integrated digital platforms for IS development, and establishing the requisite infrastructure for broadband networks. The researcher observes that the publication of the NDHS comes at fitting time, when the reorganisation of the national healthcare system is needed for the implementation of the NHI programme. In a bid to improve healthcare service delivery, the government has developed and implemented various national policies/strategies and Acts. These include the following:

- ✓ The National Health Act (Act 61 of 2003)
- ✓ eHealth Strategy South Africa (2012-2017)
- ✓ mHealth Strategy South Africa (2015–2019)
- ✓ National Health Normative Standards Framework for Interoperability in eHealth in South Africa (2014)
- ✓ National Integrated ICT Policy Green Paper (2014)
- ✓ National Health Insurance Green Paper (2011) and White Paper (2015)
- ✓ District Health Management Information System Policy (2011)
- ✓ DHMIS Policy Standard Operating Procedures: Facility Level (2012)
- ✓ National Digital Health Strategy for South Africa (2019–2024)

The development of most of these policies/strategies has been driven by the demand for a more integrated healthcare system, as well as the rapid growth in technology use in the country. As such, through the promulgation of these policies/strategies and Acts, the existing healthcare structures and management systems have seen gradual reformation (Bheekie & Bradley, 2016). For a healthcare system to successfully achieve a more holistic approach of improving healthcare service delivery, certain key areas in the healthcare systems should be given more focus. In effect, the WHO (2011) published a report on areas that healthcare systems around the world should prioritise. As depicted in Figure **2-3**, improvements in these areas should have a positive influence on the delivery of healthcare services.

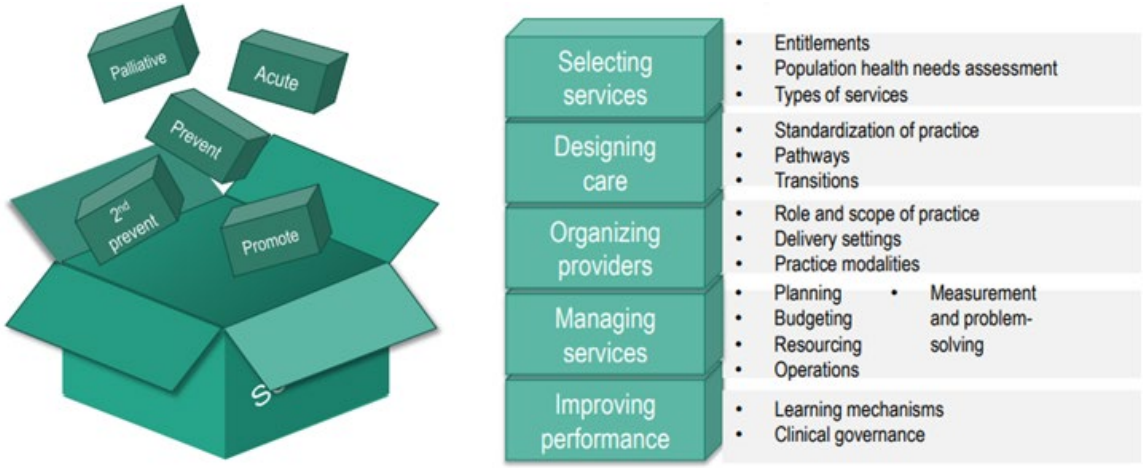

Figure 2-3: Priority areas for taking action in healthcare service delivery (WHO, 2011).

The report by WHO (2011) places great emphasis on key areas that are critical in the transformation of the delivery process of healthcare services. To facilitate this transformation, healthcare systems have had to devise strategic initiatives to improve the delivery of healthcare services. To this, (SARRAH, 2014) suggest that there is a need for

intra- and inter-departmental integration across healthcare systems. The report places emphasis on integrated work processes, stating that “the current tendency towards working in silos does not build a common and sustained message of the requirements for the improvement of quality of care”. In effect, scholars like Higgs et al. (2014), Chib et al. (2012), Scott and Mars (2015), and Lee et al. (2016) posit that there are limited rigorous evaluations of what seems to work best with regard to improving healthcare service delivery in healthcare systems around the globe. In some cases the strategic initiatives involve the adoption of technology interventions and the development of healthcare infrastructure and other resources. Weeks (2012) posits that technology interventions are often considered essential in any healthcare system framework, as they offer potential solutions to the challenge of the shortage of a healthcare workforce. Subsequently, technology has been recognised as being an integral part of the transformation of healthcare service delivery process in many countries worldwide (Poon et al., 2006; Øvretveit et al., 2007). Unfortunately, most healthcare systems face the challenge of not being able to achieve ROI as well as being able to determine the exact impact these technology interventions have on health outcomes.

The South African healthcare systems boasts various technological interventions either referred to as e-health or m-health. These interventions are aimed at improving the delivery process of healthcare services to the majority of the population. Leon and Scheider (2012) attribute this to the enabling environment the country has in terms of access to a technology infrastructure and the widespread use of digital technology. This gave rise to the concept of e-health in the quest for solutions to address the challenges faced in the delivery of healthcare services. It is in this quest for universal coverage of health that the potential of e-health systems is explored. E-health encompasses the use of various technologies, including m-health, e-prescriptions, electronic medical records, and telemedicine, among others (Weeks, 2012).

The next section discusses information systems and their applications in various organisational contexts. The focus is on the application of IS as an enabling tool in the delivery process of healthcare services.

2.3 An Overview of Information Systems

Over the years, many organisations have sought ways of increasing productivity in efficient and effective ways. This has seen an increase in innovative ways of carrying out operational processes in the different functional areas of an organisation. The emphasis on the need for such changes in the production process originated in the early 1980s (Hunter, 1983). The term ‘innovation’ has often been described as a way of doing things differently from the

old ways. West (1990) describes innovation as a person's or a group of people's intention and the application of ideas, processes, procedures or products that is considered relatively new with significant benefit to the individual or a group of people. West's definition of innovation has been widely used over the years, as the perception has been that it captures three fundamental aspects of what an innovation is. The three aspects, according to Länsisalmi et al. (2006), include the aspect of novelty (new services), the application component, and its intended benefit. In recent years, the use of technology in organisations or by individuals has come to be known as a way of being innovative. In this sub-section, the study highlights the various aspects of information systems (IS) in today's society as a form of innovation.

The information systems domain has seen exponential growth with regard to applications at various levels in society. For example, Figure **2-4** depicts the diverse areas of the information systems domain. In the diagram there are two aspects of information systems, the business aspect and the technology aspect. For many organisations, the challenge has always been how to integrate the two aspects seamlessly to achieve their objectives. To obtain a clearer perspective of this, the researcher sought to understand how information systems are viewed in a broader sense.

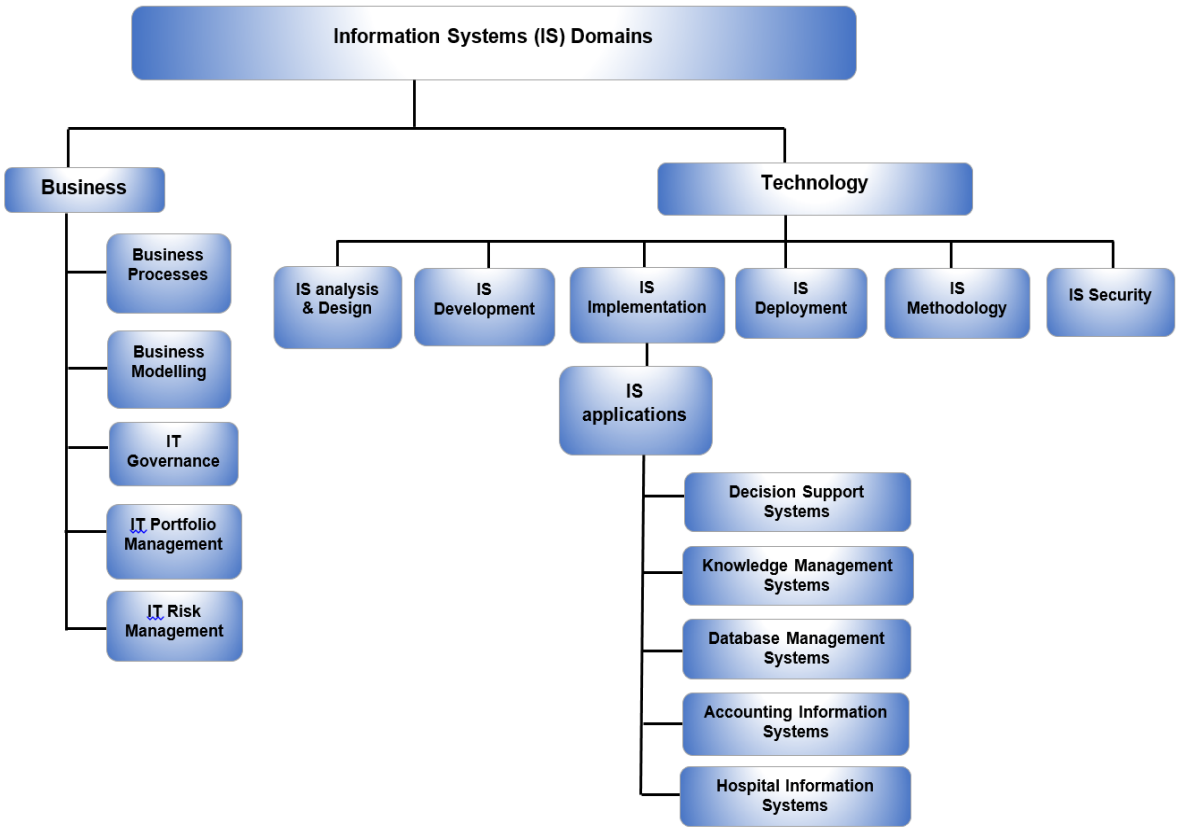

Figure 2-4**:** An overview of information system domains (adapted from Chiasson & Davidson, 2005)

Across literature, it is evident that the terms ‘information system’ and ‘information technology’ (IT) have always been used interchangeably, in some quarters referring to the same concepts. In principle, the two terms depend on the context of use, and describe different concepts. In line with this, Wager et al. (2005) posit that IT, for example describes a combination of components in a computer that is inclusive of hardware and software. An information system, on the other hand, has lacked a clear definition across the academic discipline of information systems. For instance, Land (1985:215) defined an information system as “a social system, which has embedded in it information technology. The extent to which information technology plays a part is increasing rapidly. But this does not prevent the overall system from being a social system, and it is not possible to design a robust, effective information system, incorporating significant amounts of the technology without treating it as a social system.” Davis (2000:67) on the hand defined it as “…a system in the organization that delivers information and communication services needed by the organization.” The author further notes that an information system “can be expanded to describe the system more fully.

The information system or management information system of an organization consists of the information technology infrastructure, application systems, and personnel that employ information technology to deliver information and communication services for transaction processing/ operations and administration/ management of an organization. The system utilizes computer and communications hardware and software, manual procedures, and internal and external repositories of data. The systems apply a combination of automation coming human actions and user machine interaction.” In later years, the definition of an information system has evolved to focus more on the actions of the systems. For example, Laudon and Laudon (2007:7) define an information system as “Interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis, and visualization in an organization.” Similarly, Rainer et al., (2007:393) defined an information system as “A process that collects, processes, stores, analyzes, and disseminates information for a specific purpose; most ISs are computerized.”

A common theme across these definitions is that they all define the term in the context of an organisation or the type of tasks information systems perform in an organisational context, while all the definitions include information technology. For the purpose of this study, the definition of an information system is derived from the concept of information systems being distinctive cases of work systems (Alter, 1999). Work systems in this study are understood as systems in which human agency, together with machine agencies, carries out work processes that involve several activities by employing technology,

information and other forms of resources in an organisation with the aim of producing products or services (Alter, 2008). As a construct of both the 'information' and the 'system' concepts, 'information systems' are often referred to as an interaction between a human agency, data, processes, and information technology. This interaction enacts the process of collecting, storing and disseminating the output to fit the needs of an organisation (Whitten et al., 2001). In a similar context, Valacich and Schneider (2012) describe IS as the amalgamation of software, hardware and telecommunication networks utilised in the collection, storage and distribution of information in an organisation. These descriptions further affirm the common elements in other definitions of IS.

While the application of IS in an organisational context may vary, its application typically involves the use of software, hardware, a networking infrastructure, procedures, databases, and human agency. The study deduces that this portrays an information system as a working system, and as such, the procedural element in the description of an information system becomes fundamental. Knight and Silk (1990) suggest there should be an interaction between information technology and human agency that produces accurate information that fits the intended function of that procedure. The interaction aspect in an information system provides a way for various groups or individuals to stay connected for different purposes. This is enabled through networks such as the Internet through mobile devices or personal computers (Gubbi et al., 2013). Drawing on Alter's (2002) framework for information systems, the study summarises the views from an integrated perspective that encompasses six things: business processes, information, technology, products or services, and customers. Customers are described in this context as the human agency that does the interaction in the information system through the exchange of products or services. Business processes incorporate the use of technology to facilitate new 'innovative' ways of doing things in an organisation.

2.3.1 Classification of information systems

In an organisational context, ISs are classified based on organisational needs and usage. These needs are often in operational or managerial form and as such, ISs are categorised as either operational support systems or management support systems (Dwivedi et al., 2009). Valacich and Schneider (2010) suggest that operational support systems enable human agencies to capture data that are then processed based on certain procedures and produce an output such as reports used within or shared outside of an organisation. This highlights that operational support systems in an organisational context basically facilitate transactions within a business process. The systems enable the control of production and support internal and external communication. Operational support systems are further

categorised into three types: transaction processing systems (TPSs), processing control systems and enterprise collaboration systems.

Management support systems, also commonly referred to as management information systems (MISs), constitute a further category. These types of systems are perceived to be used by managers, and as such, provide relevant information to managers for planning and decision-making purposes (Laudon & Laudon, 2011). Management information systems come in various forms, depending on the structure of the organization. **Figure 2-5** depicts the classification of information systems in a typical organisational context.

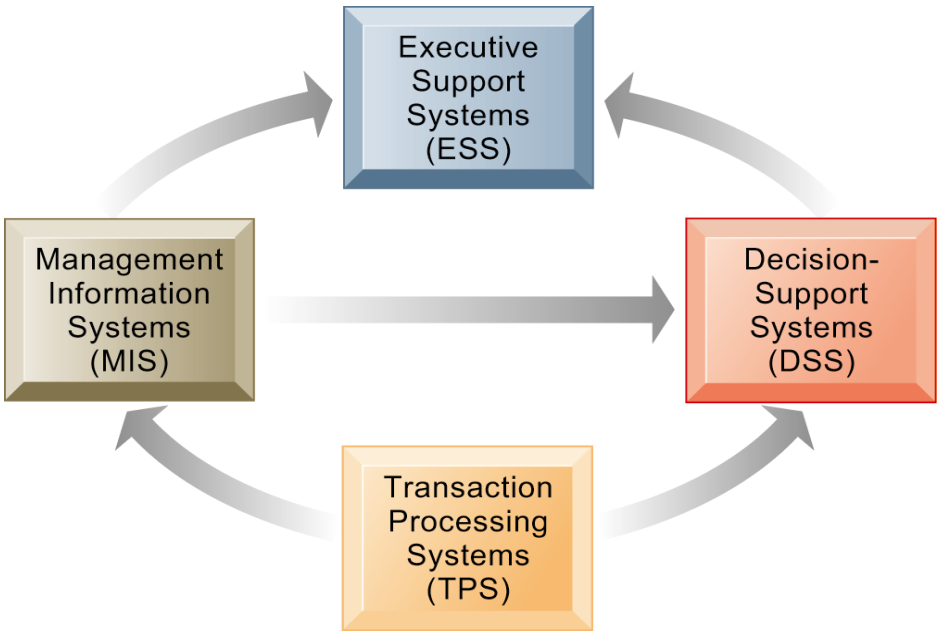

Figure 2-5**:** Classification of Information systems (Laudon & Laudon, 2011)

2.3.2 Various applications of information systems

In many organisations, ISs are often perceived as the backbone of operational processes and decision making. This is evident in many sectors having transformed their operations, for example, sectors such as education, finance, healthcare, and business have adopted information systems to some degree to enhance operational efficiency and effectiveness (Kearns & Lederer, 2004; Bhatt et al., 2010). Examples of information systems applications include the banking sector's transforming modes of payment to electronic funds transfers or the use of automatic teller machines. In the education sector, the introduction of blended learning has seen an increase in the use of learning management systems. In the healthcare sector, the use of electronic records management systems is an example of information systems applications. From an individual perspective, the use of mobile devices has created the concept of convenience that has seen an increase in the use of technology

to improve individuals' livelihoods (Gubbi et al., 2013; Kendrick, 2013). For example, communication routines have improved, and collaboration with co-workers in real time is possible, no matter how distanced individuals are.

In most instances in an organisational context, the application of ISs is often in the collection, processing, managing and retrieving of information. In such cases, it has been for the purpose of enhancing efficiency in decision making or in enhancing the quality of products and services, whether by using operation support systems or management information systems (Chen et al., 2008; Van Belle et al., 2010). An example of an MIS is the 3D barcode scanner used in retail stores to price items, monitor stock levels, and safeguard stock (Sobota et al., 2011). For the purpose of this study, the focus on the application of information systems is within the healthcare sector. The next sub-section presents a discussion of the various ways that information systems have been applied.

2.3.2.1 Information systems in the healthcare sector

In the healthcare sector, as in other sectors, information systems are perceived as a form of innovation. To this effect, Greenhalgh et al. (2004:582) posit that this kind of innovation in the health sector is "directed at improving health outcomes, administrative efficiency, cost effectiveness, or users' experience and are implemented by planned and coordinated actions". Similarly, Omachonu and Einspruch (2010) suggest that innovations in the delivery process of healthcare services play a fundamental role in enhancing the efficiency of these services and improve the act of responding to patients' needs timeously. Consequently, there has been an increased interest within the sector to implement and diffuse innovations such as ISs in the delivery process of healthcare services (Greenhalgh et al., 2004; Länsisalmi et al., 2006). As an innovative tool that encapsulates a wide range of technologies, information systems are rapidly increasing in number and diversifying in purpose (Connell & Young, 2007; Kushniruk et al., 2011; Gagnon et al., 2012).

As already established in the preceding sub-sections, ISs are the amalgamation of several components, including hardware, software, processes or procedures, networks, and people. The interrelationship between these components enables the process of capturing, storing, processing and communicating an output. In the healthcare sector, the application of information systems involves the collection of healthcare data, and processing that data into healthcare information that can then be used for decision making in relation to the management of care and the well-being of the population at all levels of the healthcare system (Fichman et al., 2011; Usher et al., 2016). The use of ISs in the healthcare sector is often to support clinical, administrative and educational requirements. Thus, many perceive ISs as an enabling tool in the delivery of healthcare processes (Eysenbach &

Jadad, 2001; Taylor et al., 2005; Page, 2011; Middleton et al., 2013). In the healthcare sector, the term ‘e-health’ is commonly used to refer to any form of technology intervention (Pagliari et al., 2005; Car et al., 2008; Tsiknakis & Kouroubali, 2009; Van Gemert-Pijnen et al., 2011; Van Velsen et al., 2013).

In the healthcare sector, ISs were introduced in two waves classified into two categories: the first and second generation (Vital Wave Consulting, 2009:6). The first generation of ISs included the use of electronic patient registry systems such as the OpenMRS or SmartCare (Vital Wave Consulting, 2009:21; Douglas et al., 2011). According to Vital Wave Consulting (2009), the characteristics common to the first generation ISs in the healthcare sector included the following:

- ✓ The ISs were developed for the public healthcare sector initially to capture data at various levels of the healthcare system.
- ✓ This resulted in significant fragmentation and duplication of data across the healthcare system.
- ✓ The various independent ISs were seldom integrated, which inhibited the ability to share healthcare data or enhance operation efficiency.
- ✓ In most instances, the information systems were not used by those practitioners providing or managing healthcare services at lower levels of the healthcare system as it was presumed that they did not need healthcare information.

The second generation of ISs in the healthcare sector were mainly systems used for the management of health information. These ISs, according to Vital Wave Consulting (2009:7), and Serbanati and Ricci (2013), have the following characteristics that set them apart from the first generation ISs:

- ✓ Enhanced tools for information management at healthcare facility levels.
- ✓ Data is captured through routine business operations.
- ✓ The information systems enable the identification of essential data sets.
- ✓ Mobile technologies became a key enabler for healthcare information systems.

In the healthcare sector, a typical IS has several interrelated components that carry out various activities, as indicated in **Figure 2-6** (Vital Wave Consulting, 2009:22).

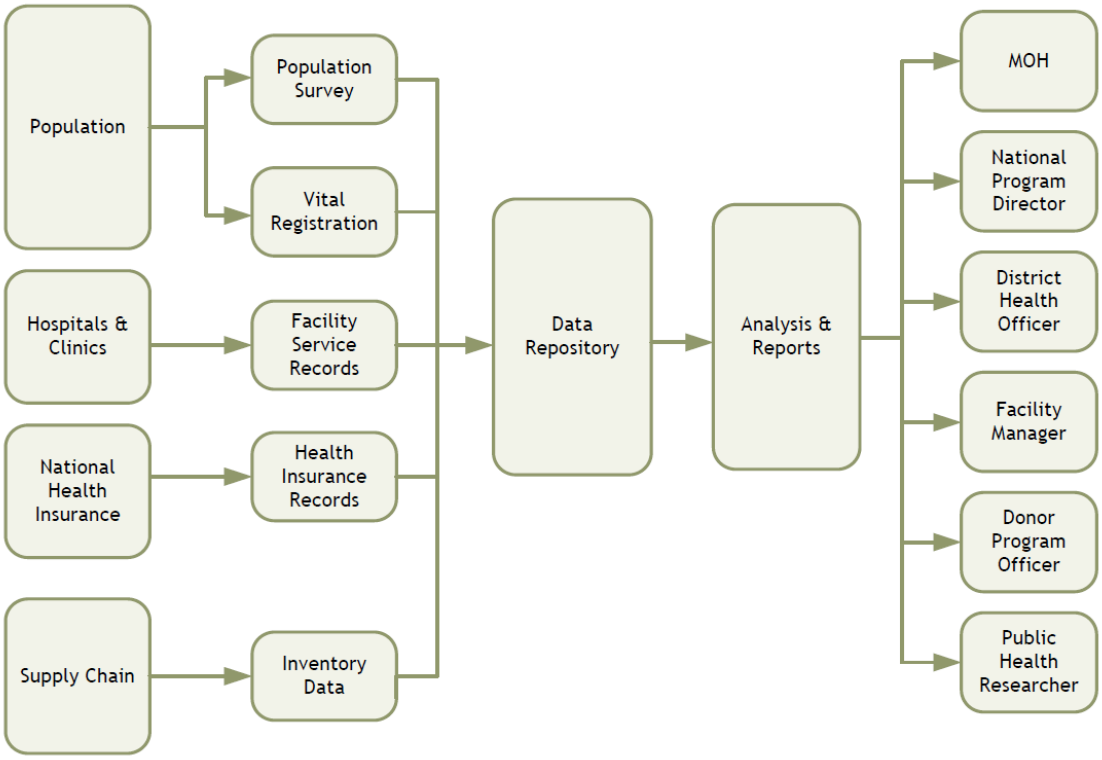

Figure 2-6: HIS typical framework in the public healthcare sector

Healthcare information systems are often implemented with the intention that they will enhance the productivity of healthcare practitioners and the management of health in the delivery process of care services to a population (Weeks, 2012). The potential benefits are numerous with regard to IS adoption, implementation improvement in service delivery and enhanced patient care outcomes. However, this is only possible when the implementation and integration of information systems are done adequately (Calligaro et al., 2017). For instance, management of patient records is quicker, which in turn reduces waiting times. Also, the use of technology has the potential to detect disease epidemics through surveillance (Denkinger et al., 2013).

In the healthcare sector, there are several types of ISs that are used in the functional units. These ISs are categorised into four groups:

- ✓ **Operational and tactical Information systems** that are designed and developed to ease the process of classifying information.
- ✓ **Clinical and administrative information systems** that are designed and developed for managing patient details on an administrative level.
- ✓ **Subject and task-based information systems** such as electronic medical records (EMRs).

- ✓ **Financial information systems** that are designed and developed for tracking revenue and managing billing submissions.

These systems are often broken up into several different software solutions (Lau et al., 2010). In a broad sense, the term 'system' suggests a connected whole; however, in the healthcare sector this is often not the case, with many ISs lacking the cohesion that makes a system whole. This can be attributed to the manner of implementation that in most cases happens in disjointed ways, shaped by context-based factors such as socio-economic factors and external donor pressures that are highly complex. In the healthcare sector, ISs are also classified depending on subject and tasks that fit the needs of the end users. For example, subject-based ISs relate to a particular individual (actor) utilising a system for a specific activity. On the other hand, task-based ISs support certain tasks in the healthcare process that do not necessarily require an individual's engagement.

In their discussion of ISs in the healthcare sector, AbouZahr et al. (2007) highlight the global concept that the introduction of these systems has brought to the sector. The authors suggest an information system pyramid from a healthcare perspective that takes into account the aspect of global information as well as the process of data collection in the formulation of ISs policies. **Figure 2-7** depicts the information systems pyramid that portrays how ISs are applied in different levels of the healthcare sector.

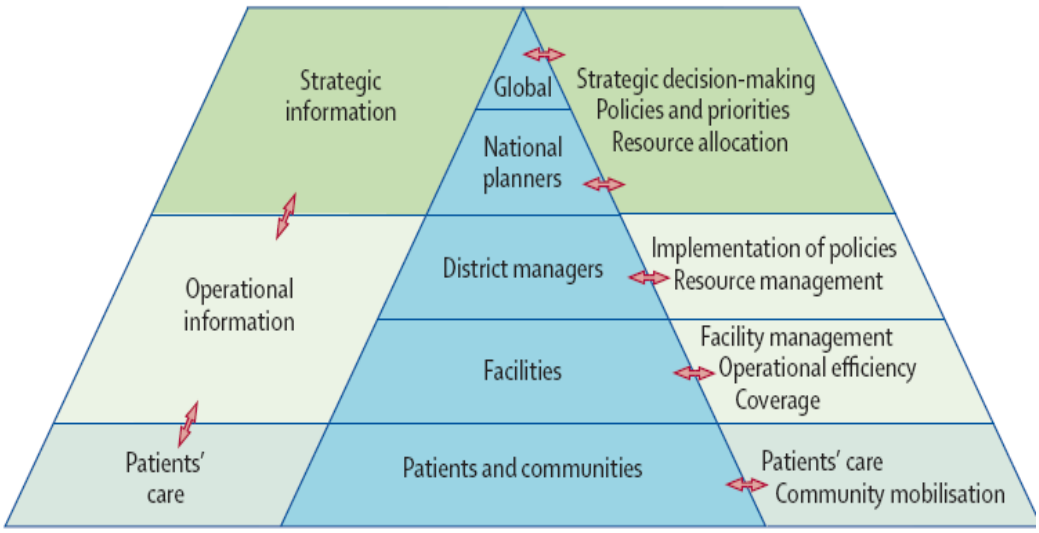

Figure 2-7: The Information System Pyramid (AbouZahr et al., 2007:1040)

To explain the information systems paradigm in Figure 2-7 further, Beaumont (2011) suggests that the pyramid enables decision makers or those in leadership positions to assess the level of computerisation in an organisation. The pyramid also to some extent

highlights the inadequacies in the development of ISs by considering the data dependency hierarchy and identifying those MIS that require an operational system to feed data into them. The pyramid highlights that an effective healthcare service delivery process relies on adequately built administrative and clinical ISs. For example, a patient admission–discharge–transfer information system enables administrative staff in the healthcare process to register and update a patient's treatment progress effectively and timeously, while minimising the potential for human error (Blaya et al., 2010). Similarly, the use of laboratory Information management systems (LIMS) increases the turnaround time for laboratory tests and the management of laboratory operations. Examples of these operations include keeping inventories of laboratory equipment and laboratory test results (Di Bernardo & Martin, 2012). Cost and time efficiency benefits are the most common benefits associated with the use of ISs in the healthcare sector. Easy access to reliable health information is also a benefit that ISs bring to the operational process, and which provides a solid anchor to clinical healthcare (Klompas et al., 2012).

Clinical support information systems are software applications that are generally designed to enhance management healthcare information and decision-making processes, as well as to facilitate adherence to clinical guidelines (Marcos et al., 2013). Blaya et al. (2010) illustrate how clinical support systems work, indicating that once a patient's symptom has been logged into a system, it is either matched with existing symptoms in a medical knowledge database or generates a new symptom in the database. This enables a clinician to examine the symptom and the patient's medical history, and make a generic diagnosis. This highlights the importance of and linkage between effective healthcare administrative systems and clinical support systems that can contribute positively towards improved healthcare service delivery (Ogundaini, 2016).

ISs in the healthcare sector also have the ability to enhance the delivery of care services in under-served contexts where resources are constrained. For example, ISs have been used in under-served contexts to enhance the quality of data and ease the bottlenecks of workflow attributed to inadequate human resources. For instance, Sharmin et al. (2017) contend that the use of ISs has contributed to the revolution of healthcare services by enhancing their timeliness, patient-centredness, equity, efficiency and effectiveness. Healthcare systems in most developing countries are often deemed dysfunctional in terms of the availability, quality and financing of healthcare. It is argued that technologies can address some the challenges faced by these systems to prevent, assess, inform and treat health behaviours and care service provision in resource-constrained healthcare settings (Borrelli & Ritterband, 2015).

Countries such as South Africa, Kenya, Rwanda, and Uganda have shown great progress in the use of technology intervention in their healthcare systems. Reports on the application of various ISs indicate that in some cases there has been an increase in the timely access to health information and easy reporting of complete information on healthcare data usage compared with earlier manual paper-based processes (Chaulagai et al., 2005; Mphatswe et al., 2012; Kiberu et al., 2014; Kariuki et al., 2017). Examples of the application of ISs in the healthcare sector around the world include the use of laboratory reporting tools for the management of tuberculosis in Peru (Blaya et al., 2010); and open medical record systems (OpenMRS) and electronic medical records for HIV/AIDS care in Rwanda and Kenya (Amoroso et al., 2010; Were et al., 2011).

The introduction of ISs in the healthcare sector has great potential to transform healthcare service delivery by making it more accessible, affordable and effective. However, research suggests that these efforts are tainted by several challenges, such as calls for more coordinated, standardised and integrated HISs implementation, mostly for the benefit of the under-served population (Pagliari, Detmer et al., 2007; Robertson et al., 2010). The next sub-section presents a discussion of some these challenges.

2.3.2.2 Information systems challenges in the healthcare sector

Healthcare systems in developing countries are often marred by healthcare challenges that have eclipsed the introduction of technology interventions. The argument is that regardless of the potential of ISs in the healthcare sector, the implementation, diffusion, maintenance, and optimisation of these systems are likely to pose a considerable challenge to healthcare systems in under-served areas with limited resources and technology expertise. Challenges include inaccuracy in data collection and timeliness in reporting of healthcare information, connectivity challenges and inadequate ICT skills (Azubuike & Ehiri, 1999; AbouZahr & Boerma, 2005). For example, in Botswana, a report on its national health information system indicated that a lack of central coordination and inadequate leadership skills contributed to the inaccuracy of the data the system produced (Seitio-Kgokgwe et al., 2015).

The cost implications of such challenges are fairly high, for example, each year an estimated 2 billion USD are spent on several aspects of ISs in the healthcare sector in developing countries (AbouZahr & Boerma, 2005). The money is usually spent in a fragmented, duplicative and uncoordinated manner that results in waste. The WHO (2012) attributes this to a lack of adequate ISs policies that provide clear roadmaps on the implementation and use of these systems. In addition, Mofleh et al. (2008) posit that a lack of adequate planning is also a challenge that leads to monetary loss with regard to ISs in the healthcare sector. Other challenges that lead to financial loss are the lack of ownership

and leadership in the implementation of ISs in the healthcare sector in most developing countries (Shvaiko et al., 2009); and the reluctance of those in leadership positions to show urgency and political willingness to address such issues in the healthcare system (Bukachi & Pakenham-Walsh, 2007). Such expenditure on healthcare systems in developing countries, according to Kirigia et al. (2011), is unsustainable, especially when healthcare expenditure competes with other priorities in a country (WHO, 2007).

Other challenges notable throughout literature associated with the application of ISs in healthcare systems in developing countries include the fragmentation and duplication of healthcare data across the systems (Bakar et al., 2012), and a tendency to depend on external technical support and donors (Stansfield et al., 2006; Lucas, 2008). In most instances, the lack of adequate system integration contributed to operational inefficiency, as did inadequate analysis and decision-making processes (Azubuike & Ehiri, 1999; Shortliffe & Blois, 2006; Katuu, 2015). Another issue that has plagued healthcare systems in developing countries is the implementation of technology interventions in silos and in an ad hoc manner, with very limited interoperability that are often not scalable (Littlejohns et al., 2003; Stansfield et al., 2008). These conditions are exacerbated by limited financial resources, a shortage of human resources and skills, and many other factors. The digital divide in developing countries also militates against the diffusion of technology interventions (Wresch, 1998; Mbarika et al., 2003).

To address these challenges, there is a need for healthcare systems to demonstrate adequate leadership and management skills required in the implementation and adoption of technology interventions (Azubuike & Ehiri, 1999; Mofleh et al., 2008). In addition, Omary et al. (2010) suggest that a skilled healthcare workforce is needed, especially in resource-constrained environments that suffer from the brain drain phenomenon (Archangel, 2007). This can also be attributed to the issue of low pay for qualified healthcare IS specialists who would rather work in high-paying areas (WHO, 2012). In line with this, Stansfield et al. (2008) and Canlas (2009) also discuss other issues that demonstrate inequality in healthcare systems. The authors note the uneven distribution of IS infrastructure between rural and urban areas. As a result, healthcare systems face the difficult challenge of implementing ISs uniformly across regions (Braa et al., 2010). In many ways, this could be why developing countries have many examples of ‘pilot projects’ whose benefits are never scaled, phased across the healthcare system or even sustained (Lucas, 2008). In most developing countries, the majority of the population rely on public healthcare services and as such healthcare systems are required to come up with innovative solutions that facilitate the delivery of healthcare services more effective and efficient for its populace (Omary et al., 2010).

Other issues that are prevalent in many healthcare systems are the varying levels of maturity in ISs implementation (Crichton, et al., 2012), a constantly changing healthcare system due to external or internal forces, non-standard data formats, and application and processes (Gibbons et al., 2007). All these make interoperability and data integration difficult to achieve (Canlas, 2009). However, despite the various challenges, many innovative solutions have been and continue to be developed in and for developing countries. The District Health Information System (DHIS) (Braa & Hedberg, 2002; Braa & Sahay, 2012) and Open Medical Record System (OpenMRS) (Mamlin et al., 2006; Seebregts et al., 2009; Braa et al., 2010; Bakar et al., 2012) are examples that have been implemented in developing countries. Rwanda implemented an Open Health Information Exchange (OpenHIE) (Crichton et al., 2012).

In response to some of the deficiencies most healthcare systems in underserved contexts face, there has been an introduction of new approaches to address these challenges (Mills, 2014). These new approaches are healthcare reforms that either speak to the implementation of technology interventions or address universal healthcare coverage (Garrett et al., 2009; WHO, 2010; Moreno-Serra & Smith, 2012). For example, countries like South Africa, Ghana, Kenya, and many others are planning and implementing e-health strategies and/or enterprise architecture (Chandrasekhar & Ghosh, 2001; Archangel, 2007; WHO, 2008; Foster, 2013). The e-health strategy in South Africa was expected to align the national government-wide enterprise architecture. This architecture utilised The Open Group Architecture Framework (TOGAF) (The Open Group) and the Zachman Framework (Zachman, 1987). For many of these countries, the e-health strategy was developed in an attempt to consolidate and expand existing ISs into a more integrated and coherent national health information system (NHIS). The focus for other reforms has been more on the financial aspect within the healthcare system and aims to bring cheaper healthcare services closer to the majority of the population that depend on public healthcare services (Mate et al., 2013). Even as access to healthcare expands, most healthcare systems in developing countries risk being over-burdened, failing to deliver the quality, effective and patient-focused care required for optimal health outcomes (Mate et al., 2013).

Many of the challenges discussed in this sub-section in relation to ISs application in the healthcare sector are largely attributed to the implementation and delays in diffusion of technology interventions in healthcare (Berg, 2001; Berwick, 2003; Fletcher, 2017). The next section discusses the implementation of ISs from a broad perspective before addressing HIS implementation.

2.4 Information Systems Implementation

In the field of information systems, the concept of implementation has been the subject of debate over the past years. Although implementation is part of the continuum of diffusion–dissemination–implementation, experts in the IS field argue that it should not be used interchangeably with the other two concepts. There is no single definition of the term 'implementation' across the field of IS. For example, Rabin et al. (2008) describe implementation as the act of putting innovations into use within a particular setting. Rouse (2015) describes implementation as a process that encompasses the act of ensuring that software or hardware operates adequately in the environment of use. The author indicates that this involves analysing the necessary requirements, the installation process, configuration of the systems, running the necessary tests in the environment of use, training end users of the systems, and systems integration. The study adopts Nilsen's (2015:2) definition of the term 'implementation' as a "process of putting to use or integrating new interventions within a setting". This definition seems to capture the essence of how the study views implementation in the healthcare environment.

In the context of this study, HIS implementation encompasses all processes involved in ensuring the system is integrated into the healthcare work practices until it becomes routinised. Beyond ensuring that the technology intervention works in its intended environment, the study also considers the implementation process as encompassing the process of defining how the technology intervention should develop, once deployed, ensuring that the information system is operational and optimally used within the context in which it has been deployed. Systems implementation also involves ensuring that IS meets the quality standards of the sector in which it is used. Another factor of IS implementation that has been the subject of debate is the impact of technical aspects *vis-à-vis* human behavioural aspects in the implementation process. In this regard, Keen and Morton (1978) suggest that because of the intuitive nature of IS implementation, the best way to address it requires technical competency.

Contrary to this stance, both Hirschheim (1992) and Friedman and Cornford (1989) argue that IS implementation should not only focus on technical aspects, but also include end-user involvement, analysis of the information on the nature of the implementation, and change agents, then focus on prototyping the IS implementation based on these elements. End-user involvement in the implementation process is further emphasised by Hwang et al. (2012), who suggest that it is fundamental, as the end users of the technology intervention may be able to pinpoint potential failures of the intervention in that particular setting. End-user involvement requires top management commitment in a particular context.

The adoption of technology interventions in many quarters of the IS field is perceived as a choice made by an individual or organisation to acquire new interventions. Based on this description, Blumenthal and Tavenner (2010) posit that the mere act of adopting an intervention does not always translate to successful implementation and actual use. Cresswell and Sheikh (2013) stress the importance of insight into organisational issues that may influence the implementation of technology interventions. They note that the issues have yet to receive adequate research attention in both the IS field and academic space. The implementation of a new technology intervention is an organisational activity that involves a set of actions by various stakeholders in creating a new activity system, referred to as a "social-technical system" (Vygotsky, 1978; Engeström, 1987; Kuutti, 1996).

The organisational activities, according to Hyötyläinen (1998, 2005), are categorised into four sets: (i) the act of defining the interventions' problem and goal setting, (ii) the act of planning for the activities, (iii) the act of outlining the implementation activities, and (iv) the development and use activity. Shaping the planning and implementation process of ISs in an organisational context may be influenced by the development mechanism in two ways: (i) strategic goal setting and the definition of planning and implementation practices performed by management as well as by planners; and (ii) the user activity (Hyötyläinen et al., 1990; Norros et al., 1990; Hyötyläinen, 1998, 2005; Kautz, 2011). Figure **2-8** depicts a summary of the planning and implementation mechanisms.

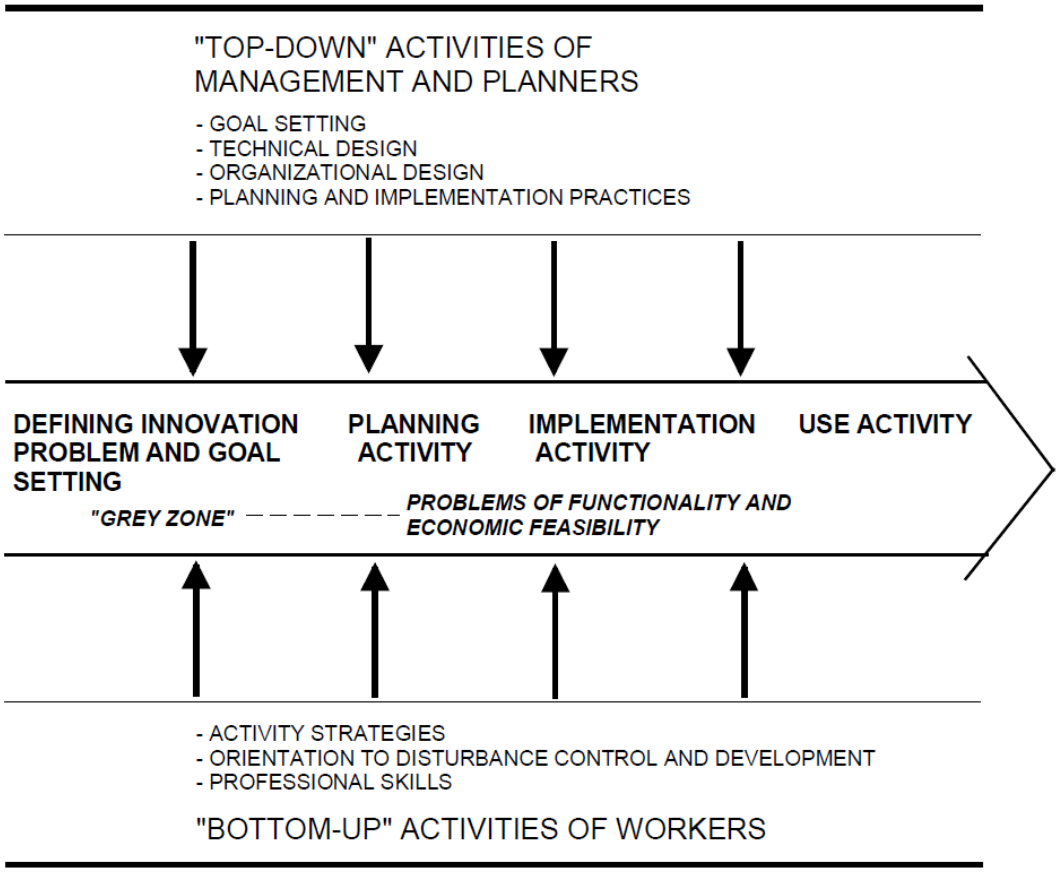

Figure 2-8: The planning and implementation model of an information system (Hyötyläinen, 1998:24)

The implementation of information systems is generally an issue most organisations still struggle with. Scott and Vessey (2000), Helo et al. (2008), and Maditinos et al. (2011) assert that failures of IS implementation are often associated with or caused by software and hardware issues. The authors suggest that this should not be the case; rather, the failures should be attributed to the high degree of complexity from the vast changes that technology interventions cause in an organisational context. To this effect, Helo et al. (2008) further argue that major organisational issues or challenges associated with the implementation of technology interventions are often human related. Examples are resistance to change, organisational culture, lack of commitment from top management, and the mismanagement of IS projects. Other issues related to IS implementation include lack of IT expertise and relevant implementation policies, and inadequate ICT infrastructure (Huang & Palvia, 2001). Hyötyläinen (2013) argues that a major issue in the implementation of IS in organisational contexts is the lack of a clear distinction between data, information, and knowledge during the implementation process. The implications of the lack of this distinction manifest when end users utilise these systems in their work activities.

Information systems generally can be can be approached from two perspectives: technological or social. The technological perspective emphasises information gathering and analysis functions (Hyötyläinen, 2013). The social perspective is deeply rooted in knowledge as a social construct in an organisational context (Berger & Luckman, 1991; Checkland & Holwell, 1998; Prieto & Easterby-Smith, 2006; Hyötyläinen, 2013). The implementation of technology intervention can be viewed as the development of an organisation that comprises learning and innovative processes, where different stakeholders are involved and influence the actions adopted (March & Smith, 1995; Nonaka et al., 1996; Lewis et al., 2005). With any major software implementation, one changes the entire operation of the organisation. If not done appropriately, this can result in costly disruptions to work activities in the organisation.

In the next sub-section, the implementation of ISs in the public healthcare sector for the purpose of facilitating the delivery process of healthcare services is discussed.

2.4.1 Implementation of information systems in healthcare settings

Information systems in healthcare are perceived to offer enabling conditions for informed decision making, and have four key functions as established in the previous sections. The four functions are: generation of data, storage of data, analysis and synthesis, and communication at all levels within the healthcare system. These functions are required to produce quality, relevant and timely data for conversion into health information that enables informed decision making (Chan et al., 2010). Cresswell and Sheikh (2013) posit that the implementation of technology interventions in the healthcare sector is complex. This is attributed to the range of interrelated sociotechnical factors shaped by organisational factors that need to be considered in the implementation process. According to Cresswell and Sheikh (2013), not much attention has been given to the organisational factors that influence technology implementation.

In their study on the implementation of technology interventions in a healthcare setting, Greenhalgh et al. (2004) state what they consider to be attributes of the implementation process: (i) the receiving organisation and its surrounding context, (ii) the complex nature of the start–stop of the implementation process – usually from diffusion and dissemination, to assimilation, and (iii) positioning preliminary links among the implementation concepts. The implementation of technology interventions in the healthcare context is considered a relatively new area of research (Eccles et al., 2009), even though there is a substantial body of work on factors that promote successful implementation (Grol & Grimshaw, 2003; Helfrich et al., 2007). There has been evidence of many debates on the understanding of the implementation processes of technology interventions and the theoretical tools that

would best explain the implementation process (Eccles et al., 2009). As a result of these debates, many implementation frameworks that are more generalisable have emerged and are applied across differing settings and individuals. The success and survival of innovations in the healthcare industry depend on the effectiveness and efficiency of IT/IS implementation and use (Liaw, 2002).

Despite the large number of investments in technology interventions in healthcare settings, the overall benefit and value of the technology have not been realised (Littlejohns et al., 2003). In addition, scholars like Heeks (2006), Garde et al. (2007); Rahimi et al. (2009) and Kuziemsky and Peyton (2016), suggest that the implementation of ISs in the healthcare context has not met their expectations adequately and thus perceive it as a failure. There is evidence of large-scale implementation of ISs such as electronic medical records (EMRs) and electronic health records (EHRs) systems globally. However, there are still challenges and barriers associated with the implementation of these systems, especially in under-served contexts (Were & Meslin, 2011; Fernández-Alemán et al., 2013; Jawhari et al., 2016). Some of these emerging challenges and barriers include the following:

- ✓ Inadequate clinical trials of the interventions to determine their likelihood of successful implementation.
- ✓ Across the IS field there is an inclination to report positive impacts of technology interventions as opposed to the challenges encountered.
- ✓ There are challenges with regard to infrastructural barriers such as reliable power sources and network connectivity and capabilities where EMRs are deployed, especially in developing countries.
- ✓ Human workforce issues, such as high staff turnover, absence of local technical support and low levels of computer literacy.
- ✓ Organisational barriers such as lack of leadership or coexistence of multiple co-deployed systems without coordinated leadership.
- ✓ Limitations of existing EMR systems such as scalability, compatibility bugs, missing features and poor performance contributing to user resistance.
- ✓ Inadequate ethically grounded EMR policies or policies that appropriately address security and privacy issues in developing countries.

Effective implementation of technology intervention in the healthcare sector requires that leaders and decision makers recognise complexities in implementation processes that

require systemic change to the organisation's structure, staffing, and workflows, and the coordination of technology use by healthcare practitioners (Holahan et al., 2004; Weiner et al., 2009). The task of choosing the best implementation strategy for any technology intervention is challenging, as the experience of each implementation is said to vary (Moullin et al., 2015). In most cases, many organisations choose a combination of several strategies, as implementation strategies may vary in orientation and design. Not all strategies targeting a particular innovation cover all implementation concepts. Touching on core implementation concepts, Fixsen et al. (2005) suggest the consequences of applying the wrong strategy for the implementation process will result in poor results.

2.4.2 Context-based factors in healthcare information systems implementation

Although still considered a new area in the field of information systems, there is a substantial body of work on factors that promote successful implementation of technology intervention in healthcare settings (Grol & Grimshaw, 2003; Helfrich et al., 2007; Eccles et al., 2009; Cresswell & Sheikh, 2013; Fletcher, 2017). In recent years there has been renewed interest in context-based factors that influence the implementation process of technology interventions in healthcare settings. As previously mentioned, scholars have often focused on the implementation failures effected by software and hardware issues, as opposed to the environmental complexities and issues that influence the implementation process (Scott & Vessey, 2000; Helo et al., 2008; Maditinos et al., 2011).

The study's conceptual framework shown in Figure **2-9** depicts the dynamics between ISs and the public healthcare sector and external environment. It shows the correlation between the different aspects within the healthcare sector, including the components of a public healthcare system, the delivery of healthcare services, ISs providers and the various applications of ISs in a particular context. It also illustrates that the implementation process of ISs can have an effect on the adequate use of these systems in the delivery of healthcare. The effects can be determined by contextual factors, and in this case, can be enabling or inhibiting factors within a resource-constrained environment that will determine how hospitals use these systems to provide healthcare services. The results of this correlation will be either a desired or undesired health outcome for a country.

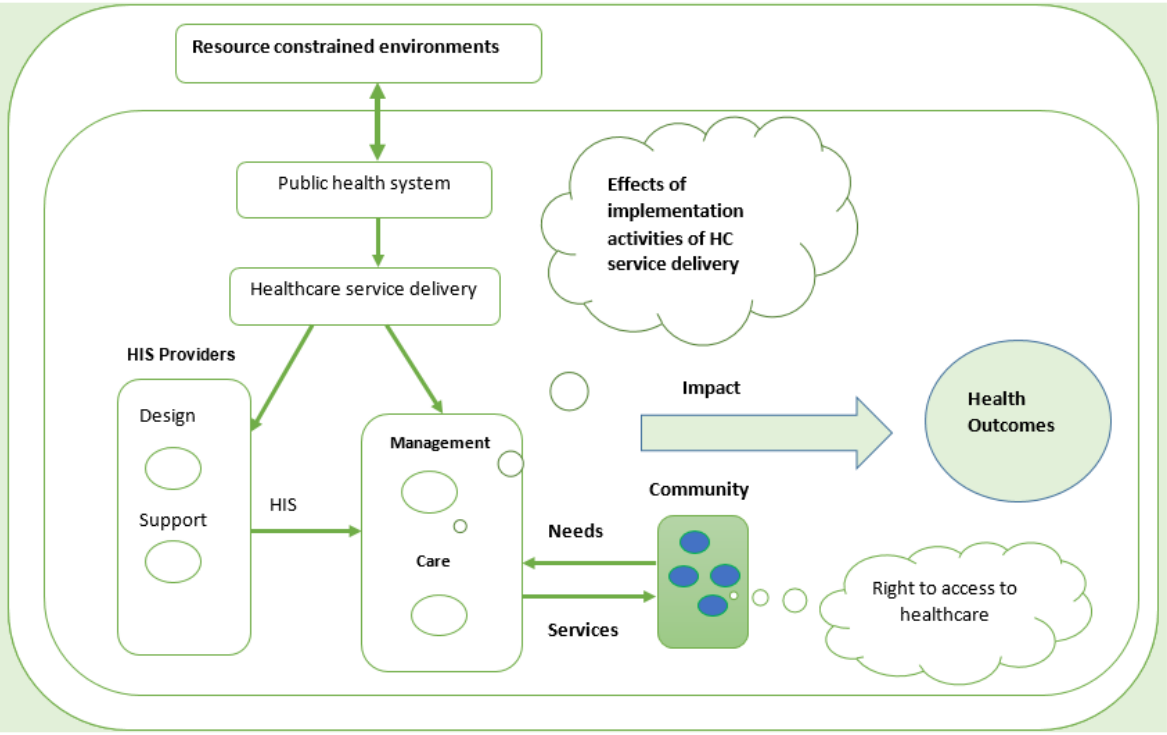

Figure 2-9: Conceptual Framework: HIS and the public healthcare sector

2.5 South African Healthcare Information System Landscape

In an effort to strengthen the public healthcare system in the country through the use of technology interventions, several reforms have been put in place by the national government. For example, in 2012 the e-health strategy was published to provide a roadmap for the implementation of e-health technologies in the country (DoH, 2012c). Through the e-health strategy document, the government expressed its intentions of strengthening the healthcare system by making all the ISs in the country more patient centred. This may have been a clear indication that the Department of Health had prioritised HIS to improve the quality of public healthcare services. HISs in South Africa and their benefits are well documented, commencing with the DHIS implemented in 1999 and other currently in use in the public healthcare sector. There were about 42 different information systems across the healthcare system, although this number may have increased or decreased over the years (Chowles, 2014). Of the 42 systems, only seven were operational in five of the nine provinces in the country. Five of the seven operational systems were used for surveillance and monitoring, while the remaining two were used for patient care. However, it is also noted that these systems have not produced the desired outcomes fully and that the ROI remains very low. Of interest is that despite the number of ISs in the

healthcare sector, the majority of public healthcare facilities still make use of manual paper-based systems (O'Mahony et al., 2014).

The sheer number of dysfunctional systems indicates the possible lack of an implementation plan. Most were implemented in silos as the need for different task-based services emerged, such as the surveillance of HIV/AIDs in healthcare facilities. This resulted in many legacy systems across the nine provinces that made it virtually impossible to have an integrated national information system. ISs in the healthcare domain in South Africa are classified into three categories: (i) patient-care level systems such as clinical care and supporting services; (ii) operational-level systems that are used for monitoring and evaluation, and for administrative purposes; and (iii) strategic-level systems. For patient care, electronic health records (EHR) systems are commonly used in most public healthcare facilities. For example, some healthcare facilities in KwaZulu-Natal make use of HISs such as the Medicom or Meditech EPR systems. Similarly, in Limpopo, hospitals use either the Medicom or UniCare EPR systems (Ataguba & McIntyre, 2012). Some healthcare facilities in the Western Cape use the UniCare EHR system. The patient care systems are used comprehensively in capturing patient health history and stored for easy access and central coordinated control (DoH, 2012b). A challenge that the implementation of these systems has posed is that in most instances they are developed and implemented by different vendors. Thus, there is a lack of coordination and integration among these systems.

Other notable HISs on the patient level include the TrakCare Lab system, which is used by most laboratories and is responsible for all diagnostic pathology tests in the public healthcare sector. Triegaardt (2013) reports that many hospitals have implemented picture archiving and communication systems (PACS); however, none of the implemented systems are optimally operational. Digital radiology imaging machines, according to Boochever (2004), still use the Digital Communications in Medicine® standards (DICOM) to communicate standard information on captured images. What is revealed from other reports is that because the systems come from different vendors, they are not interoperable, and it is thus very costly to migrate files from a system while moving from one vendor to another. As a result of this, in most cases when moving from one vendor to another, there is disruption of the healthcare workflow in healthcare facilities (Cilliers & Flowerday, 2014). The problem is exacerbated by the absence of government-imposed standards in respect of PACS integration in the healthcare system. Another example is the CLINICOM hospital information system used to provide patient demographics and hospital administration data in the Western Cape province. Another HIS in the patient-care category used in healthcare facilities is the Delta 9™ Hospital Information System. Used in almost 108 healthcare

facilities across the country, this system also has a master patient index that can provide demographic and administrative data about patient visits to hospitals based on input from paper records. Rx Solution is a stock control programme funded by the United States Centers for Disease Control and Prevention (CDC); another system is the Primary Health Care Information System for Community Health Centre (PHCIS), developed for public-sector community health sectors and clinics in the Western Cape province. Lastly, there is the Patient Record and Health Management Information System (PREHMIS), operated by the City of Cape Town in primary healthcare clinics.

HISs in the operational and strategic category in South Africa are mainly used for monitoring and evaluation. For example, the national Health Patient Registration System (HPRS) implemented countrywide in almost 650 healthcare facilities allows patient identity verification and records the purpose of the visit. According to the CSIR (2016), this HIS is a reliable source of national patient demographic data. Another HIS in this category is the DHIS responsible for the collection and analysis of routine healthcare data from all the primary and district healthcare facilities in the country (DoH, 2011). The DHIS was established as a routine system for tracking healthcare service delivery in the public healthcare sector in 1996/97. Developed by the Health Information Systems Program (HISP), the system was implemented to play a vital role in the collection, capture, storage, analysis and reporting of routine data (Jacucci et al., 2006; Venter, 2007). Used as the institutional vehicle for primary healthcare service delivery, the DHIS achieved great success in fulfilling its purpose. However, an increase in demand for routine information in the public healthcare sector exposed gaps in the system, such as poor data quality and dataflow bottlenecks (Mchunu, 2013) and reporting discrepancies at different levels. A web-based DHIS2 was introduced to mitigate some of the problems with the earlier version. However, this was only done in one province, while other provinces continued with the DHIS.

2.5.1 Existing healthcare information system challenges in South Africa

There are various challenges inherent in the existing implementation and use of HIS in the South African healthcare context and some are well documented. One problem is the challenge of poor data quality in most public healthcare facilities. The e-Health Strategy highlights that data quality will remain inferior where there are mainly paper-based systems or a mix of paper and computerised systems (Chaudhry et al., 2006). Another documented challenge is that of the nationwide master patient index that has yet to be rolled out in all the hospitals despite it being mentioned in some health strategies and policies, the country has yet to roll out a nationwide master patient index. This would enable the national

government to be able to link and track patients across the healthcare system. According to Mayosi, Mekwa et al. (2012), the inconsistencies in the public healthcare system exist because most indicators are included in the system only for the purpose of reporting. The authors posit that these indicators have no clear delineation of the health outcomes they support. In addition, the ICT infrastructure required to support the already implemented HIS is highlighted as a major challenge for the government.

A lack of sufficient capacity for data analysis in the healthcare sector further exacerbates the problem. As a result, there has been a difference in maturity levels of e-health across the country. This creates the problem of having many healthcare information systems across the nine provinces in South Africa, with little to no interoperability and communication. This results in healthcare information in silos across different healthcare facilities, causing duplication and discrepancies in reporting (Ajami & Arab-Chadegani, 2013). The National Health Research Summit identified inadequate information systems in healthcare facilities to provide information on the implementation of health interventions. Similarly, Venter and Barker (2013) note that there is inaccurate reporting on numbers, treatment and outcomes in hospitals.

The next sub-section explores the evolution of ISs in the healthcare domain on digital platforms.

2.5.2 Evolution of digital healthcare applications in South Africa

Over the years, there has been interest among scholars on the application of mobile technology (m-health) in the healthcare sector for healthcare services. Mobile technology has in many ways already transformed the delivery of healthcare services by making them more accessible and affordable (Ivatury et al., 2009; Mechael, 2009). With increasing technological advances, mobile phones have become vital in the monitoring and delivery of healthcare services. This can be attributed to the prevalence of digital devices worldwide. Digitisation in the healthcare sector promises great potential; however, for this potential to be realised, issues such as inadequate management and leadership, poor ICT infrastructure, and inadequate training of healthcare personnel need to be addressed. M-health is a sub-component of e-health and is described by the Global Observatory for eHealth (GOe) as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices".

2.5.2.1 Mobile health applications

The increase in healthcare apps in recent years has been beneficial to both healthcare practitioners and patients alike. It is argued that these apps can improve ease of access and speed of access to clinical data and information, as well as facilitating analysis and turnaround time (Chib et al., 2015; Lohnari et al., 2016). Istepanian and Lacal (2003) argue that mobile Health (mHealth) can be described as wireless telemedicine involving the use of mobile telecommunications and multimedia technologies and their integration with mobile healthcare delivery systems. This description is inclusive of any mobile device used to assist in the provision of healthcare services. For example, healthcare information systems such as electronic medical records systems and PACS can be accessed using smartphones (Baumgart, 2011). At the same time, m-health also bridges the barriers in healthcare delivery such as quality of services, cost of delivery, and resource allocation. Classified into five types, mobile healthcare services include the provision of health information by using an on-off line, a form of keeping the connection between healthcare facilities and patients. Such services include personal exercise management, personal healthcare self-assessments, and services for the improvement of life habits such as diets, sleeping patterns, etc. (Kim et al., 2015). Examples of medical applications on mobile platforms include the computerised physician order entry (CPOE) system, electronic prescribing, EMR systems and alerts, and communication systems.

Qiang et al. (2011) identify several ways in which mobile health applications are used in healthcare management. These include treatment support, patient tracking, supply chain management, emergency services, healthcare financing, education and awareness, and disease prevention. In the treatment support category, m-health care services are employed for facilitation of treatment, rather than treatment of health problems. For instance, in South Africa, a treatment support application is a compliance reminder which uses the short message service (SMS) on mobile phones to send reminders to TB patients to take medication on a regular basis. Another application of m-health is in the emergency services, including ambulance services. In the patient-tracking application, mobile health applications are used to track patients' medical records, reducing errors by medical practitioners in diagnosis, treatment and prescription of medicine. Significant mobile penetration in South Africa has seen the realisation of mobile healthcare benefits (Ojo, 2017).

In recent years, the digital health platform in South Africa has seen great initiatives, such as MomConnect. This mobile platform has been used by the Department of Health to provide pregnant and postpartum women with weekly health information via instant

messaging apps such as WhatsApp or SMS (Barron et al., 2018). Statistics show that in just over three years since its inception, MomConnect has become available to well over 95 percent of public healthcare facilities across the country and services about 63 percent of pregnant women. One of the benefits of this platform is that there has been a significant reduction in cost to both patients and healthcare facilities, as the Department of Health is able to collect real-time data easily (Barron et al., 2018).

The next section discusses the theoretical underpinnings of this study.

2.6 Theoretical/Analytical Frameworks

The use of models, frameworks and theories on evidence- based research has been prevalent for several decades. However, the focus has often been on the use of frameworks and models, rather than theories. This has changed in recent years, where there has been renewed interest in the field of social science research on the use of theories and theoretical or conceptual frameworks as some form of heuristic guide in evidence-based research (Rycroft-Malone, 2007). The use of theories regardless of format is driven by the need of researchers to gain insight into the possible contributions that theories make in the understanding of evidence-based research (Rycroft-Malone & Bucknall, 2010). The authors suggest that theories in social science research are relevant in the implementation of evidence-based research in a number of ways, including employing the use of a theory in the identification of “appropriate outcomes, measures and variables of interest” (Rycroft-Malone & Bucknall, 2010:24).

Theory has been conceptualised in different ways by philosophers and academic scholars. For example, Argyris and Schön (1974:4-5) describe a theory as “a set of interconnected propositions that have the same referent – the subject of the theory”. Similarly, Kerlinger (1986:9) describes a theory as “a set of interrelated constructs, definitions, and propositions that presents a systematic view of phenomena by specifying relations among variables with the purpose of explaining and predicting phenomena”. From these two descriptions, what is apparent is the aspect of interconnectedness and interrelations; these two aspects also feature in later descriptions of theory. For example, LeCompte and Preissle’s (1993:239) description of theory mentions that theorising “is simply the cognitive process of discovering or manipulating abstract categories and the relationships among these categories”. Strauss (1995) gives a different perspective in his description, noting that a theory essentially provides a roadmap of the general causes of the happenings in a social world as it is. According to the author, theories are simplifications of the social world and as such are employed to offer clarity on and explanations of some aspects of how the social world functions. Without disregarding other definitions of theory, the current study favours

Strauss's (1995) views on the concept of theory. Based on the author's description, the intention of this study was to employ two theoretical frameworks in search of clarity in respect of the outcomes with regard to the delivery of healthcare services and HIS implementation in public healthcare facilities.

The discussions in this study so far have highlighted the complex nature of the delivery process of healthcare services. It is because of these complexities that the researcher found it appropriate to employ theories to understand the phenomena under investigation. The identification of key constructs of the issues under investigation provides reasons why certain things happen the way they do in the complexity of things, how societies or organisations operate, or why people react in a particular manner (Reeves et al., 2008). Drawing on the philosophical stance of this study, the principle of the abduction inference strategy in critical realism emphasises the application of a theory as analytical lens through which an investigation and its analysis can be based. Critical realism therefore uses the abduction inference strategy as a thought procedure for theoretical redescription, abstraction and conceptualisation. There is an understanding among scholars in social sciences that in qualitative research, a theory relates to the methodology employed (Crotty, 1998; Guba, 1990; Lincoln & Guba, 1985; Denzin & Lincoln, 2000) in the research and the epistemologies underlying that methodology (Creswell, 1994, 1998, 2014; Gall et al., 1996; Patton, 1990, 2002; Yin, 2003). In relation to methodologies, Yin (2009) suggests that case study strategies, unlike other research strategies, require that a researcher identify a theoretical perspective at the onset of choosing a research design.

While the study gives recognition to other social theories in the IS field such as Actor Network Theory (ANT), Structuration Theory (ST) and Stakeholder Theory, the study adopts the Activity Analysis and Development (ActAD) model together with the Normalization Process Theory (NPT) as analytical theoretical frameworks. The ActAD model based on Activity Theory (AT) is employed as a backdrop to the conceptual exploration, and as an analytical lens. The principles of the ActAD model are employed as they have similar traits to critical realism principles in being relatively open in respect of particular methods, providing an overarching frame and conceptual tools of enquiry – they provide exploratory guidance rather than strict rules. NPT on the other hand is employed as an explanatory framework for examining interactions between structures and agency, as well a theoretical lens for characterising generative mechanisms that produce certain outcomes of HIS implementation activities. The rationale for this is discussed in the sections that follow.

The next sub-section discusses the theoretical frameworks employed in this study.

2.6.1 Activity Theory

Activity Theory (AT) (Leont'ev, 1978; Engeström, 1987, 1999) is a multidisciplinary framework that has been useful over the years for investigating human practice by interspersing social structures and individuals (Kuutti, 1996; Barab et al., 2004). AT has been employed in various aspects of the IS field as a tool which facilitates a more holistic view and has been adopted by information systems practitioners and developers. In the IS field, Activity Theory has been applied in many studies as early as the 1990s. It was mainly based on Engeström's (1987, 1999) Developmental Work Research (DWR) model. The focus of its use has been on the perceptions that objects in an IS are part of a work activity in the development of IS. However, Korpela et al. (2004) argued that in the field of IS, AT was not being applied as expected, nor did it fit the context of IS development and use. The authors then developed the ActAD model depicted in **Figure 2-10**, that focused on the emancipatory effects of IS and its development (Korpela et al., 2004). Subsequently the model has been applied in numerous descriptive IS research projects. For example, the ActAD model was applied in the analysis of the development of ISs for Nigerian software companies. The model was also employed as an analytical lens to analyse healthcare activities and information needs of nurses and doctors (Korpela et al., 2000; Korpela et al., 2002; Mursu et al., 2003).

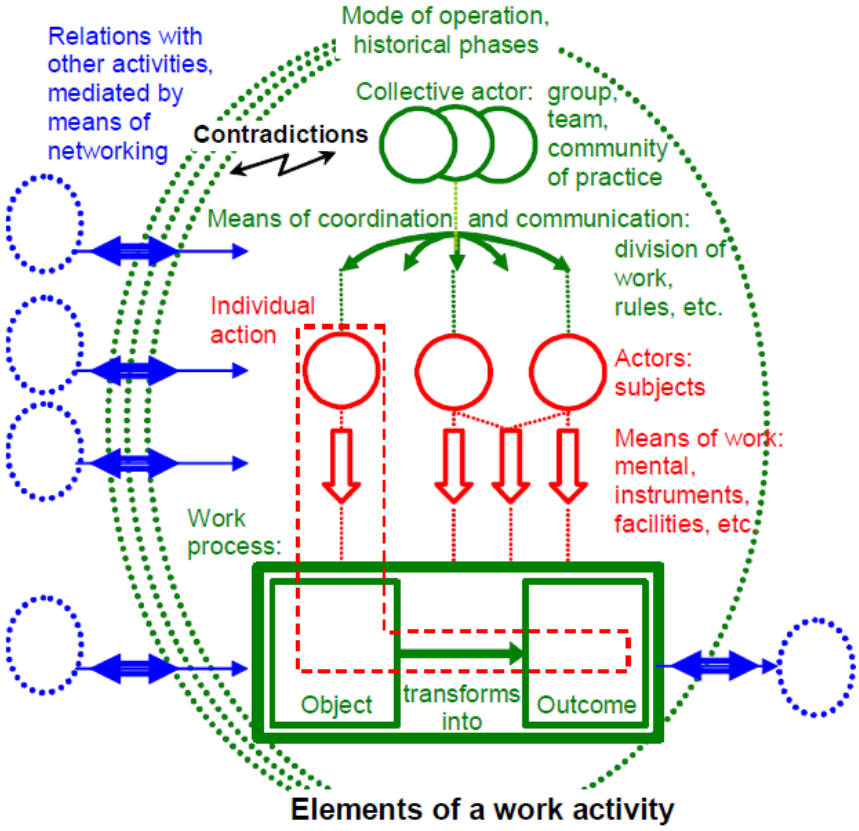

Figure 2-10: The ActAD model: the structure and relations of a work activity as a systemic entity (Mursu et al., 2003, based on Korpela et al., 2000)

In the ActAD model, the presence of individual actors within an activity system is made explicitly clear, and hence work activities in an activity system are explored by means of coordination and communication. In the model, the aspect of networking is portrayed in the systematic manner in which activities are included in the overall mode of operations. Drawing on this model, ISs are viewed as tools that can be used to facilitate work activities as well as the collaboration between actors in a work activity system. AT conceptualises work activity development as a fundamental component in the development of ISs. The depiction of elements of work activities in Figure 2-10 used in this study is based on the analysis of work activities by Mursu et al. (2003), adapted from Korpela et al. (2000). It is employed to illustrate healthcare practitioners' work activities in a healthcare service delivery process work activity system.

2.6.2 The work activity system

The ActAD model reaffirms the emphasis on human activity as the core of design science research. The concept of a work activity system is adapted from Engeström's (1987) systematic structure of work activity. **Figure 2-11** depicts an adaptation of the work activity

system based on Engeström's (1987) work, re-modelled from the original triangle of the developmental work research to accommodate IS development. The ActAD model in Figure **2-10** focuses on work activities of individuals (actors) in an organisational context that have a shared object and motive. The common goal in most cases comes from the organisation's strategic objectives (Korpela et al., 2000, 2002, 2004). Translating this to the current study, the healthcare service delivery process encompasses a work activity system with several individuals (healthcare practitioners and other relevant stakeholders) who carry out different work activities with the common goal of improving healthcare outcomes in the healthcare system.

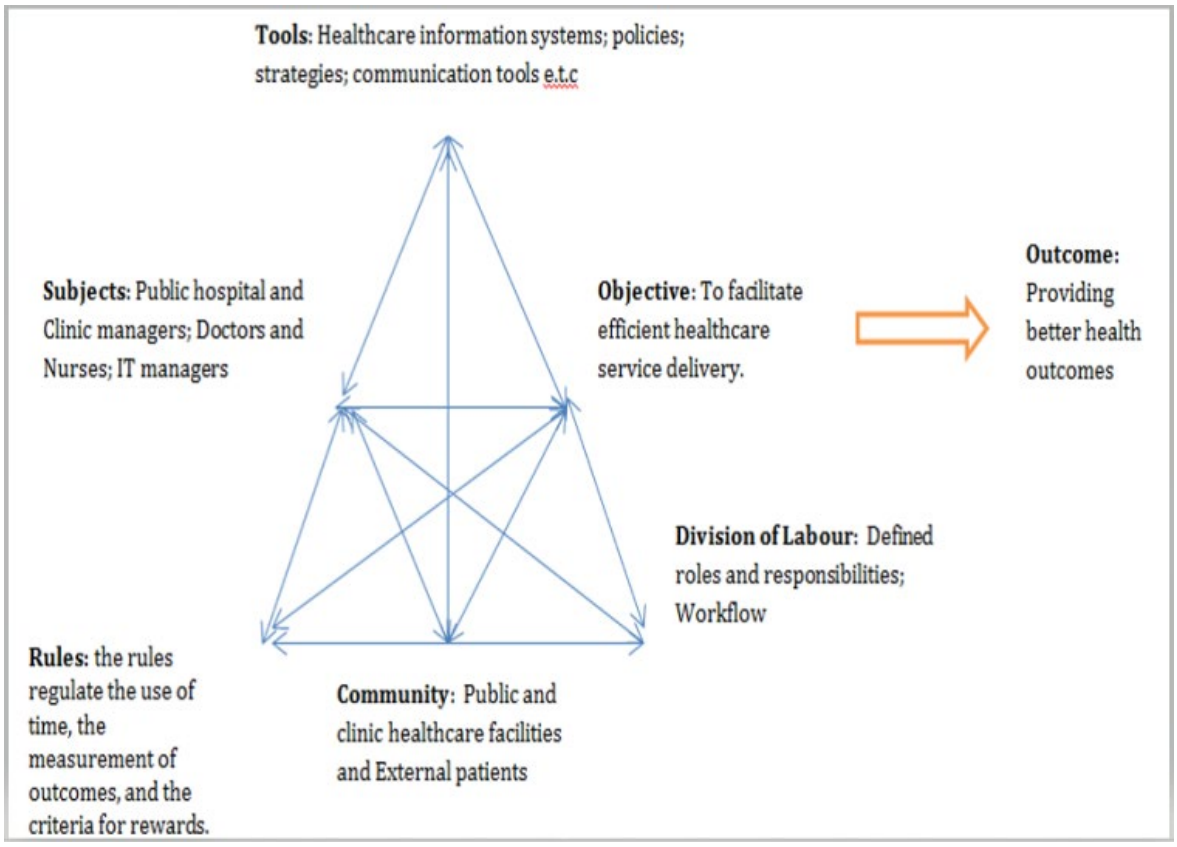

Figure 2-11: Healthcare service delivery work activity system (adapted from Engeström, 1987)

The ActAD model retains the same elements of Engeström's work activity as a systematic entity, including individuals in isolation or groups working towards a shared outcome/objective. Elements in the ActAD model include Actor; Object; Outcome; Means of work; Means of cooperation; communication and coordination; Collective actor; and Process, Input and Output. The model is applicable to action and design science where a group, team or community of practice work collaboratively in the entire design process. In IS development, Orlikowski and Baroudi (1991) suggest a critical element of emancipation,

where individuals have a say in their work activities. It can thus be argued that an improved information system should mean that individuals do their work better. ActAD models IS development as a work activity. Mlitwa (2011) notes that ICT within the ActAD framework can be used as a means in three different ways: (i) facilitating individual work, (ii) coordination and communication for collaboration and cooperation between actions, and (iii) networking between activities. The framework allows researchers to analyse actors, means of work, means of coordination and communication, work processes, and information flow.

Translating the concept of the work activity system within the context of this study, the healthcare service delivery process is considered a work activity system. In this work activity system there are several actors (clinical and administrative healthcare practitioners, leaders and managers, among other revelant stakeholders); these actors employ different means of work, such as using technology interventions as well as other medical equipment in the case of medical practitioners. Technology interventions may also be used as a means of coordination and communication within healthcare facilities (and outside the facilities as well) for collaboaration. Work processes and information flow in this instance are aligned with the clinical and administrative healthcare processes that form part of the healthcare service delivery. To gain insight into the healthcare service delivery process as a work activity system, the ActAD framework in **Figure 2-12** was developed, and informed the data-collection instruments. The development of ISs is viewed as an emanicipatory process where individuals in that process have a say in their work activities (Orlikowski & Baroudi, 1991).

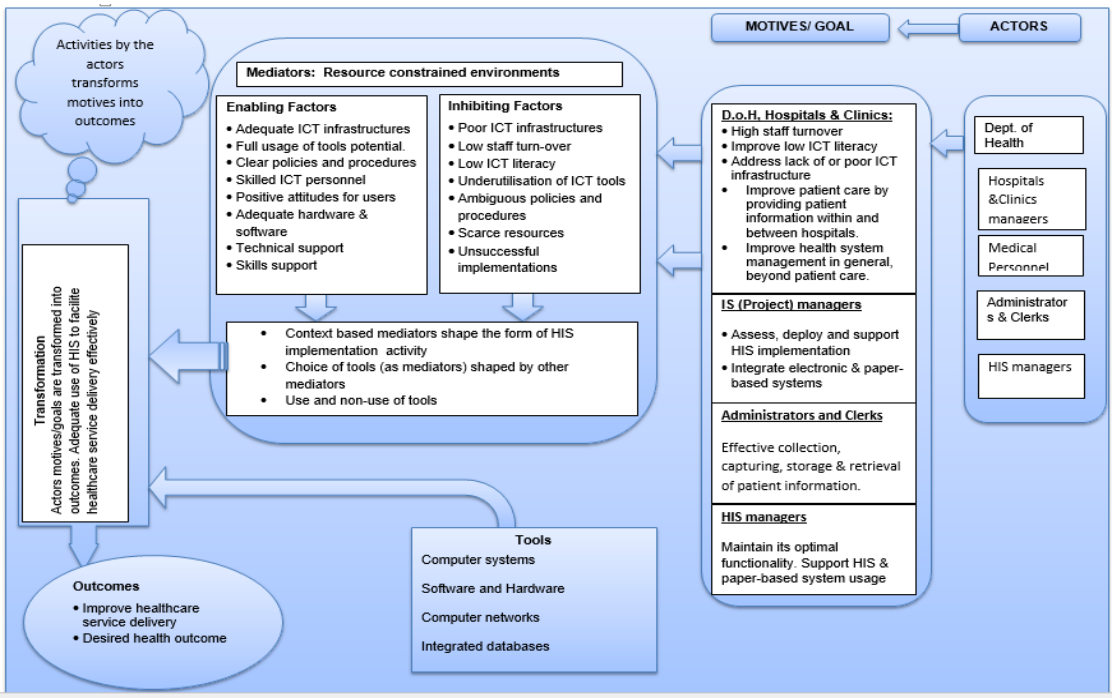

Figure 2-12: ActAD framework for HIS implementation and use in public healthcare service delivery

Figure 2-12 depicts an adaptation of the ActAD model to fit the context of this study in which healthcare service delivery is considered a work activity system. In the framework, the actors are shown to have common goals and motives at different levels within the public healthcare system. These goals and motives are mediated by environmental mediators that transform the activities within the delivery process of healthcare services into an outcome (desired or undesired). Tools in the framework enable the work activities carried out by the actors. The mediators are categorised as either enabling or inhibiting, depending on the context-based factors and the available tools.

A discussion of the interpretation of the ActAD framework as applied in this study follows.

2.6.3 ActAD framework as an explanatory and analytical tool

Drawing from the framework, the actors in a work activity system continuously create artefacts that enable the realisation of the outcomes of the activity system. Based on the work activity system concept, the notion of an object or purpose suggests that the implementation of technology interventions in the delivery of healthcare systems is not meant to unfold without purpose. In this case, the purpose of the implementation of technology interventions is in pursuit of an identifiable outcome such as enhancing the activities of healthcare practitioners, which in turn would result in desired health outcomes. The approach taken to integrate technology interventions with work activities in the delivery process of healthcare services has an impact on whether the intervention is optimally used.

This is an important point in understanding the factors of HIS implementation and subsequent use, in that it could (together with other mediators) explain some aspects of implementation and use (or non-use). Though the purpose is closely related to the outcome, they are separate phenomena (Mursu et al., 2007). The purpose exists before and alongside the activity; it has a finite time frame that culminates in the transformation of an object into an outcome (desired or undesirable) due to contextual or mediator tensions. An activity is therefore never ending in itself, but is a goal-oriented process towards the realisation of the outcome. In the case of HIS implementation and use, Davis (1989) argues that perceived benefit and usefulness inform the initial intention to adopt, implement and use. Depending on the synergies and tensions among the activity mediating factors, HIS implementation and use for an improved public healthcare service delivery may be fully or partially realised, or not realised at all. In summary, the ActAD model views IS research as an activity system where collective work activities are carried out by actors individually or as a group in pursuit of a common objective. In other words, healthcare service delivery is not an individual exercise, but collective activities carried out individually or as part of a group.

HIS implementation and use for improved public healthcare service delivery as an activity objective

In the ActAD model, the work activity is the main unit of analysis in the activity system. In this study, the interactions between healthcare practitioners (actors), tools, mediators and the actual healthcare service delivery process constitute the main activities. The broader Department of Health objective is in the form of a mission, and not as specific as a goal. A goal therefore is an elaborate and practical means to carry out the Department of Health's objective. In starting with the healthcare service delivery as an activity objective in the system, healthcare practitioners need to believe in the usefulness (perceive the value) of the tool (HIS) as an enabler of the work activity. The nature of the task carried out by the actors, relative to the use of the tool, rules of its usage and the social context, determines usage or non-usage of a tool. This aspect of the model was integrated into the data-collection instrument to determine the purpose and value healthcare practitioners ascribe to HIS use in facilitating healthcare service delivery.

Work activity as transformation

One of the main research questions that guides the enquiry of this study interrogates the existing HIS implementation in facilitating public healthcare service delivery. The notion of transformation refers to the actual work process, where policies, tools, procedures and activities converge to produce a desired outcome. In the case of HIS, the purpose of HIS

implementation and use is to facilitate and improve the healthcare service delivery process. Transformation will take place when HIS is embedded adequately in healthcare practitioners' work activities. This notion is integrated in the data-collection instrument in a manner which clarifies the purpose and manner of HIS implementation and subsequent use in public healthcare facilities.

Improved healthcare service delivery as activity outcome

The objective of the healthcare system is to provide quality healthcare services; thus, an intended outcome of the healthcare service delivery work activity system. For this outcome to be achieved, all the elements in the work activity system need to merge seamlessly to produce the outcome of improved healthcare service delivery.

2.6.4 Normalization Process Theory (NPT)

The majority of existing frameworks, models and theories across the literature on implementation generally tend to focus on descriptions and explanations of the implementation process of intervention in retrospect. In some cases, this often limits the potential, such as a theory/frame/model's predictive power. However, there are scholars who address such limitations, for example, in the development of the Normalization Process Theory (May, 2006; May et al, 2009; Murray et al., 2010). The works of these authors give the impression that NPT was developed through rigorous qualitative research and has since been applied successfully to understand healthcare-related issues. The theory explains how 'work activities' involved in the enacting of an intervention of practice are accomplished through the operation of its four constructs or mechanisms: coherence (involves sense-making activities of the intervention); cognitive participation (involves the relationship of the activities and the effects they produce); collective action (involves the activities of enacting the work); and reflexive monitoring (involves continuous appraisal of the work activities). It is based on the understanding of these constructs that the study employs this theory to identify, characterise and understand what the causal powers of these mechanisms are and how they influence the implementation and normalisation of HIS in public healthcare settings.

While there are similarities between other theories and NPT, the latter expands a researcher's insight into the concept of implementation by offering a probable third perspective – *a successful implementation of an intervention is the product of 'work activities' people in an organisational context have to do either individually or collectively.* It is based on this argument that NPT is employed in this study. According to May (2006), NPT is a theory on the collective 'work or effort' done individually or collectively to implement

and sustain an intervention. Based on this perspective, work is defined as a “purposive social action that involves the investment of personal and group resources to achieve goals” (May & Finch, 2009). Normalisation in NPT theory is referred to as the process of embedding an intervention as routine (May, 2006). The study takes the stance that normalisation of interventions should be differentiated from adoption and rejection, as they are two processes different from normalisation.

2.6.4.1 Rationale for employing NPT in the study

A major rationale for employing NPT in the study is because of its focus on implementation, embedding and integration of new interventions into work practices (May et al., 2007). Implementation in this context refers to the process of bringing an intervention into action; embedding on the other hand is the activities involved in making an intervention become routinised or not in the daily work activities of the intended users. Integration here refers to the activities involved in making an intervention reproduce and be sustained among the social matrices of an organisation. The rationale for the study’s adoption of NPT is that one of its important strengths is its focus on “workability in practice” (May, 2006). As such, it is employed iteratively to study changes in perceptions, actions and outcomes. A further reason for employing NPT is it assists in the identification, characterisation and explanation of mechanisms that have been demonstrated empirically to motivate and shape implementation processes and affect their outcomes (May et al., 2009).

The investigations of this study provide insight into issues relevant to the normalisation of technology interventions in public healthcare facilities in resource-constrained environments.

2.7 Summary of Chapter 2

This chapter shed and underscored the key concepts that position the study in the IS field, as well as in the field of health informatics. The chapter reviewed the implications of the application of information systems in the healthcare sector. The various applications and use of HIS in healthcare were illustrated and their contributions observed. The existing gap between the implementation of information systems in different contexts was highlighted. Several factors affecting the implementation of information systems in resource-constrained environments were also explored and examined. The role of healthcare information systems in the public healthcare sector and the benefits they offer were illustrated. The role of government policies in promoting the implementation of information systems was examined critically. The role of theoretical frameworks was explored to understand both their premise and relevance. Activity theory, particularly the ActAD model, was adopted as

the theoretical foundation for the study because of its applicability to the research. Whereas the NPT theory was adopted as an explanatory theoretical framework to identify, characterise and understand causal mechanisms in the implementation of technology interventions within a healthcare setting.

3 CHAPTER 3 – PHILOSOPHICAL UNDERPINNINGS

"No man's knowledge here can go beyond his experience"

John Locke

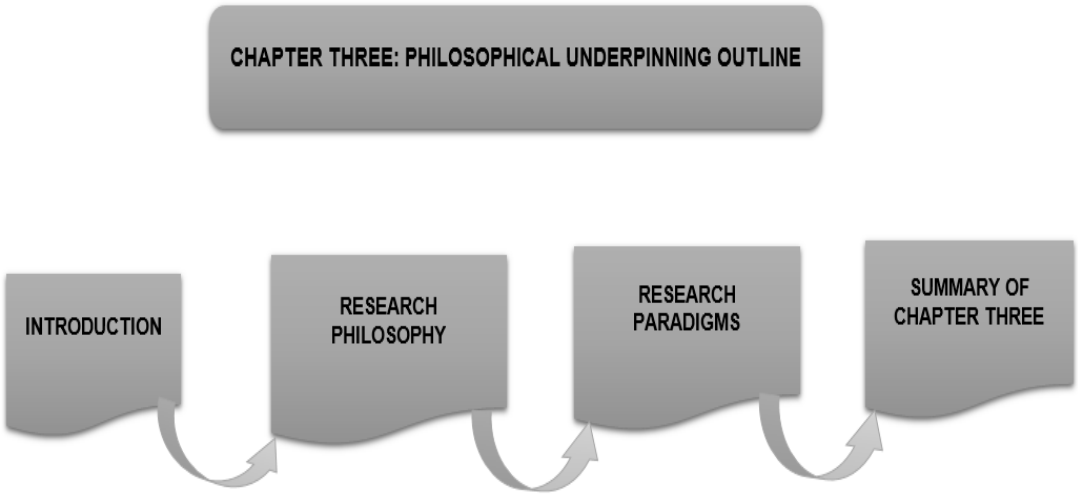

Figure 3-1: Chapter 3 outline

3.1 Introduction

This chapter provides in-depth insight into a suitable research approach for the investigation. Mlitwa and Van Belle (2010) note that a research approach comprises the philosophical beliefs and theoretical assumptions researchers hold as they undertake an investigation. This implies that research requires a clear research outlook in order to extrapolate relevant thought patterns that point to logical lenses through which knowledge can be extracted and analysed (Tedre, 2006). Building on this, the researcher deduces that the philosophical underpinnings of research constitute the fundamental foundation of a study. Through these underpinnings, the researcher selects an appropriate strategy, formulates the research problem, and collects and analyses data.

The concept of paradigms emerged from the field of philosophy and was popularised by Kuhn (1962), who referred to the term as an all-inclusive theoretical research structure. Over the years many scholars and philosophers have adopted and refined this mode of reasoning. For example, Guba and Lincoln (1989:107) define a research paradigm as "a

set of basic beliefs (or metaphysics) that deals with ultimate or first principles. It represents a worldview that defines, for its holder, the nature of the 'world,' the individual's place in it, and the range of possible relationships to that and its part". On the other hand, Burke (2007) contends it is a concept which individuals may employ to reflect and share values and assumptions relating to a discipline. Drawing from these descriptions of the term 'paradigm', the researcher deduces that it is employed as a guide that positions the study theoretically or epistemologically, and therefore informs the interpretation process of data within the phenomenon under study. In his later works Kuhn (1996) posits that in a study, a research approach should be inclusive of methodologies, methods or techniques for collecting and analysing research data.

Based on these concepts, the chapter presents the research approach that guides the study throughout the investigation. The chapter begins by exploring the philosophical stance of the study.

3.2 Research Philosophy

A common practice in the field of social sciences is that research is grounded in fundamental philosophical paradigms (Myers, 1997). Research philosophy forms an integral part of the methodology that guides the investigation and involves theories and beliefs that a researcher employs. Merging the two concepts (philosophy and paradigm), Saunders et al. (2009:107) refer to philosophical paradigms as involving "the development of knowledge and the nature of that knowledge". Flick (2009) suggests that understanding the underlying philosophical paradigm is essential in facilitating the research process of an investigation. In effect, Kroeze (2011) suggests that the philosophical stance of an investigation provides a broader sense of description of a viewpoint, value of belief of a phenomenon under investigation. The current study inclines to the views of Creswell (2013:16) of research philosophy as "the use of abstract ideas and beliefs that inform our research". The study identifies three classifications of research philosophy: axiology, epistemology and ontology. The study underscores ontological and epistemological research philosophical constructs and how these underpin this study.

Ontological and epistemological underpinnings inform the fundamentals of a research methodology. The ontological stance of a study divulges the intrinsic nature of the issues under investigation, whereas the epistemological stance presents a roadmap of what can be known about the object believed to exist and may be socially constructed (Peters, Pressey et al., 2013). The two forms of research philosophy basically formulate two types of research questions: the 'why' and the 'what'. Research methodology thereafter provides strategies that enable the researcher to gain a better understanding of the object or issues

they imagine to exist in a phenomenon. It can thus be concluded that in essence, ontology grounds epistemology in research. This in turn grounds the methodology of the study. Methodology provides the methods or techniques used for an investigation (Mingers, 2001).

3.2.1 Ontological perspective

The previous section related the importance of a philosophical paradigm in an investigation; this sub-section examines the ontological perspective of a study. Ontology is perceived as the origin of an investigation and therefore is focused on the conceptualisation of research knowledge (Gruber, 1993). It has been referred to as the study of 'being' by scholars such as Crotty (1998) and Grix (2004). Providing an elaborate description of the concept of ontology, Tolk (2013) posits that apart from being known as the study of being, ontology provides several perspectives that the world of science holds, including the view that ontological assumptions relate to what constitutes reality. It is essential therefore for a researcher to take an appropriate stance that is aligned with the primary issues under investigation. This is with regard to their own perceptions of how things are and how they really work. In the current study the ontological assumptions relates to the realities of public healthcare service delivery in resource-constrained environments as well as the implementation of HIS to facilitate that process. Through the ontological stance of an investigation, a researcher seeks to answer the question: What is the truth? Ontology therefore explains perspectives of the nature of reality, based on the phenomenon under investigation (Blaikie, 2004; Saunders et al., 2009; Easton, 2010).

Ontology is classified into two categories that influence the stance of a researcher: realism and relativism (Wahyuni, 2012). These two categories have differing claims or assumptions about the existence of reality – either objective or subjective (Searle, 1996). For realists, reality is stable and may be observed and described from an objective perspective (Levin, 1988). Meaning, that the realist ontology relates to a single reality that is independent of social actors and their interpretation of the situation (Saunders et al., 2009). Realist claims align with the way natural scientists and empiricists approach knowledge (Uddin & Hamiduzzaman, 2009). Relativist ontology on the other hand view reality as dependent on social actors, and therefore social phenomena exist as a result of their influence (Wahyuni, 2012). Reality to relativists is socially constructed within the mind of social actors and as such, no one 'true' reality exists because the actors responsible for creating reality by characterising concepts (Gruber, 1993; Krauss, 2005).

The relativist stance of ontology classification fits the context of this study, meaning no one 'true' reality exists in the healthcare service delivery process work activity system in public hospitals. Relativist ontology was therefore chosen as the underpinning approach. The

focal point of this stance is the presence of entities, causal powers, generative mechanisms, and deep structures in reality. It is from this standpoint that the study approaches the investigative issues.

A discussion on the epistemology philosophical stance follows.

3.2.2 Epistemological perspective

As noted, the ontological stance of an investigation grounds the epistemological assumptions. The assumptions of this perspective are formulated on the beliefs of individuals about knowledge of what exists (Creswell et al., 2003; Krauss, 2005; Wahyuni, 2012). In short, epistemology is simply the theory of knowledge, and its assumptions are all about how knowledge in a given phenomenon is created, acquired and communicated. Essentially, epistemology probes the question: “What is the nature of the relationship between the would-be knower and what can be known?” (Guba & Lincoln, 1994:108). The ontological assumptions of an investigation are supported by its epistemological stance that provides a roadmap for the best possible options for investigating reality. The study deduces that epistemology is crucial in an investigation as it informs how a researcher frames their study in their attempt to discover knowledge. This can be from a subjective or objective stance (Bhattacherjee, 2012). From an objectivist standpoint, the most appropriate way to view reality is by carrying out an objective empirical study while drawing from realist ontology. From a subjectivist standpoint, meaning is derived from the context subjectively while interpreting the way in which to study a social reality.

Researchers who hold an objectivist stance believe that social entities exist only externally to the reality of social actors. Contrary to these views, researchers who hold a subjectivist stance argue that the perceptions and actions of social actors result in a social phenomenon (Saunders et al., 2009). Building on these understandings, the study deduces that the manner in which knowledge is acquired from an epistemological stance can be classified into two categories: empiricism and rationalism. Empiricists believe that the only reality that exists is that which comes from social actors’ sensory experience. On the other hand, rationalism involves human moral reasoning (Hirschheim, 1992; Neuman, 2011). The study acknowledges the existence of other philosophical assumptions; however, it focuses on the underlying epistemological assumptions commonly applied in the IS field. Examples of these include positivism, interpretivism, and critical realism (Orlikowski & Baroudi, 1991). The discussion below begins with an overview of the concept of research paradigms before presenting an in-depth discussion of the critical realism philosophical paradigm which underpins this study.

3.3 Research Paradigms

The choice of a research paradigm is dependent on a researcher's alignment of both the ontological and epistemological assumptions. In addition to this, the choice of paradigm should underpin the study, as this directly informs the choice of research questions, methodology and intentions. In the following section, both positivism and interpretivism are outlined, with reasons for their rejection as underpinning philosophies.

3.3.1 Positivist paradigm

The underpinnings of the assumptions in this paradigm are based on the views of the French philosopher, Auguste Comte (1798–1857), on social reality. Comte (1975) argued that human behaviour is best studied by observation and reasoning. This view dismisses the concept of subjectivity in the method of enquiry, and instead accommodates an objective mode of enquiry (Burke, 2007). The researcher's interpretation of this assumption is that positivists contend that reality is objective, and as such, stable. This can therefore be observed and described without influence from individuals' opinions or feelings (Levin, 1988). It is evident that positivists believe that only facts that are observable, verifiable and objective should be considered in the attempt to gain an understanding of natural and social phenomena (Bezuidenhout et al., 2014). The ontology in the positivist paradigm assumes that social reality is objective and therefore measurable, using properties that are independent of a researcher's views and methods of enquiry. Positivists believe that scientific knowledge consists of facts only, and their ontological stance is that reality is independent of any kind of social construction (Walsham, 1995). Scholars who adopt this philosophical stance mostly employ formulated hypotheses and theory testing that focus on enabling generalisations and predictions (Myers, 1997; Klein & Myers, 1999).

Positivists frequently favour only one perspective of enquiry in a quest to understand the dynamics of a social context, such as healthcare in this case. In social contexts, other paradigms require more than just deductive reasoning to gain an in-depth understanding. It is for this reason that the study does not consider this philosophical paradigm as an underpinning approach. To be able to explore the social context of healthcare service delivery adequately, subjective insight into the sociotechnical context of interventions such as technology in public healthcare settings is vital.

3.3.2 Interpretivist paradigm

Built on the shortcomings and limitations of the positivist paradigm, especially in its application to the social sciences, interpretivism stresses the fundamental differences between people and objects (Bezuidenhout et al., 2014). This standpoint accommodates

the complexities of how human beings make sense of a particular situation (Kaplan & Maxwell, 1994). Interpretivists believe that the mode of enquiry between human beings in their natural environment differs from that of objects (Burke, 2007). Simply put, the circumstances surrounding human beings change at all times and are influenced by the environment. Thus, interpretivists believe reality is constructed by subjective perceptions and meanings are therefore socially constructed. Positivists understand a phenomenon subjectively by observing human activity empirically (Saunders et al., 2009). The emphasis is on the researcher's interpretation of the phenomena as experienced by human beings (Orlikowski & Boroundi, 1991). Unlike positivists, whose sole purpose is to explain causal relationships between two or more objects, interpretivists wish to understand the behaviour of humans in a social context (Bezuidenhout et al., 2014).

Ontologically, both positivists and interpretivists hold similar assumptions; however, differences emerge in their epistemological assumptions, where positivists claim that knowledge is objective and achievable, while interpretivists claim that knowledge is subjective, dependent on individuals, social context and the researcher's interpretation (Niehaves & Stahl, 2006). Scholars like Burrell and Morgan (1979) and Neuman (2011) argue that studies under this paradigm focus on how individuals in a social context create and communicate their knowledge. This means that interpretivists assume that the social world is what individuals perceive it to be. As a result, generalisation of findings is never the goal (Neuman, 2011). Although the context of this study may have fitted the assumptions of the interpretivist paradigm, the aims and objectives of this study required more than just the researcher's interpretation of the individual realities of public healthcare service delivery and HIS implementation in healthcare facilities in resource-constrained environments. In addition, a weakness of the interpretivism paradigm is its tendency to subvert the differences that exist between the essence and appearance of reality. As such, interpretivists in some instances misconstrue the possibilities of false consciousness. The paradigm is also faulty in its understanding of agents in a particular setting.

In both of these philosophical paradigms, there is a general tendency by their advocates to minimise the weight of statements about a reality to just mere statements about human knowledge about the reality. This, Bhaskar (1978), the founder of critical realism, believes is an 'epistemic fallacy'. In addition to the epistemic fallacy, Smith (2005) and Fletcher (2017) posit that positivists and interpretivists often assume that what exists is only what is experienced and observed in a social context. However, Bhaskar (1978) argued that one should look beyond what is experienced and observed in order to gain complete understanding of a social context. It is on the basis of these arguments that the critical realist philosophical paradigm is adopted in this study.

3.3.3 Critical realist paradigm

This sub-section discusses the main tenets of critical realism that distinguish it from the other two paradigms. The section also highlights how the aims and objectives of this study fit into the context of the paradigm. The application of this paradigm displays its ontological realism that is intertwined with its epistemological relativism. The paradigm's methodology, which is iterative and pluralist, and its reflexive and emancipatory values are discussed. The combination of these attributes makes this paradigm more suited to understanding and explaining the context-based conditions under which interventions such as healthcare information systems are implemented in healthcare contexts. These context-based conditions have the ability to produce desired or undesired outcomes in work activity systems such as healthcare service delivery process (Dobson et al., 2007; Carlsson, 2012). For example, the researcher adopted the critical realist paradigm to obtain greater understanding of the context-based conditions under which HIS implementation and use have desired or undesired effects in the public healthcare service delivery process. The paradigm allowed the researcher not only to look at individual experiences and observations, but also to interrogate the underlying causes of those outcomes.

Within the IS field, the tenets of critical realism not only mediate between interpretivist assumptions, but those of positivists as well (Mutch, 2002; Mingers, 2004; Carlsson, 2012). This positions the critical realist paradigm at the vanguard of the IS research domain as it enables researchers to capture the complexities of the real world holistically by advocating the use of multi-pluralistic techniques. In this study, multi-pluralistic techniques were employed to gain an understanding of the reasoning behind the failure of the current HIS implementations in facilitating public healthcare service delivery. In doing this, the study ascertained the context-based conditions that enable or inhibit both the implementation of HIS and healthcare service delivery in public healthcare facilities in resource-constrained environments. The implication of this is the inability of the healthcare system to improve the quality of the healthcare services that the majority of the population depends on. It is the ability of critical realism to systematically confront the concerns of the other discussed paradigms, such as the differences between the natural and social sciences, that make it particularly attractive to scholars within the IS field.

Bhaskar (1978) proclaims that the philosophy of reality starts with the theory of being, which according to him differs from the theory of knowledge. Essentially, he suggests that the theory of being is basically ontological, while the theory of knowledge is epistemological. Bhaskar notes further that critical realism is threefold: a combination of transcendental realism and critical naturalism – an attempt to unite social and natural sciences; the second

element centres on dialectical critical realism, and in the third, the central focus is on spirituality, which the author terms 'meta-reality' (Bhaskar, 2008). The arguments premised in this study are formulated mainly with the first element of critical realism. The next sub-section explores critical realist concepts that are fundamental to the objectives of the issues of the current study.

3.3.3.1 The ontology of critical realism

The ontology of critical realism is based on two assumptions: that an independent reality exists that incorporates different dimensions and domains, and one of a stratified ontology. In the first assumption, the world is perceived to have two dimensions: transitive and intransitive (Bhaskar, 1986). Bhaskar refers to these two dimensions of knowledge as the transitive and the intransitive respectively. The transitive refers to the dimension of the social in the production of knowledge, such as inherited discourses, scientific training, institutions, and so on. By contrast, the intransitive refers to the domain of being that would exist regardless of whether or not humans know of them (Bryant, 2011). To understand the two forms of knowledge, it is important to unpack the different ways in which individuals think in both the social and natural contexts. In the next section, the study explores the common modes of thinking in IS social research.

3.3.3.1.1 Modes of inference (thinking)

There are four identified mode of inference in social sciences research: deduction, induction, abduction, and retroduction. Each of these modes of thinking represents a different logic that can be employed in an investigation to create knowledge about the reality of a phenomenon (Danermark et al., 2002; Chiasson & Davidson, 2005). Although the four modes of inference complement one another, there are clear distinctions. In employing the abduction mode of inference, researchers are able to interpret and contextualise the issues under investigation with a theory in order to understand the phenomenon in a different perspective (Danermark et al., 2002). In the retroduction mode of inference, researchers employ counterfactual ways of thinking. The researcher's interpretation of this is that the retroduction mode of inference is intended to be a deliberate and recursive process that goes beyond what is done in the abduction mode of inference. In the retroductive mode of inference, events are explained through the identification and hypothesis of causal powers and mechanisms that are capable of producing them (Bhaskar, 1978; Sayer, 1992). Pawson and Tilley (1997) postulate that researchers engage in an iterative process where the elimination of hypotheses occurs by engaging participants in a dialogue that originates from the context of investigation which culminates in the development of new knowledge. In the IS field, and specifically in the critical realism research paradigm, scholars like

Williams and Karahanna (2013) have employed the retroduction and abduction approaches. Similarly, Ngwenyama and Nielsen (2014) employed abduction; however, in non-realist research.

Abduction inference strategy

Critical realism posits that in the application of this mode of inference, researchers pose questions that relate to the existence of objects. Sayer (1992:91) provides such questions that researchers are tasked to ask: "What does the existence of an object presuppose? Can it exist on its own as such? If not, what else must be present? What is it about the object that makes it do such?" Abduction as an inference mode of thinking requires the application of theoretical redistribution, abstraction and the careful conceptualisation of the issues under investigation in a social phenomenon (Sayer, 1992; Danermark et al., 2002). Within the context of this study, it would mean the researcher posing questions such as: What does the implementation of HIS and its use in public healthcare facilities to facilitate healthcare service delivery presuppose? Can the implementation of HIS exist independent of the healthcare system context? If that is not the case, then what are the structures and mechanisms that must be present for it to be actualised successfully? Another question would be: What is it about the implementation process of HIS that makes it conducive to facilitating healthcare service delivery? Once these questions are posed in the researcher's mind during the investigation process, then the main objectives of the investigation may be addressed. In summary, Sayer (2000:16) says that these questions help the researcher to distinguish between "what *can* be the case, from what *must* be the case, given certain preconditions".

In the abduction inference strategy, researchers are expected to re-contextualise the actual events by employing theories to formulate hypothetical models about structures and relations at play (Danermark et al., 2002). This, Bhaskar (1986) and Peacock (2000) argue is achieved by employing a theory with significant explanatory power and matching its constructs against empirical data. Bygstad and Munkvold (2011) further reiterate that the act of theoretical matching against empirical evidence increases the awareness and understanding of the actual events. Moreover, theoretical redescription involves the interpretation and explanation of the concepts of a theory and their relations. Eastwood et al. (2014) suggest that such interpretations of theory should result in the elaboration of the theory, once it is compared and integrated. In this study, ActAD model is employed as a theoretical framework and its constructs (actors, motives, goal, tools, rules, etc.) are matched against empirical data in order to gain an in-depth understanding of the actual events in the public healthcare service delivery process in South Africa.

Retroduction inference strategy

In critical realist ontology, retroduction as a mode of inference involves analysing the reasons why things happen, including why empirical data appear in the manner that they do. Retroduction is proposed by scholars who are advocates of realism, like Lawson (1994) and Sayer (1992), as an alternative to the conundrum that the deduction and induction approaches suffer from. Both of these modes of inferences tend to rely solely on the iterative observations of empirical events that may produce insufficient data about the real causes of social events. Easton (2010:123) describes the process of retroduction as "moving backwards", starting from events that are observable and have been re-contextualised through the abduction process to identify and characterise the causal mechanisms. From another perspective, Mingers et al. *(*2013) suggest that retroduction involves the act of going from the observed events to hypothesising the underlying mechanisms responsible for the events that occur. In Figure **3-2 ,** the bold arrows depict the act of moving backwards from the domain of the empirical that has observable events, to the domain of reality that unearths the mechanisms in their situated contexts.

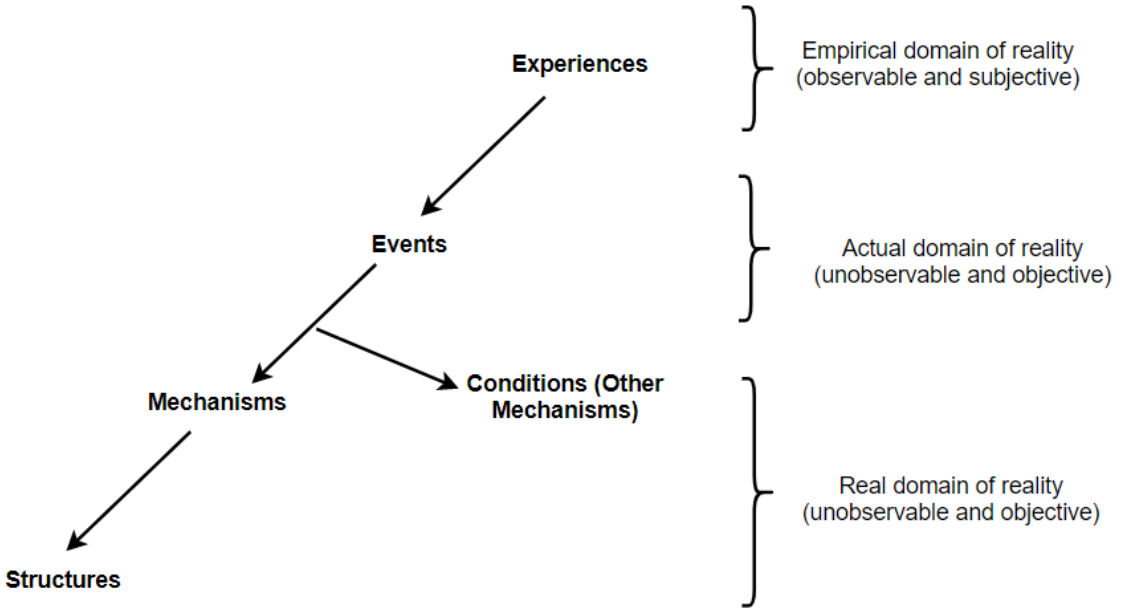

Figure 3-2: Three domains of reality and retroduction logic (adapted from Sayer, 2000:15)

Essentially, the key aspect of the retroduction approach is that it requires researchers not only to focus on the description of empirical experiences, but also to explore unexplained causal powers and mechanisms in the domain of reality that makes a phenomenon possible (Volkoff et al., 2007; Zachariadis et al., 2013). For critical realists, the retroduction process that critical realism entails, possesses two features: a clarification of the events in focus from empirical observations, and (ii) a hypothesis of the causal powers, mechanisms and

their underlying structures that emerge subject to direct observation. The argument is that this gives the critical realist ontology the depth required in the understanding of why things differ as well as how things may have been different. Lawson (1994:116) sums up these two features by providing an analogy of the retroduction mode of inference:

> "If deduction is illustrated by the move from the general claim that 'all ravens are black' to the particular inference that next one seen will be black, and induction by the move from the particular observation of numerous black ravens to the general claim that 'all ravens are black' retroduction ... reasoning is indicated by a move from the observation of numerous black ravens to a theory of a mechanism intrinsic (and perhaps also extrinsic) to ravens which disposes them to be black."

Realists believe that the concepts of critical realism do not align with the views that deductive or inductive modes of thinking are sufficient to generate a robust knowledge of explanations. Sayer (2000) posits that effects of generative mechanisms have nothing to do with the occurrence of their observations or how many times they have been conceptualised. The methodology of critical realism requires that researchers go beyond empirical facts (i.e., transfactual), which is counterfactual (Chaiasson, 2005; Danermark et al., 2002). When researchers engage in the retroductive process, the unpredicted relations are filtered from the important relations that may exist among objects and events they generate. Sayer (1992:88) stresses the importance of going through such a filtration, stating that "[n]either objects nor their relations are given to us transparently; their identification is an achievement and must be worked for". Both abductive and retroductive modes of thinking have similar traits (Blaike, 2007). Bhaskar (1986) advocates that the two be applied in combination. Bhaskar's views are a consequence of the bias that exists in social actors' interpretations of their actions in unearthing motives behind their experiences.

Based on the discussions in this section, the study concludes that the process of retroduction is a unique method of analysis that allows an investigation to ascertain the conditions that necessitate the occurrence of something. Sayer (1992:104) notes: "To ask for the cause of something is to ask what 'makes it happen', what 'produces', 'generates', 'creates' or 'determines' it, or … what 'enables' or 'leads to' it." The study also summarises that to be able to proclaim that a certain mechanism is the actual cause of an outcome methodologically, it is fundamental that a researcher describe and specify the causal powers and liabilities possessed by the mechanism. Danermark et al. (2002) note that mechanisms have powers which may or may not be triggered. As such, even if these causal powers are exercised, they may not necessarily manifest in the empirical domain (observed events). This is due to other counterbalancing powers of other generative mechanisms.

Mechanisms can also at times possess liabilities (Easton, 2010). As such, the liabilities are often susceptible to performing an action or set of actions.

Inductive and deductive approaches are the most commonly applied modes of inference in the field of IS research. The inductive approach, also commonly referred to as bottom-up reasoning, is where the premise of an investigation supports the conclusion. In the deductive approach, reasoning becomes a basic form of valid reasoning, that is, deductive reasoning begins with a hypothesis, thereafter a researcher finds a plausible, logical conclusion. In this study, the researcher draws on the works of Mingers (2004), Easton (2010), and Mingers et al. (2013) and employs a strategy that combines two modes of inferences (abductive and retroductive) in an attempt to address the issues under investigation. Mingers (2011) suggests that the combination of the two modes of thinking, which employs systematic thought patterns, produces an empowering element of lenses of reasoning that enables the researcher to extend beyond the observable and experiences of users. This was the intention of this study, where the researcher went beyond the observable outcomes of the implementation and use of HIS in healthcare-service delivery, and identified and understood the underlying causal mechanisms and their effects on the work activity system. Mingers (2004:95) notes that for critical realists to reveal mechanisms, they have to go “from experiences in the empirical domain to possible structures and mechanisms in the real domain”.

In the second set of the critical realism ontological assumption, Bhaskar (1986) discusses the concept of a stratified ontology. The three-level ontology includes the domain of reality, actual and real, as depicted in Figure **3-3**. In the diagram, the elements of a stratified ontology comprise the structures and their relations, mechanisms, events, experiences and open systems. The concept of a stratified ontology implies that what is observed and experienced can be at times be false.

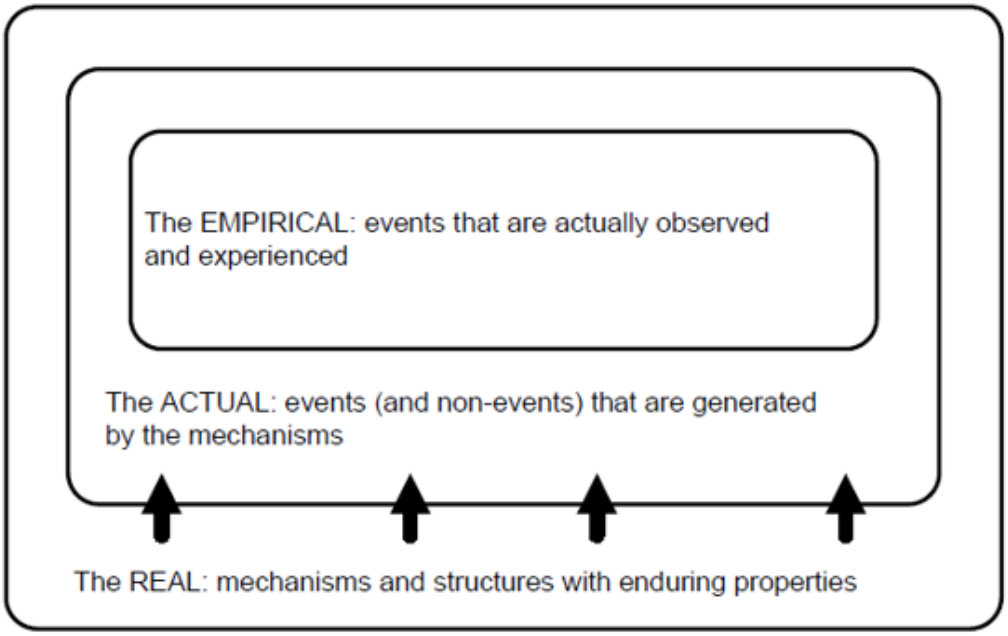

Figure 3-3: Stratified three domains of reality (Mingers, 2004:94)

Based on the three overlapping domains, the empirical domain is where events that humans experience and observe are generated (Carlsson, 2004). In this domain, the subjective nature of understanding things in the social world manifests and is a subset of the actual domain. The actual domain therefore comprises all the events that are occur, whether they are experienced or not. Advocates of stratified ontology believe the events that occur in the actual domain are shaped by the context in which they occur, and therefore different observers of the events will often have differing accounts of the occurrence (Dobson, 2001). The actual domain then is a subset of the real domain where actual events reside. These events are viewed as "specific happenings resulting from causal mechanisms being enacted in some social and physical structure within a particular … context" (Williams & Karahanna, 2013:939). The events in the real domain occur whether they are observed or not by individuals in a social context. In the real domain, realists go beyond what happens in the actual and empirical to determine the causal mechanisms that may have produced the observed events. This is what sets critical realists apart from positivists and interpretivists, whose main focus is on events that take place in the empirical domain.

It is therefore clear from a realist perspective that events that occur in the actual domain reflect the changes that occur when the causal powers and their relations are activated in the real domain (Mingers, 2004; Mingers et al., 2013). As such, the three domains create an overlapping structure of events as depicted in Figure 3-3. What attracts the researcher to this paradigm is the emphasis on understanding the connection among the three domains and the deeper dimensions of realities in a social environment. Realists believe that such

understanding creates a space where researchers can give causal-based explanations of mechanisms, structures and the relations they possess in the environment they reside in that explain the causes of events observed and experienced. Sayer (1992:104) states: “To ask for the cause of something is to ask what ‘makes it happen’, what ‘produces’, ‘generates’, ‘creates’ or ‘determines’ it, or, more weakly, what ‘enables’ or ‘leads to’ it.” The author further mentions that the real domain houses generative causations that can be categorised into four entities of reality. These include the ideal reality, the artefactual reality, the material reality, and the social reality. Thus, the *real domain* incorporates both the empirical and the actual, and also contains the underlying objects and structures. This domain includes generative mechanisms, referred to as “causal structures that generate observable events” (Henfridsson & Bygstad, 2013:911) that exist independently of social actors but are capable of creating patterns of events. Realists contend the mechanisms are intransitive in nature as they have objective reality independent of human thoughts or beliefs.

3.3.3.1.2 Structures

Critical realists believe that unobservable structures cause observable events and that the social world is better understood when researchers first understand the social structures that generate those events. Structures are defined by Sayer (1992:92) as “set[s] of internally related objects or practices”. Danermark et al. (2002:47) further add that structures “constitute the real entities we seek to investigate in a specific contextual situation”. Thus, Kemp and Holmwood (2003) posit that structures have causal powers that influence events in a social world. What this suggests is although social structures may be real, they may not be made actual at the level of events. These structures also exist independently of social actors; however, in specific cases, structures are dependent on social actors’ activities. As social actors continuously perform these activities, the structures are transformed (Archer, 1995; Mingers, 2004; Fleetwood, 2005). In the IS field, material structures are also considered social because they are formed by human activities (Leonardi & Barley, 2008).

Fleetwood (2005) argues that because social structures are not independent of the agencies that form them, they cannot be directly observed. Wynn and Williams (2012) suggest that although not observable, social structures’ symbolic artefacts reveal themselves to researchers. For example, a healthcare system as a social structure in a country may not be directly observed, but the activities and experiences within it reveal it as a structure. Drawing on Bhaskar (1986), critical realists perceive that knowledge about social structures resides in the transitive dimension (i.e. individuals’ subjective and

dependent view of knowledge). Thus, knowledge in the transitive dimension is mediated by our individual or collective experiences, beliefs, and values, and by existing theory and other social structures. As such, their relations may influence a social structure such as the healthcare system, depending on certain mechanisms and circumstances (Bhaskar, 2008; Wynn & Williams, 2012).

3.3.3.1.3 Causal mechanisms

As previously mentioned, an important aspect in the ontology of critical realism is the identification of causal mechanisms. For that reason, it is important to understand what exactly causal mechanisms are. There are several definitions of causal mechanisms in the field of social sciences. For example, Sayer (2000) describes causal mechanisms as explanations of the varied conditions, structures and other mechanisms that form relations which produce events in the actual and the empirical domains. A similar description of causal mechanisms is given by Fleetwood (2005), who refers to them as entities that emerge from the relations formed by social, ideations or psychological structures. Drawing on these two definitions, the study concludes that causal mechanisms pose causal powers as a result of the ever-changing state of the interactions that produce outcomes. Realists posit that the mechanisms last longer than the events they generate. The causal mechanisms either implicitly or explicitly manifest themselves in a setting, for example, the innovation of IS (Carlsson, 2003).

In the context of this study, the researcher believes that the manifestation of causal mechanisms exists in the implementation and use of healthcare information systems to facilitate the healthcare service delivery process. The effects of these mechanisms are observed and experienced in the outcomes (desired or undesired) of healthcare service delivery. Figure **3-4** depicts critical realists' views of the interactions between the structures that have mechanisms. These mechanisms have causal powers that generate events.

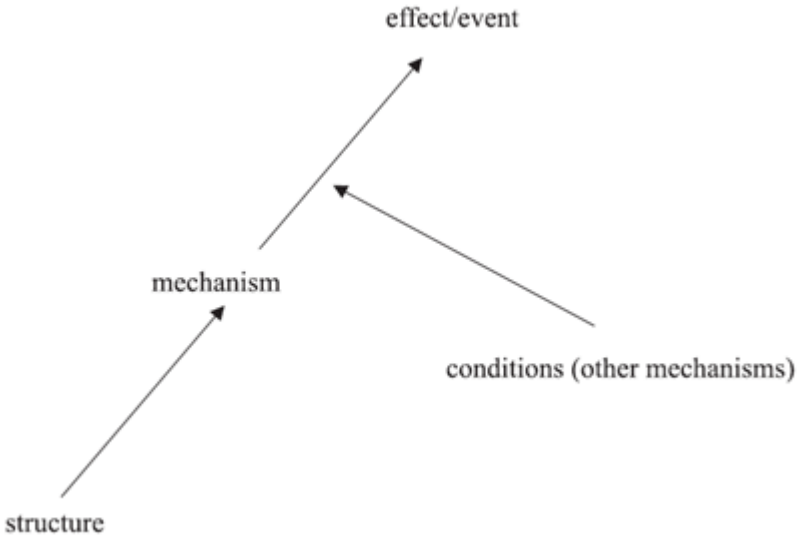

Figure 3-4: Critical realist view of mechanisms (Sayer, 2000:15)

Events may or may not be generated, should mechanisms be exercised and actualised. Collier (1994:62) states that “a generative mechanism can be argued as that aspect of the structure by virtue of which it has a certain power”. Power in this context is seen as the things that an entity possesses by virtue of its nature. These powers will exist whether they are actualised or not. The unique characteristics of causal mechanisms are reactive to the contexts, and as such, generate causal effects because of the interactions they share with other features in a social environment. Arguments by scholars, including Mingers (2004), and Wong et al. (2013), are that the effects produced by the powers are not intrinsic to any other mechanisms. Based on these arguments, realists believe that mechanisms can be employed in the development of mid-range theories used to explain the events that occur in a social environment. However, these theories provide fallible accounts of what and why events occur as they occur. In summation, Astbury and Leeuw (2010:368) postulate that in order to gain an understanding of the interrelations between contexts and the outcomes that are produced within them, the concept of generative mechanisms must be employed. Astbury and Leeuw (2010:368) describe generative mechanisms as “underlying entities, processes, or structures which operate in particular contexts to generate outcomes of interest”.

Since mechanisms may be observed or not (Fleetwood, 2011), there is the possibility of more than one mechanism being responsible for a single outcome. It is from this notion that critical realists apply judgemental thinking to select a plausible explanation. Unobservable mechanisms can be explained or described using theory (Fleetwood, 2002). Bhaskar (2008) suggests that causal powers can only be known but not shown. A good example and analogy in the field of social science is that the material objects of information systems

are not observable to users; however, by employing design theories, their characteristics manifest, enabling these features to be known (Hanseth & Lyytinen, 2004; Leonardi, 2011). It is based on this that software designers and developers provide explanation to codes around the properties for their intended purposes (Polites & Karahanna, 2013).

3.3.3.1.4 Events

In critical realism, events are deemed essential, with Williams and Karahanna (2013:939) describing them as "specific happenings resulting from causal mechanisms being enacted in some social and physical structure within a particular organization context". In the context of this study, events can translate to non-use or use of technology interventions for the purpose of delivering healthcare services in hospitals. Overall mechanisms are causal powers that explain the relation of experiences and observed events in a social context (Bygstad et al., 2016). Sayer (2000:14) notes that the explanation of events depends on "identifying causal mechanisms and how they work, and discovering if they have been activated and under what conditions". For instance, in the context of this study, the healthcare system is taken as a social structure that has causal powers that generate one or more mechanisms in the delivery of healthcare services. The demand for improved quality healthcare services is a condition that may lead to the adoption and implementation of HIS as a tool to improve the quality of healthcare services.

Within the context of this study, and drawing on the concept of Bhaskar's (2008) stratified ontology, the implementation of HIS in public healthcare settings is viewed as a result of the enactment of certain causal mechanisms. The causal mechanisms in this instance maybe the demand of a more integrated healthcare system that triggers the implementation of technology interventions. Bhaskar (2008) argues that the events in question are ontologically distinct from the structures and generative mechanisms that produce them. The study deduces that events produced in structures are a representation of the effects that causal mechanisms generate when there is an interaction, as such, events can be described by employing certain conditions.

3.3.3.2 The epistemology of critical realism

Epistemology, as discussed earlier, is the branch of philosophy concerning the theory of knowledge, and thus the epistemology of critical realism proposes that knowledge is firstly derived from observations, and secondly from the regularity of events. For critical realists, the social world is more than just written or spoken communication, and its understanding should not be combined with its construction. Fleetwood (2005) posits that there is some sort of independency for socially produced entities such as theories and concepts. Similarly, Sayer (2004:19) contends that "to acknowledge that most social phenomena are concept-

dependent is not to imply as in idealist fashion, that they are dependent on concepts alone, for it takes more than just thinking to produce social institutions and practices."

Advocates of the critical realism paradigm such as Bhaskar (1998) suggest that epistemology in critical realism has two dimensions: transitive and intransitive. Bhaskar argues that the intransitive dimension of knowledge is the realm of real things (mechanism and structures) that are scientifically considered as causal efficacious. There would not be researchable or observable outcomes without the transitive dimension. As such, social theories and the construction of knowledge occur in the transitive dimension of the epistemology of critical realism. Critical realists believe that ignoring the intransitive domain results in the 'epistemic fallacy' which other paradigms seem to suffer from (Bhaskar, 2008). Critical realists believe that epistemic fallacy leads to the dissolution of the ontological stance of a study. Moreover, realists suggest that epistemic fallacy in most cases is accompanied by what they refer to as 'ontic fallacy', which Bhaskar (1998) refers to as the act of researchers denying the existence of the social aspects of knowledge, and thus disregarding the fact that knowledge is a social product. The consequences of this is that knowledge can be perceived to be fallible, which may not necessarily be true, because some knowledge is close to the truth. Thus, Sayer (2004) posits that critical realism is a paradigm that tries to avoid foundationalism. This means that in the epistemology of critical realism, some beliefs can be justifiably held by inferring to other beliefs which themselves are justified directly.

Because of the existence of the two dimensions of knowledge, Bhaskar (2008) argues for the position of a two-phased ontological realism and an epistemological relativism. In critical realism, other core concepts of epistemology exist, such as the logic of scientific enquiry, un-observability of mechanisms, and the abduction and retroduction inference approaches.

3.3.3.3 Critical realist methodology

This section discusses the application of a critical realist methodology and its use in IS and how it was applied in this study. Critical realists perceive that the purpose of an investigation and "therefore the application of methodology is the theorising of explanations for 'tendencies' in the phenomena that have been observed or experienced" (Haigh et al., 2019). The focal point of these explanations of the tendencies are the mechanisms that can generate events as well as the properties of entities that provide them with such mechanisms. A critical realist methodology, Bygstad and Munkvold (2011) suggest, seeks to find mechanisms and structures for hypotheses of how events experienced may be explained. Realists believe that the three overlapping layers of the stratified ontology

provide an opportunity for understanding the phenomenon under investigation as much as possible.

Mingers (2006) posits that the core tenet of a critical realist methodology is that science is concerned with explanations, understanding, and interpretation, rather than with predictive ability, universal laws or simple descriptions of meanings and beliefs. Zachariadis et al. (2013) suggest that the methodology of critical realism depends on methodological multifariousness as well as pluralism. This is as a result of the presuppositions of the realist ontological and constructivist epistemology. Realists thus advocate for an argumentation approach to research in social sciences which gives a researcher an open choice of methodology (Lopez & Potter, 2001). Easton (2010:123) suggests that researchers who want to adopt a critical realist methodology ask, "What caused the events associated with the phenomenon to occur?" To address such a question, scholars like Bygstad and Munkvold (2011), Wynn and Williams (2012), Danermark et al. (2002) and Fletcher (2017) suggest the use of a stepwise framework for data analysis.

There are several frameworks within the critical realist methodology that may be used to guide the process of investigating observable events. These include: (i) Archer's (1995) morphogenetic approach; (ii) the Transformational Model of Social Activity (TMSA) of Bhaskar (1979); (iii) Layder's (1993) Research Map; (iv) Jessop's (2005) strategic relational approach (SRA); (v) the realistic evaluation framework by Pawson and Tilley (1997), Bygstad and Munkvold's (2011) six-stepwise framework; and (vi) the six-stage explanatory framework of Danermark et al. (2002). Although there are similarities in all the noted frameworks, the researcher's bias substantiated the choice of Bygstad and Munkvold's (2011) stepwise framework for data analysis. The framework and its application are discussed below.

The six-step methodology

In their framework, Bygstad and Munkvold (2011) suggest that the process in a realist-based methodology begins with a description of the events in the phenomenon under investigation. In this process, events are identified which then become objects of enquiry throughout the investigation. In this study, the description of the events in the issues under investigation highlights the healthcare service delivery process as well as the implementation of healthcare information systems in public healthcare facilities as the objects of enquiry. The outcome of these events takes place in the domains of the actual and empirical. However, the events that are experienced and observed can only be described in the domain of the empirical. These events, based on critical realism, happen in the actual and empirical domains; however, the events experienced or observed can only

be described in the empirical domain. In the actual, events happen whether experienced or not. In the study, the description of events involved understanding the context of the phenomena and identifying social structures and conditions that trigger those events. This is presented in Chapter 6 of the study.

The second step in the framework involves the identification of objects and relations that characterise the phenomenon under investigation and the collection of data about the objects (Easton, 2010). Essential objects here are people, organisations, and systems that form part of the structures (i.e., the interconnected objects that interact to produce some events) with causal powers. The application of this in the study involved identifying key stakeholders within the healthcare services delivery system and the implementation of HIS. This included healthcare practitioners (doctors, nurses, healthcare administrators) and the provincial Department of Health. The third step in the framework is the interpretation of the data (Easton, 2010), also known as the theoretical re-description (abduction) process (Bygstad & Munkvold, 2011). For this step, the study employs the ActAD framework, using constructs such as context-based mediating factors in the search for a theoretical understanding of the empirical case, which gives an in-depth perception of the events that occur.

The identification of mechanisms that explain events in the previous step (3) occurs in the fourth step, *retroduction,* which is a key epistemological process. Easton (2010:124) defines retroduction as “a meta-process, the outcome of which is the identification of mechanisms that explain what caused the events to occur”. Drawing on this framework, the retroduction process is categorised into two steps: (i) determining the interplay between the objects, and (ii) determining the micro-macro mechanisms. Essentially, once the description of events occurs and reveals the deeper structures, the next step requires that the researcher formulate a hypothesis of the mechanisms and conditions that may have generated the events. This is an iterative process that involves unearthing mechanisms from empirical data confirming it through the application of several theoretical lenses. The outcome of this retroduction process is analysed by using the employing forward chaining method in order to understand the intention or the backward chaining method to gain an understanding of the results (Bygstad & Munkvold, 2011).

In the fifth step, the outcomes of the retroduction process are presented and further used to decide if the explanations found are satisfactory or not (Easton, 2010). This done by categorising the mechanisms according to those most likely to have caused the events. Easton (2010:124) suggests judgmental rationality. “It means that we can publicly discuss our claim about reality as we think it is, and marshal better or worse arguments on behalf

of those claims". For example, in this study, reasons for unsatisfactory implementation and subsequent inadequate use of HIS are identified/determined. The study therefore looks for those mechanisms that led to the outcomes. This step prepares for step six, where a decision is made whether the mechanisms are satisfactory. The mechanisms, however, cannot be used for prediction of satisfactory HIS implementation and subsequent adequate use outcomes, but can rather be used as possible explanations for the '*how*' and '*why'* of the outcomes of HIS implementation and subsequent use to facilitate public healthcare services produce desirable outcomes and others do not in a given context.

3.3.3.4 Critical realism research in the IS field

In the field of IS, studies that have adopted the critical realism paradigm have increased exponentially in recent years. Literature shows that publications on critical realism in the IS field resort under five streams: (i) those studies that portray the critical realism paradigm in a subordinate role in the IS field. These types of studies, Hostettler (2010) suggests, are based on misunderstandings and are often conceptual, with a focus on how critical realism can be employed to overcome the inconsistencies in theory–practice and the epistemic fallacies of positivism and interpretivism. Examples of authors who have done research projects under these assumptions include Dobson (2001), Mutch (2002), Mingers (2004), Carlsson (2004, 2012), Smith (2006), and Mingers et al. (2013).

In the second stream (ii), there are those scholars who have adopted the morphogenetic approach of Archer (1995). Using this approach, scholars have discovered the vital role critical realism plays in aiding researchers gain a better understanding of the adoption and implementation of ICTs in an organisational context. This, Dobson et al. (2013) argue, is based on individual reflexivity and structure that explain the adoption decisions. There are other realists who follow Bhaskar's (1979) TMSA. This model is similar to Archer's morphogenetic approach. Faulkner and Runde (2013) adopt Bhaskar's TMSA to develop a systematic theory of nature. In the third stream (iii), scholars have adopted the realist evaluation framework of Pawson and Tilley (1997). The realist evaluation framework regards projects in the IS field as social interventions with the potential to effect change in society (Carlsson, 2012). Authors whose work has applied this approach include Oroviogoicoechea and Watson (2009), whose work involved the impact of user perceptions of IS on health practice; Hrastinski et al. (2010), whose work involved the design of synchronous electronic learning; and Tona and Carlsson (2013), whose work involved the emergent use of IS.

The researcher observes that most work done under this stream often sought to understand the 'why', 'who' and 'under what conditions' mechanisms cause the changes or events

under investigation in the IS field. In the fourth stream (iv), the Danermark et al. (2002) model is mostly applied explicitly or implicitly by researches. For example, Bygstad (2010) applied it in the identification of causal mechanisms for innovation in information infrastructures, while Henfridsson and Bygstad (2013) adopt it in the analysis of digital infrastructure evolution. Volkoff and Strong (2013) employed it in developing a mechanism-based theory of information technology associated with organisational change. Other examples of scholars employing this approach include Williams and Karahanna (2013), who in their study used the model of Danermark et al. (2002) to uncover mechanisms that generate effective governance of structures. Dobson et al. (2007) applied the model in their investigation into implementing automated performance management systems. Morton (2006) applied it in the analysis of the life cycle of the strategic planning of IS, and Fox (2009), on the other hand, investigated IS investment decisions using the model of Danermark et al. In the fifth stream of critical realism is emerging research on the implications of the methodology of critical realism research, specifically in the IS field. Authors such as Wynn and Williams (2012) developed principles to guide the process undertaken in a critical realism case study IS study. Zachariadis et al. (2013) investigated the effects of methodological critical realism in mixed-methods research.

3.3.3.5 Rationale for choosing critical realism

The key aspect of the critical realism paradigm is its ability to enable researchers to find the best possible explanations for social realities. CR does this through the engagement of existing albeit fallible theories about the reality under investigation. Based on a critical realist perspective, this study sought to understand and explain context-based events that are associated with the introduction of new interventions such as healthcare information systems in public healthcare facilities to facilitate healthcare service delivery. Drawing on arguments by Volkoff and Strong (2013), the study identified and characterised generative mechanisms that have causal powers to produce some sort of effect in the implementation of HIS in public healthcare facilities. The study acknowledges that the paradigm's aims are not to identify general laws that may predict outcomes in a specific social context, but rather to enable the identification of the underlying mechanisms inside social structures that may have produced certain phenomena such as those under investigation in this study. The study therefore takes the stance that methodologies that are derived from the critical realist paradigm, such as the ones discussed in Section 3.3.3.3, present a satisfactory lens that reveals social structures, conditions and generative mechanisms that may have generated the issues under investigation in this study.

The choice of critical realism as the underpinning explanatory philosophy was also guided by the main research question of the study which is: *Why is the existing HIS implementation not adequately facilitating public healthcare service delivery?* According to Smith (2006:200), the 'why' questions in an investigation presume a realist's ontological underpinning and therefore re-enforce the concepts of critical realism characterised as being "ontologically bold, but epistemologically cautious". This reiterates the fundamental importance of critical realism studies to put more emphasis on the contexts, experiences of individuals, and perceptions used in the inferring process of the causal mechanisms without refuting their existence (Smith, 2006; Syed et al., 2009). The study therefore adopts the critical realism philosophical research paradigm for its strong ontological underpinnings that advocate for the existence of a reality that is independent of researcher observations and at the same time is "accepting [of] the relativism of knowledge [that is] … socially and historically conditioned in the epistemological domain" (Mingers, 2014:16).

The study's conceptual framework in Figure **2-9** (Chapter 2) is aligned with the critical realist view and is synthesised from the literature review. The conceptual framework is integrated with the complementary ActAD model as an analytical lens that enhances the explanatory power of the theories used in the study to investigate the phenomenon (Miller & Tsang, 2010; Matthyssens et al., 2013). The paradigm enables the researcher to draw a clear distinction between an event such as the inadequate implementation of HIS to facilitate healthcare services and the underlying causal mechanisms that may have generated such an event. Further, critical realism enables the researcher to have greater in-depth exploration of these causal mechanisms by employing the retroductive inference approach. This allows the researcher to hypothesise these mechanisms using the explanatory or theoretical models adopted in this study. The argument is that should such mechanisms exist, they would explain the events identified. Scholars like Archer (1995) and Leonardi (2013) suggest that critical realism offers an analytical view of the interactions between the autonomous structures and agencies that can assist researchers in the understanding of how information system structures condition individual actions in the adoption and use of technology interventions. In return, researchers are also able to understand how those individual actions can transform social structures in a sociotechnical environment. These two perspectives are equally real in an ontological sense (Leonardi & Barley, 2008; Syed et al., 2009).

Building on this, Leonardi (2013) argues that data collection happens of both structures and agencies without mixing them. Scholars like Archer (1995) and Peters, Pressey et al. (2013) suggest that in this case, agency can be both human and non-human. In the human sense within a specific context, it is categorised into three: agent, actor, and person. The

study therefore deduces that the concept of human agency can capture an individual's identity as the one that experiences the phenomenon (in this case the use of HIS to facilitate healthcare service delivery). The actor in a social environment captures the participatory role that users play in a sociotechnical environment (Fischer & Herrmann, 2011). The expansive nature of critical realism epistemology enables researchers to be able to give thorough attention to social structures without losing the main focus of the individual actions, experiences and perceptions (Carlsson, 2012; Syed et al., 2009).

3.4 Summary of Chapter 3

This chapter gave an overview of research philosophical paradigms in the IS field, with critical realism as the chosen paradigm discussed in depth as the underpinning philosophy for this research. It deliberated why the existing implementation and use of HIS do not facilitate healthcare service provision in public healthcare facilities, focusing on those in resource-constrained environments. The next chapters (Chapters 4–8) present a six-step methodology, using the case of public healthcare hospitals within resource-constrained environments. The six-step methodology, beginning with a case description in Chapter 6, is drawn from 21 interviews conducted from March to July 2018.

4 CHAPTER 4 – RESEARCH METHODOLOGY

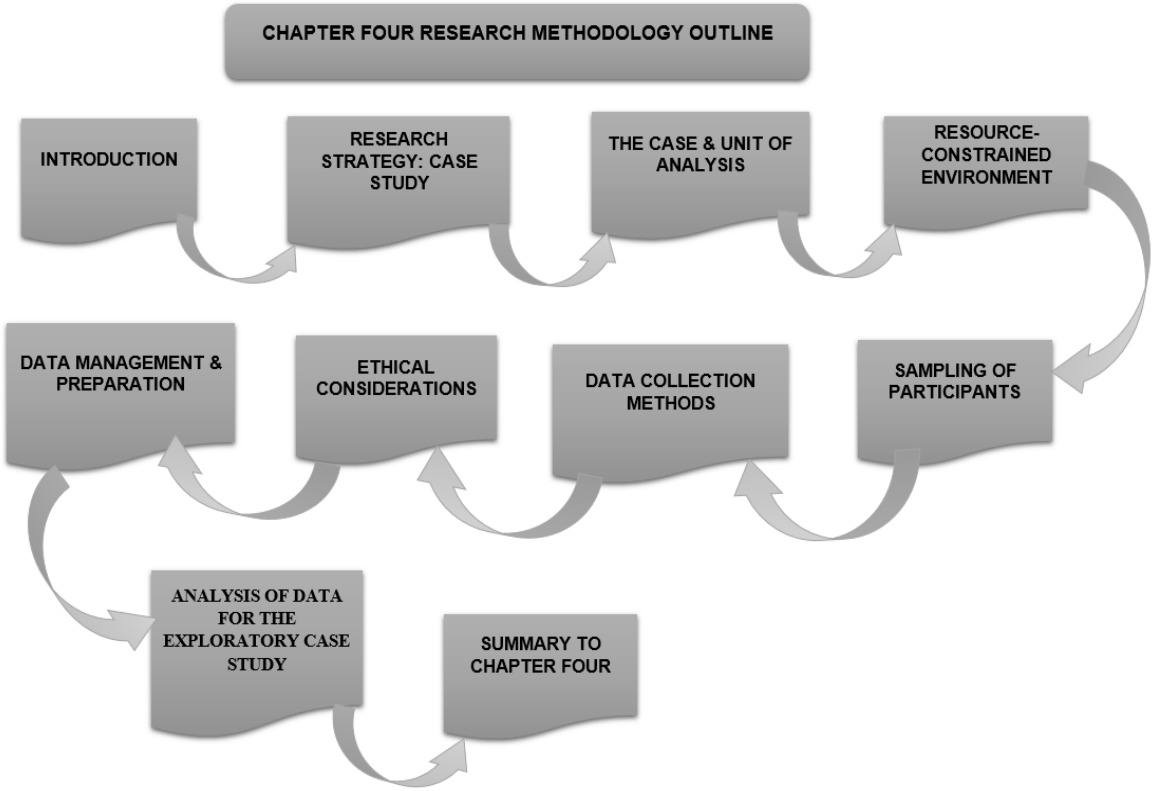

Figure 4-1: Chapter 4 outline

4.1 Introduction

Subsequent to the discussions on the philosophical underpinnings that ground this study in the previous chapter, the methodological approach adopted is presented in this chapter. The chapter is structured into ten sub-sections that include a discussion on the research strategy (single case study) adopted for the study in Section 4.2. In Section 4.3 a discussion on the empirical case and its context is provided. In Section 4.4, resource constraints and how the empirical case fits into that context are addressed. Section 4.5 outlines the sampling methods adopted. Section 4.6 discusses the data-collection methods employed in the study. Ethical considerations that the study adhered to are noted in Section 4.7. The way the study managed data and the preparation process of that data are discussed in

Section 4.8. Finally, Section 4.9 discusses the analysis techniques the study adopted. The chapter concludes with a summary in Section 4.10.

The outlined methodology and methods in this study were deemed appropriate to the investigation of the issues in the study. It is understood that a suitable research approach is fundamental to the exploration of the phenomenon under investigation. The research approach and design include the collection and analysis of data to address those issues under investigation involving the phenomenon (Robson, 2002; McDaniel et al., 2009). A single-case study strategy was employed as an appropriate design, considered a system of enquiry that co-evolves during the course of the investigation. Consistent with the critical realist paradigm, the study is divided into two phases: the *exploratory*, which morphs into the *explanatory* phase. In the exploratory phase, the first three steps of the Bygstad and Munkvold (2011) six-stepwise framework are carried out. This involves a description of events, where objects of enquiry are identified, key objects noted, and in the process, social structures and conditions that trigger events are identified. In the second phase, an explanatory approach is adopted, where the last three steps of the stepwise framework are carried out. This commences with the identification of mechanisms that explain the findings from the exploratory phase.

It is in the exploratory stage that the researcher understands the phenomenon under investigation. This, Wynn and William (2012) suggest, is where realist work starts in an investigation. The exploration phase captures Step 1 of Bygstad and Munkvold's (2011) six-stepwise framework. The study was therefore interested in three main exploratory research objectives. The first was to establish the implementation process of HIS to facilitate the delivery of healthcare services. The second objective was to establish the influence of healthcare policies and strategies that inform the implementation of HIS in the public healthcare sector. The third objective was to determine the context-based factors that influence the implementation process and use of HIS in the delivery of the healthcare service. An exploratory case study (Patton, 1990; Stake, 1994) elicits patterns in the data, enabling the achievement of research objectives. Stake (1994) adds that case studies require some sort of flexibility in order to adapt to the evolving process in pursuit of new data-collection directions, as the researcher gains more insight into the issues under investigation during the process.

4.2 Research Strategy: Case Study

Case studies are used for several purposes in a research study. Examples of their application include the exploration, description and explanation of different phenomena. There are several interpretations of the case-study concept. One description often used is

that of Schramm (1971), cited by Yin (1989:22-23), that suggests that “The essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions, why they were taken, how they were implemented, and with what result.” Building on this definition, Yin (1994) notes that case studies ideally should reflect the topic to which they are applied. According to Hartley (1994) case-studies as serve more purpose in exploring new processes or phenomenon that is less understood. To this, authors such as Leonard-Barton (1990) argue that the case-study strategy is particularly useful in answering the *how* and *why* questions.

4.2.1 Variants of case study strategies

There are two variants in the case study approach: single and multiple (Easton, 2000; Yin, 2009). Both authors suggest that the decision as to which one of the two variants researchers should employ in their studies is usually done during the research design phase. Distinguishing between the two variants, Yin (2009) contends that single-case study strategies involve a single aspect of a case under investigation. A multiple-case study strategy is an investigation carried out on a unique phenomenon, but in two organisational contexts. Taking into consideration the two descriptions of case studies, it is clear that this particular study fits the description of a single case-study strategy. The phenomenon under investigation in this study focuses on a single case, healthcare service delivery, in public healthcare facilities in resource-constrained environments. Within this case, the study also investigates the implementation of HIS in public healthcare facilities.

4.2.2 Justification for choosing a case study

Every type of strategy has some limitations, and thus no one strategy is superior to another (Benbasat et al., 1987; Yin, 1994). The choice of a strategy relies on the researcher’s arguments for its suitability to address the issues under investigation. What determines the appropriate strategy is the context within which the research problem of the study is structured and the alignment of the chosen methodology with the research problem. This implies that for researchers to optimise the benefits of a particular research strategy, it is fundamental that they understand the selected research methods. Ideally the researcher should be aware of these methods’ strengths and limitations in the pursuit of addressing the issues under investigation and the purpose for use. A combination of the selected case-study strategy and qualitative research methods is one approach to approaching the investigation of a phenomenon. Yin (1994) proposes three fundamental aspects that a researcher should consider when choosing an appropriate case study strategy: types of research questions; control the researcher has over actual behavioural events; and the focus on contemporary versus historical phenomena.

Benbasat et al. (1987) suggest that the ontological, epistemological and methodological approaches should also influence the selection of a case study. Usually, the choice of a case study is justifiable when the research questions asked in the study emphasise the 'how' and 'why' events occurring in the phenomenon under investigation. Case studies are also more appropriate in settings where the researcher has minimal control over the events that take place in real-life situations. Creswell (2009) posits that explanatory case studies seek to explain relationships between variables within a context. Similarly, Babbie (2010) suggests that explanatory case studies investigate subjects that are already within a context, by clearly defining them to better understand the variables and their relations. Reviewing both the study's research questions and the conditions illustrated in Table **4-1** by Benbasat et al. (1987) and Yin (1994), a case study is the most appropriate strategy for this study. A case-study strategy enables the study to establish a more in-depth understanding of the issues under investigation. This is demonstrated by the design of the two main research questions that address the 'how' and 'why' of the phenomenon. Case studies are often used in exploring existing theories, while also critiquing existing theories by posing new questions (Saunders et al., 2009).

Table 4-1: Key characteristics of case studies (Yin, 1994)

1. Phenomenon is examined in a natural setting.
2. Data are collected by multiple means.
3. One or few entities (person, group, or organization) are examined.
4. The complexity of the unit is studied intensively.
5. Case studies are more suitable for the exploration, classification and hypothesis development stages of the knowledge building process; the investigator should have a receptive attitude towards exploration.
6. No experimental controls or manipulation are involved.
7. The investigator may not specify the set of independent and dependent variables in advance.
8. The results derived depend heavily on the integrative powers of the investigator.
9. Changes in site selection and data collection methods could take place as the investigator develops new hypotheses.
10. Case research is useful in the study of "why" and "how" questions because these deal with operational links to be traced over time rather than with frequency or incidence.
11. The focus is on contemporary events.

Yin (1994) provides three common reasons for selecting a single-case study strategy as an investigative method: single case studies represent unique examples of some phenomenon worth investigating; the single case investigated could be representative of other critical

cases for testing existing theories; and the selected case may be appropriate if or when it serves as a revelatory case. What this means is that a case a single-case strategy may provide the researchers with a contextual setting where they can observe and analyse a particular phenomenon that would ordinarily be inaccessible for enquiry. Thus, the uniqueness of the context of the study may provide future studies with the background for testing theories such as implementation theory in healthcare facilities in a resource-constrained environment.

4.3 Case and Unit of Analysis

4.3.1 Empirical case

Figure 4-2: Map of the regions of the Eastern Cape province

The empirical case chosen for this study is located in one of biggest municipalities in the Eastern Cape province of South Africa. Compared with other municipalities in the province, the O.R. Tambo District Municipality accounts for a total of 1.47 million people or 21 percent of the Eastern Cape population (Stats SA, 2016). According to the last census of 2016, the municipality is the most over-crowded district municipality in the province. The empirical case where the study is conducted is Nelson Mandela Academic Hospital (NMAH). The hospital is one of the largest provincial government funded hospitals and is situated in central Mthatha in South Africa. The hospital also serves as a tertiary teaching hospital and forms part of the Mthatha hospital complex with Mthatha general hospital.

The hospital handles a number of patients from in and around the municipality. The facility experiences challenges such as a shortage of staff, where the patient–doctor ratio as promulgated by the World Health Organization has not been met. As observed, the healthcare practitioners are overwhelmed by their workloads. The selection criteria of the facilities were based on the availability of health information systems such as the district health information system, patient records management system, laboratory information system, and radiological information system.

4.4 Resource-Constrained Environment

The term ‘constraint’ is used in this study to refer to those effects that limit healthcare service delivery in public healthcare institutions. Constraints in a study are classified into two categories: time and resource limitations. The study conceptualises ‘time constraints’ as the overall turnaround time of achieving healthcare service delivery outcomes, while ‘resource-constraints’ are the more controllable elements or resources in the healthcare system, such as the medical equipment and staffing required for healthcare activities. The public healthcare system is mandated by the Constitution to provide access to quality healthcare services to the population. To be able to carry out this mandate adequately, healthcare facilities are required to have access to adequate resources. This includes access to a qualified human workforce, material resources (medical equipment), funding, and competent leadership and management. The empirical case for this study fits the description of a resource-constrained environment.

4.5 Sampling of Participants

The sampling process is an integral part of any research, and selecting an appropriate sampling technique is largely determined by the type and composition of the research population. It is therefore a process that generally involves selecting a representative portion of a population from which the sample has been taken (Neuman, 2011). That sample then becomes the source of empirical data and analysis of the phenomenon (Onwuegbuzie & Collins, 2007; Marton 2013). In addition to this, Marton (2013) posits that sampling informs researchers’ thinking patterns and links data collection and analysis to research questions. There are two classification of sampling that a researcher may choose: probability and non-probability sampling. A researcher may choose between the two, depending on the sample size and accessibility of the research population (Mlitwa, 2011).

4.5.1 Sampling technique

In scientific studies, sampling is a fundamental aspect of data collection. Babbie and Mouton (2001:166) note “it is appropriate … to select a sample on the basis of the expertise

of the population being studied, elements in the population, the researcher's own judgment or the purpose of the study". An appropriate technique should be employed, so the selection of a sample from a population is largely determined by the type and composition of the research population. Singleton and Straits (2005) describe probability sampling as most likely to determine that any person in a population group has an equal opportunity of participating in a study. In this instance it is only achievable if the population number of the study is accurately determined. Non-probability sampling, on the other hand, is the selection of participants not readily identifiable. As a result of the sample size not being known, there is some element of bias in the study, and it is most appropriate in cases where the probability sample employed in expansive social surveys, for instance, is not ideal (Bhattacherjee, 2012). In terms of the methodological approach, probability sampling is mainly associated with quantitative research methods, while non-probability sampling is associated with qualitative research methods. This is not to say that probability and non-probability sampling techniques cannot be used in both methodologies. The selection of the sampling technique is tied to the subjective decision a researcher makes, based the research question that guides the investigations (Flick, 2009).

Of paramount importance in any investigation is the choice of a sample that represents the population from which the sample size is drawn (Bhattacherjee, 2012). Drawing on the study's research problem, main questions and methodology, the study employs the non-probability sampling technique. Saunders et al. (2009) argue that generalisation of results from a non-probability sample is not encouraged. The commonly applied methods in non-probability techniques include: convenience, purposive, and judgemental sampling. In case-study strategies, the most commonly used sampling methods are purposive and snowball sampling (Flyvbjerg, 2006). The same techniques are appropriate for critical realist research designs, where it is fundamental to understand the underlying phenomenon under investigation (Yeung, 1997; Iosifides, 2011).

It is on this basis that purposive and snowball sampling techniques are employed in this study. A purposive sample's main objective is to generate a sample reasonable enough to represent accurately the population it is drawn from. In order for researchers to be able to accomplish this accurately, they are required to apply their knowledge of the population expertly and select in a non-random manner. For the purpose of this study, the sample consisted of the healthcare facility managers (in charge of managing various areas and levels of the facility and therefore knowledgeable about HIS and the healthcare service delivery process). Another set of participants consisted of doctors, clinicians and nurses (the main participants in the delivery of healthcare services and who use the existing HIS at the facility). The third set of participants included administrative staff (who play a vital

supporting role to the medical staff and use the HIS for administrative purposes). The last set of participants comprised provincial representatives in the ICTs unit in the Eastern Cape Department of Health (who oversee the implementation, monitoring and evaluation of the HIS in public healthcare facilities in the province). In total, 21 participants were interviewed as illustrated in Table 4-2, before the researcher started noticing repeat patterns in the responses. This means no new perspectives was emerging from the interviews. The interviews took place over a period of six weeks between June and July 2018.

Table 4-2: Participants in the study

Participants in the study		
Respondent Group	**Role in Healthcare information systems implementation process**	**Number**
1. Provincial Level Managers/ policy makers	Implementing national policies/strategies and developing province-level policies/strategies	1
2. Provincial level information system	Managing health information systems	1
3. Local level management (in hospitals)	Managing healthcare service delivery and HIS at hospital level	5
4. Medical healthcare personnel	Carry out clinical services using HISs	10
5. Administrative healthcare personnel	Carry out administrative healthcare services including patient records management	4
Total		**21**

4.5.2 Justification of sample size

The debate on sample size in qualitative research studies amongst scholars and academics is an on-going one (Sandelowski, 1995; Morse, 2000; Marshall et al., 2013). However, uncertainties still linger on whether there is definite number that represents an appropriate sample in an investigation. In some quarters, scholars and academics have the perception that a sample size should be large enough that it sufficiently describes the phenomenon under investigation. However, on the other hand there are arguments that a larger sample size risks having repetitive data. To this effect, several authors in the qualitative research field argue that there are a number of factors that may influence an investigators decision on sample size. For example, Patton (2002:242-243) argue that “sample size depends on what you want to know, the purpose of the inquiry, what’s at stake, what will be useful, what will have credibility, and what can be done with available time and resources.” Other factors include quality of the interviews, sampling technique and the experience the researcher has on conducting interviews (Lincoln & Guba, 1985; Strauss & Corbin, 1990; Morse, 2000; Richardson et al., 2005). Authors such as Vasileiou et al., (2018:2) argue that the

determination of a sample size in qualitative research arise from the “methodological, theoretical, epistemological and ideological pluralism that characterises qualitative inquiry.”

Another concept that emerges in the debate of sample size is data ‘saturation’. From a broader perspective, data saturation is generally reached when more participants are added to the study and no new perspectives or information emerge. (Lincoln & Guba, 1985; Faulkner & Trotter, 2017). In contrast, Strauss and Corbin (1998:136) suggest that data saturation is a “matter of degree.” The authors argue that the more a researcher engages with their empirical data, there is a likelihood for “new [information] to emerge.” In effect, Lincoln and Guba (1985) suggest that a sample size should be guided by the criterion of ‘information redundancy’ set by the researcher(s). Similarly Mason (2010) the guiding principle for researchers should be data saturation. Although authors such as Morse (1995) and Bowen (2008) argues that most researchers claim to have reached data saturation but often fail to demonstrate how they reached it. In phenomenology studies, Creswell (1998) suggest a sample size between 5-25, whilst Morse (1995) suggest a size of at least 6 participants who can be extremely fruitful and yield applicable results. This would of course be only after a rigorous recruiting process is put in place. Researchers using grounded theory methodology require more participants according to Morse (1994) and Creswell (1998) the average number of sample size is 30. A search across literature shows that this numbers seems to only provide guidance to researchers but there is no justification as to why this specific numbers and not others.

The justification of the current study’s sample size is the heterogeneity of the sample population, the use of purposive sampling technique as a selection criteria for participants of the study. Together with the scope of the study and context of the topic to this, Jette et al., (2003) argue that participant’s expertise in the research topic can significantly reduce the number needed in the study. As such, purposive sampling enabled the researcher to select participants who had knowledge of the implementation of technology intervention at the hospital as well as in the provincial department of health. Other participant had experience in the healthcare service delivery process and to some degree had used healthcare information systems in their line of work. Scholars such as Lee et al., (2002) argue that studies that employ multiple data collection methods as is the case in this study, may require fewer participants. A combination of all these factors makes the sample size in the current study justifiable.

Table **4-3** illustrates how the researcher identified data sources and implemented collection methods as well as the units of analysis and observation using purposive sampling. The sub-sections that follow provide detailed descriptions of the issues under investigation.

Table 4-3: The study's investigative issues

Main Questions:

1. Why is the existing HIS implementation and use not adequately facilitating healthcare service delivery in public hospitals?

2. How can HIS implementation and adequate use facilitate healthcare service delivery in resource-constrained environments in South Africa?

Issue/Point of Investigation	Data Source	Tool/s	Unit of Analysis	Unit of Observation	No. of Participants
Background, methodology & theories	• Literature analysis	• Read, analyse & write	• Journals, Internet sources, print media, books	• Healthcare service delivery journals • Policy and strategy documents • Information systems theory books & journals • Methodology books & journals	
Status of healthcare service delivery in public hospitals in resource-constrained environments	• Literature analysis • Public Hospital	• Read, analyse & write • Interviews	• Books, journals, reports • Hospital admin officials • Healthcare practitioners	• Dept of Health policy and strategy documents on public healthcare services delivery • Independent /private news • Health practitioners (doctors, nurses, clinicians)	
Status of HIS implementation and use in public healthcare institutions within resource-constrained environments	• Literature analysis • Public hospital	• Read, analyse & write • Interviews	• Journals, articles • Senior hospital admin officials • IT managers	• HIS implementation documents • Dept of Health policy and strategy documents on e-health • IT manager, hospital managers, DoH	

				representative, provincial Department of Health	
Role of HIS in public HSD process	• Literature • Public Hospital	• Read, analyse & write • Interviews	• Journals, govt polices/strategies; theses • Senior hospital admin officials • Clinical staff	• HIS journals/articles • IT manager, hospital & clinic managers; • Dept of Health policy and strategy documents on e-health, m-health, digital health • practitioners (doctors, nurses, clinicians) • Journals on medical informatics	
Purpose (aims & objectives) of HIS implementation & use in public HC institutions	• Literature • Public Hospital	• Read, analyse & write • Interviews	• Journals, govt polices/strategies; • Senior IT administrators • Senior hospital admin officials	• HIS documents • IT managers, hospital & clinic managers • Doctors and nurses	

4.5.3 Issues/Points of Investigation

Using the purposive sampling technique, the objectives of the first phase of the research (exploratory) single-case study design are outlined in the following sub-section. To achieve this, the three research sub-questions are split into four investigative issues as outlined in Table **4-3**.

4.5.3.1 Status of public healthcare service delivery in healthcare facilities in resource-constrained environments

The issue of investigation at the forefront of the exploration phase was the current status of public healthcare service delivery in healthcare facilities in a resource-constrained environment. The researcher found this to be fundamental to a basic understanding of public healthcare service delivery processes and activities involved in healthcare facilities. The sources of data for addressing this issue of investigation were primary and secondary sources. For secondary data sources, journal publications, reports, academic theses and dissertations, and books pertaining to public healthcare service delivery in South Africa were consulted. Other secondary sources considered included news agencies, blogs, and websites. The means of data collection in respect of secondary sources were by reading, analysing and writing. Primary data were obtained through interviews with all participants of the study who were asked for their perceptions of the public healthcare system.

The three-tiered public healthcare system is plagued by many challenges, as already established in the earlier introductory chapters of the study. The governance structure of the healthcare system is three tiered as well, involving national, provincial and district levels of management. Healthcare services at the district level are the first point of contact between a patient and the healthcare system. Facilities in this level include clinics, community-based care, and home-based care. However, with limited resources, these facilities usually do not handle patients with special clinical needs such as surgical care or laboratory testing, and refer their patients to the second or third level of the healthcare system (Richards & Jacquet, 2012). Clinical care varies at the different hierarchical levels of healthcare institutions, hence, a public clinic and hospital facilities at both primary and secondary level were chosen. An additional consideration for the selection of these two institutions includes their geographical location and the categorisation of the population they serve as under-served communities. Reichert (2011) notes the healthcare service delivery process is complex, and therefore an alignment of activities in the process is of particular

importance and requires a good understanding of the interactions among the actors involved.

Two sets of interview questions were formulated and administered, one for healthcare practitioners and the other for administrative staff. The questions were used to determine participants' views on healthcare service delivery based on their work experience at the hospital. Based on the responses, the section also highlights workflow processes and the network of activities performed by different actors within the healthcare delivery system at the hospital.

4.5.3.2 Status of HIS implementation in public healthcare facilities

The issue under investigation was focused on the status of HIS implementation in public healthcare facilities. To investigate this issue, the researcher needed to understand basic phrases commonly used that would imply that participants were aware of the HIS in the facility, if the system was used, and if so, for what purpose and how. Background data employed for this issue of investigation were obtained from both primary and secondary sources. Secondary sources included books, journal articles and web sources on HIS, while primary sources included interviews at a selected public hospital within a resource-constrained environment.

4.5.3.3 Purpose of HIS implementation and use in public healthcare facilities

The central focus of this issue of investigation was on the respondents' views on the implementation and use of existing HISs at the facility. This helped the researcher establish the reasons for the implementation of these systems, if the systems were performing as intended, and how participants viewed the usefulness of the systems in terms of the change in work strategies. To fulfil the objectives of this issue of investigation, secondary sources such as document reviews and journal articles were used. Primary sources of data were from selected participants from the provincial Department of Health and the selected hospital, through interviews. Scholars contend that technologies break down barriers of time and space; in this context, it translates to bringing actors from different service delivery contexts (units/departments) together to provide healthcare services in a more efficient way. Hesse and Shneiderman (2007) argue that technology also generates various service interaction types between actors and tools (systems), thus creating an even more complex healthcare delivery system. The rationale for this issue of investigation was to obtain participants' knowledge/awareness of existing HISs and experience of using these in their daily work activities.

4.5.3.4 The role of HISs in the public healthcare service delivery process

This issue of investigation presents the role of technology interventions in the delivery process of public healthcare services in healthcare facilities. There has been an undertaking by healthcare systems worldwide to find innovative ways to integrate information systems or technologies into the delivery of healthcare services, with the aim of improving quality, managing costs, and enhancing efficiency in the delivery process (Zeng et al., 2009). The ultimate goal of these healthcare systems is to improve the experience of patients in the delivery of healthcare, with healthcare systems that are patient centred. The logic is that technology interventions are able to provide platforms that underpin effective decision making across the healthcare system.

The vital role technology plays in the delivery of healthcare service processes cannot be overemphasised. David and Jahnke (2004) note that the implementation of technology interventions has a significant influence on healthcare activities, and by extension the quality of service. This is most visible in the form of cost reduction and turnaround times in the delivery process. HISs collect data from healthcare facilities and perform analyses to ensure quality, relevance and timeliness. The analysed data are then processed into information for decision making. In most healthcare systems, challenges are often experienced in cases where healthcare practitioners are burdened with an excessive inflow of data and an increase in reporting from often inadequately coordinated sub-systems in healthcare facilities.

4.6 Data-Collection Methods

4.6.1 Interviews

In this study, semi-structured interviews were employed as one of the primary sources of data. The researcher understands that interviews in qualitative research are often employed as a way of understanding “the world from the subjects’ point of view, to unfold the meaning of people’s experiences, to uncover their lived world” (Kvale, 1996:1). Interviews are especially used for their effectiveness in analysing individuals’ perceptions and motives (Keats, 1999). Since the research design in the current study required the analysis of the participants’ views and motives, interviews were considered an appropriate technique for primary data collection. The technique allowed the researcher to capture participants’ experiences in the public healthcare service delivery process and the implementation of HIS in public healthcare facilities. In qualitative studies, interviews are classified into three categories: semi-structured, structured, and unstructured interviews. The structured interview category is often perceived as a technique that is rigid, as it does not allow researchers to deviate from their predetermined interview questions. Unstructured

interviews are more flexible compared with structured interviews, as they allow researchers to redirect the original questions so that they can elicit emerging issues during the interview process. A semi-structured interview is basically a combination of the techniques of the structured and unstructured methods. **Figure 4-3** depicts the types of interviews often employed in qualitative research. As highlighted in the figure, the face-face interview method was employed.

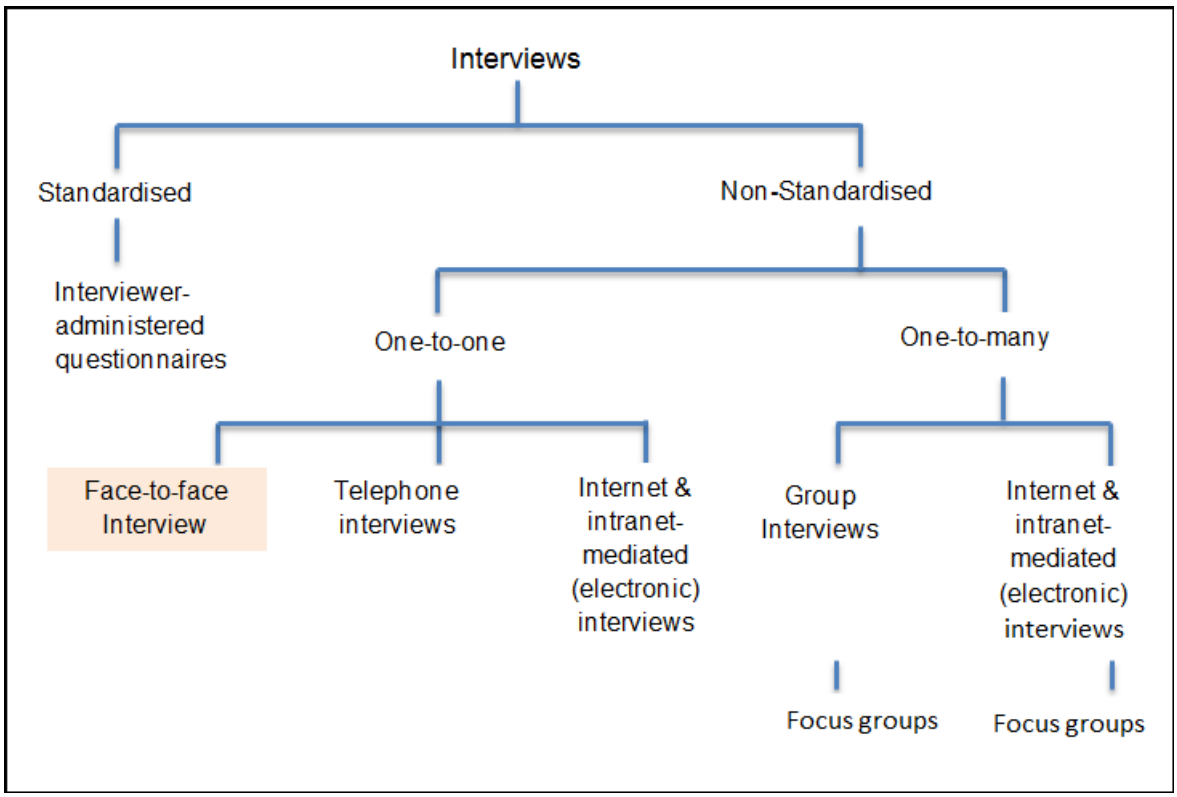

Figure 4-3: Types of interviews (adapted from Saunders et al. (2009:321)

The rationale for employing semi-structured interviews was to gain insight into participants' views on public healthcare service delivery and the implementation and use of HISs (Archer, 1995; Mingers, 2001). The researcher considered this technique of data collection as the most appropriate, as it allowed the researcher to unpack the hidden mechanisms and contextual factors (enabling or inhibiting) from the participants' perceptions of the phenomenon. Appendix F provides a sample of interview questions derived to align with the purpose of the exploratory phase of the case-study design. The interview questions were divided into two categories: one set of questions was for healthcare practitioners (doctors, nurses, administrators), while the other set of questions targeted managers and hospital administrators, including the ICT services department and a representative from the provincial Department of Health with knowledge of healthcare information systems implementations.

4.6.2 Document review/analysis

This sub-section reports on the review of documents pertaining to public healthcare service delivery in South Africa and also their implementation and use in public healthcare facilities. The documents reviewed were mainly policy and strategy documents and reports pertaining to healthcare service delivery. Other documents within the context of the issues under investigation were also reviewed and analysed. The study adopted Atkinson and Coffey's (1997:47) views on documents in research as "social facts that are produced, shared and used in socially organised ways". The documents used in this study were publicly available from government websites and free to download. Others included public reports, blogs, vlogs, and newspapers that reported on public healthcare service delivery in the country. The researcher integrated all the summarised information from the document reviews with the empirical data from the interview sessions to elicit substantial differences in meaning, interpretation, and attitude existing in the sources on the issues under investigation in this study. To this effect, after the analysis of documents relevant to this study, the researcher produced excerpts that then were organised into themes and categories (Labuschagne, 2003).

The rationale for document analysis is that it gave the researcher an opportunity to triangulate data from various sources to strengthen her arguments (Denzin, 1970). This gives the researcher the ability to converge and corroborate the findings through multiple sources of evidence (Yin, 1994). In addition, triangulation of data "provides a confluence of evidence that breeds credibility" (Eisner, 1991:110). Through document analysis, the researcher was able to gain an in-depth understanding of the historical aspects of the public healthcare system.

4.6.2.1 Document sampling

The sampling technique used for document sampling was purposive, within the population of relevant publications on public healthcare service delivery and HIS implementation and use.

Document sampling criteria included the following:

Elements relevant to public healthcare service delivery from a broader context (the whole country) were identified. These were then narrowed down to public healthcare facilities in resource-constrained environments such as the empirical case in this study. This was followed by the link between these elements, according to the thematic analysis technique steps. The results were then incorporated with the other empirical data to add value to the study's analysis of the phenomenon under investigation.

4.7 Research Ethical Considerations

4.7.1 CPUT ethics approval

In any scientific research, ethical considerations are an important aspect, and their principles and regulations should be adhered to while conducting any form of investigation involving social contexts (Sarantakos, 2005). In this study, the researcher adhered to all the ethical procedures stipulated by the Cape Peninsula University of Technology. This commenced with approval from two faculty research ethics committees and other institutional ethics committees. On receipt of ethics approval from CPUT, the researcher then requested and obtained ethics approval from the Department of Health in the Eastern Cape. See Appendix A to D for all ethics approval letters.

4.7.2 Eastern Cape province Department of Health ethics approval

Upon receiving ethical clearance from CPUT, the study approached the provincial head office of the Department of Health in Bisho, Eastern Cape. As the case study was based in the Eastern Cape province of South Africa, it was required that the researcher seek approval from the Eastern Cape Department of Health (ECDoH) before data collection in any public healthcare facilities could commence. Authorisation to carry out the investigation was approved in December 2017. A copy of the approval letter is attached in Appendix C and D.

The researcher was then allowed to approach the healthcare facilities for permission to carry out the investigations. In total, ethics approval for this study took six months.

4.7.3 Individual participants' informed consent and confidentiality

Appendix E presents the information sheet together with the consent form. All participants were informed of the aims and objectives of the study before being requested to sign consent forms upon agreeing to participate. No personal information that could identify the participants was collected. For confidentiality during the analysis of data, the researcher allocated pseudonyms known only to the researcher, to all participants.

4.8 Data management and preparation for analysis

This sub-section describes how the researcher managed the data once collected. Once the data-collection process ended, the first step was to present the data in written format as prescribed by Saunders et al. (2009). This was done through a transcription process where the researcher listened and typed out (in an MS Word document) the recorded interview sessions. The researcher then went through each interview session and arranged data into similar concepts. Keywords were then identified and coded, based on their inferred

connotations. This process, Richards and Morse (2007:154) claim, “leads you from the data to the idea and from the idea to all the data pertaining to that idea.”

Figure 4-4 depicts a coding manual suggested by Saldaña (2009) that enables researchers to gain insight into the coding process that evolves from concepts to categories and eventually themes that are presented as findings. Miles and Huberman (1994:56) describe codes as “tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study … codes usually are attached to ‘chunks’ of varying sizes – words, sentences, phrases, or whole paragraphs, connected or unconnected to a specific setting”.

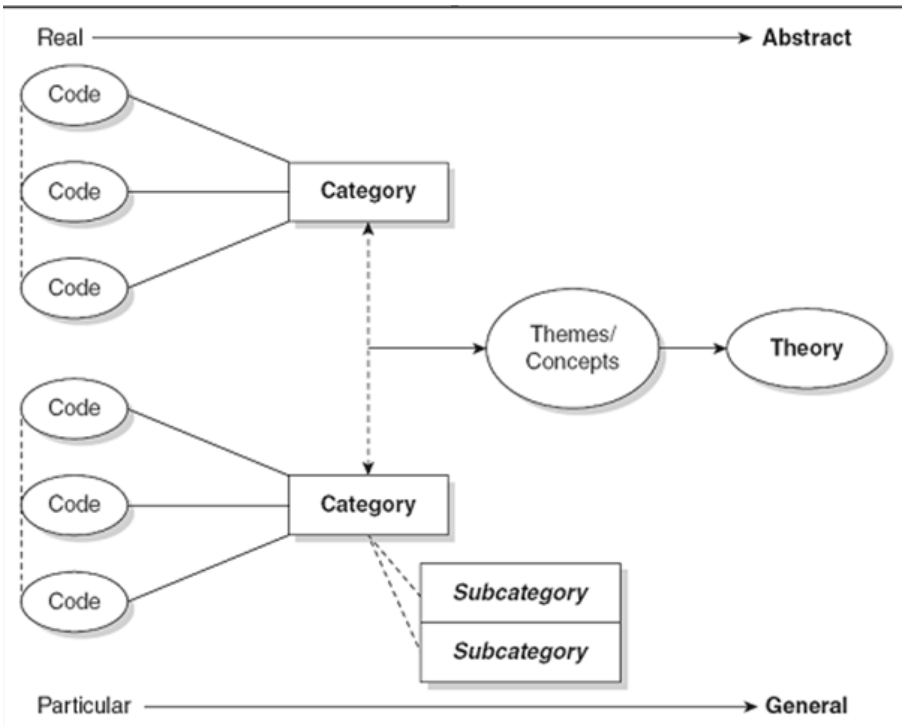

Figure 4-4: Streamlined codes-to-theory model for qualitative inquiry (Saldaña, 2009)

4.9 Analysis of data for the exploratory case-study

In this section of the chapter, thematic analysis is discussed by illustrating how the techniques were used to formulate themes and categories in the analysis of data from both interviews and documents. The rationale for choosing thematic analysis techniques is that they allow the researcher to report on the emerging themes from the study’s participants, captured during the data-collection process. Braun and Clarke (2006:79) refer to thematic analysis as a technique “for identifying, analysing and reporting patterns within data”. Saunders et al. (2009) note that data collection and analysis are interactive in nature, thus allowing the researcher to visualise and recognise the fundamental themes, patterns and relations as they emerge from the empirical data.

The thematic analysis technique, according to Braun and Clarke (2006), is perceived as a realist method to enable researchers to report experiences, meanings and the realities of participants. Thematic analysis can also be employed from a constructionist perspective, enabling the researcher to examine ways in which events, realities, meanings and experiences are the effects of a range of discourses operating in societies. For document analysis, ATLAS.ti software was used to analyse some documents used in the study. Using a simple, thematic coding system, qualitative data can be analysed after an iterative process of reading through the transcribed data and summarising it to make meaningful sense of the data. This method of analysis is employed by researchers as it gives the researcher the ability to search through texts to identify themes that emerge frequently. Using Figure **4-4** as a guide, the researcher kept a log of notes and ideas from the interview transcripts. The researcher then highlighted the codes throughout the transcripts, indicating the relevant points from the participants' responses. After going through all the interview transcripts, the codes were then re-examined in order to highlight emerging patterns which were then labelled as potential themes for further analysis. The researcher made a judgement call on data saturation when the analysis of the interview responses ceased to yield new themes. Through an iterative process, the researcher examined the themes and patterns until deciding on the more dominant themes. The results of these findings are reported descriptively in Chapter 6.

4.10 Summary of Chapter 4

Chapter 4 discussed the methodological approach adopted in this study and clarified how the study fits into the critical realist ontological, epistemological and methodological assumptions. The chapter further discussed the application of a single-case study strategy, and critical realist data collection, analysis and management techniques. The chapter also considered ethics. The next two chapters focus on data analysis, with Chapter 5 focusing on the analysis of documents such as policies, strategies and reports on healthcare information systems implementation in public healthcare facilities for the purpose of improving the delivery of healthcare services.

5 CHAPTER 5 – THEMATIC ANALYSIS OF DOCUMENTS PERTAINING TO HEALTHCARE SERVICE DELIVERY

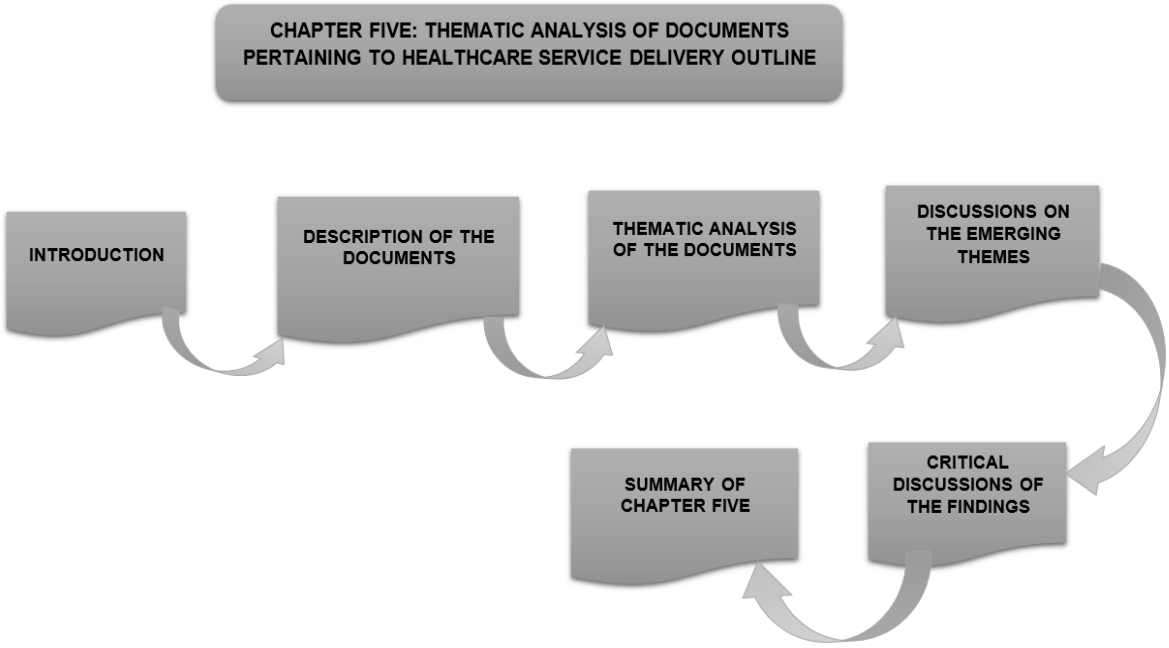

Figure 5-1: Chapter 5 outline

5.1 Introduction

The study executed a multi-layered data analysis that included the analysis of documents and interviews. The presentation of these analyses begins with the description of the thematic analysis of policy documents pertaining to healthcare service delivery in the South African context. The examination of these documents was done from three perspectives: (i) context in which the documents were prepared, (ii) meaning of text in these documents, and (iii) the consequences that the other two perspectives may have in the broader context of public healthcare service delivery. Based on the three perspectives, the study employed an interpretive exploration using a deductive thematic analysis approach to elicit emerging patterns and consequent themes that signalled change in the delivery of care services in the public healthcare sector. To address the study's objectives, the researcher deemed it vital to analyse documents in the public domain pertaining to healthcare service delivery and the use of technology interventions in the delivery of the care process. Document

analysis allowed the researcher to uncover the meanings, interests and motives intended with the promulgation of the policy/strategy documents. Beyond just the meanings, interests and motives, the study's intention with the analysis of these documents was to uncover also the impact these documents have at facility level.

To illustrate the analysis process of the documents, the chapter is structured in the following format. Section 5.2 gives a description of the documents analysed. In Section 5.3, the thematic analysis process of the documents is presented. Section 5.4 contains a discussion on the emerging themes from the analysis. Section 5.5 presents a critical discussion of the findings. The chapter concludes with a summary in Section 5.6.

5.2 Description of the Documents

The documents analysed in this study all pertained to e-health, which emanated from the public healthcare system's quest for innovative solutions to redress the challenges faced in the delivery of healthcare services. E-health, in the context of this study, embodies the use of technologies, including mobile health, electronic prescriptions, electronic medical records, telemedicine, and many other forms of services in the health sector (Weeks, 2012). The use of technology interventions in the healthcare sector are mostly for the sole purpose of improving the quality of the healthcare service delivery process. The focal point of the document analysis was to gain insight into the intentions and motives behind the implementation and adoption of interventions for improving public healthcare service delivery, and simultaneously identify, from the perspective of policy and decision makers, what factors would enable or inhibit the improvement of the delivery process of public healthcare services. As a member state of the World Health Organization, South Africa is committed to improving public healthcare service delivery in line with the organisation's goals. The national government therefore has over the years developed and implemented several e-health policies/strategies across the healthcare sector. The document review in this chapter focuses mostly on policies/strategies that have been drafted to improve quality in the delivery of healthcare services. Other documents analysed focused on the historical aspect of the country's public healthcare service delivery. Overleaf are some of the national policies and strategies that the study examined:

- ✓ The National Health Act, (Act 61 of 2003)
- ✓ eHealth Strategy South Africa (2012–2017)
- ✓ District Health Management Information System Policy (2011)
- ✓ DHMIS policy Standard Operating Procedures: Facility Level (2012)
- ✓ mHealth Strategy South Africa (2015–2019)

- ✓ National Health Normative Standard Framework for Interoperability in e-Health in South Africa (2014)
- ✓ National Integrated ICT Policy Green Paper (2014),
- ✓ National Health Insurance Green Paper (2011) and White Paper (2015)
- ✓ National Digital Health Strategy for South Africa (2019–2024).

In the next section a brief description of the documents is presented. The descriptions of the documents focused on two aspects: (i) aims and objectives of the documents, and (ii) strategic intentions of the documents in the healthcare delivery process.

5.2.1 The National Health Act, 61 of 2003

This document is one of the major strategic documents in the healthcare sector, developed by the national government to address issues within the sector stemming from the previous regime. The aims and objectives of this Act were to provide a framework that would standardise the South Africa healthcare system. The development of the National Health Act 61 of 2003 seemed to have taken into consideration the mandate by the Constitution of all citizens having the right to access quality healthcare services. In Section 74 of the Act, there is reference to the "co-ordination of a national information system" (DoH, 2003). Section 75 of the Act also refers to provincial obligations with regard to health information being fundamental in a bid to increase the capabilities of the healthcare system. The key components relating to health information in the Act prescribe that the Department of Health "shall facilitate and coordinate the establishment, implementation and maintenance of the information systems by provincial departments, district health councils, municipalities and the private health sector … to create a comprehensive national health system".

Consequent to the National Health Act, 61 of 2003, the Department of Health initiated a plan for the development of a National Electronic Health Record for South Africa (eHR.ZA). The eHR.ZA system's strategic objective was to provide an effective mechanism that enabled data integration across the healthcare system. However, the initiative was halted in anticipation of the eHealth Strategy (2012–2017). The National Health Act, 61 of 2003 was amended in 2014 to add the requirements of the National Health Normative Standards Framework for Interoperability in e-Health.

5.2.2 The National eHealth Strategy (2012–2017)

The fundamental goal of the eHealth Strategy is to provide the healthcare system with a comprehensive roadmap to accomplish "a well-functioning national health information system with the patient located at the centre" (DoH, 2012b:5). By the time of the release of the strategy, many healthcare facilities around the country were already making use of HISs

at different levels. Widely used at the time was the DHIS (Mars & Seebregts, 2008); however, the systems in the public healthcare domain were fragmented, uncoordinated and lacked interoperability. In response to these issues, the eHealth Strategy provided a roadmap for an integrated and well-functioning national patient-based HIS. This patient-based information system was built on scientific standards for interoperability. Upon successful implementation of the ehealth strategy, the outcomes were expected to improve efficiency in the clinical care process and the provision of health indicators required by management in facilitating the mobility of patients (DoH, 2012b). The Department of Health employed several principles to enable them to achieve the objectives of the eHealth Strategy.

The principles included “getting the basics right, taking an incremental approach, building on what already exists and looking for early wins” (DoH, 2012b:8). Yet another important principle of the strategy was the constant evaluation of e-health initiatives. This principle was to be used to measure improvements to health outcomes to build an evidence base to demonstrate the benefits of e-health (DoH, 2012b). At the time the e-health strategy was published, the Department of Health identified various components that it considered new or requiring extensive procurement and implementation. These components included the following:

- ✓ The implementation of the Electronic Health Record (EHR), national patient registry built on a Patient Master Index (PMI).
- ✓ The implementation of primary healthcare patient management and electronic medical record (EMR) systems in clinics.
- ✓ The implementation of pregnancy and neonatal EMR systems to record clinical details with links to EHR.
- ✓ The implementation of EMR systems to monitor anti-retroviral treatment (ART) and TB treatment.
- ✓ Pharmacy systems’ interface with EMR systems.
- ✓ The implementation of a uniform Integrated Document and Records Management System (EDRMS) at all levels (DoH, 2012b).

The implementation of these identified components in primary healthcare facility documents is guided by both the eHealth Strategy and the e-health programme. Speaking on the implementation of technology interventions in the healthcare sector using the eHealth Strategy as guide, Masilela et al. (2014) note that while the development of the eHealth Strategy was an important milestone in the South African healthcare system, its impact depends on the effective implementation of its monitoring and evaluation measures.

As the healthcare landscape in South Africa changed to adapt to the widespread ownership and use of mobile devices among its citizens, the Department of Health formulated a strategy that would provide a roadmap for the use of mobile technologies in the healthcare environment – the national mHealth Strategy 2015–2019.

5.2.3 The National mHealth Strategy (2015–2019)

The mHealth Strategy is a sub-set of the eHealth Strategy which was developed with the aim of providing a "single, harmonised and comprehensive mHealth strategy and implementation plan" (DoH, 2015c:9). Together with this aim, the Department of Health had a mission of "empower[ing] patients with information, improving access to health services and real-time data management to assist in addressing the current inefficiencies in service delivery" using this strategy (DoH, 2015c:6). In the document there is a description of mobile health as the application of mobile technologies encompassing the use of mobile devices such as cell phones and sensors in the delivery of healthcare.

The strategy employs the following principles (DoH, 2015c:9):

- ✓ Adhere to the standards set out in the Health Normative Standards Framework.
- ✓ Apply simplicity in the design and development of mHealth interventions while still addressing the needs of users.
- ✓ Build a sustainable partnership inclusive of incentives for continued participation.
- ✓ Strengthen the capacity to use mHealth by seeking to converge mHealth initiatives with other ICT initiatives.
- ✓ Look for points of intersection with other eHealth programs.
- ✓ Anticipate future areas of technology convergence between mobile and fixed technologies.

There are several initiatives that the Department of Health has scaled across the country. A good example is the MomConnect initiative, using short message services (SMSes), introduced to help educate pregnant women and mothers. The initiative helps women strengthen their knowledge of 'good' healthcare practices for their babies.

5.2.4 The District Health Management Information Systems (DHMIS) Policy

The use of health information systems in South Africa began with the development of the DHIS in 1996/97 as routine data collection from all public healthcare facilities. Owing to the challenges associated with the system, the DHMIS policy was established to, among others things, "to ensure uniformity in the implementation of DHMIS" (DoH, 2011). The DHMIS policy affords the healthcare system a regulatory framework under the National Health Act, 61 of 2003 for the district health management information systems in healthcare facilities.

This authorises the country's minister of health to establish legal frameworks for dealing with HISs in the healthcare domain. In essence, the policy prescribes who should control and have access to the DHMIS data. The policy also mentions that the functions of the National Health Information System of South Africa (NHISSA) committee shall include the "development of policies and regulations to govern information management in the health sector" (DoH, 2011:18). The key aspects of this policy are to: (i) strengthen the concepts of monitoring and evaluation through harmonising information across the healthcare system, and (ii) explicitly clarify main roles and responsibilities of individuals at each level of the healthcare system.

To guide the implementation of the DHMIS policy, the department of health published a DHMIS policy standard operating procedures: Facility level (DoH, 2012) document. The promulgation of document set out to standardise operating procedures for data management at facility level. This is because it is at this level that the quality of data collection can be improved. The purpose of standardising operating procedures of DHMIS is to promote a more homogenous process of collecting, capturing, collation, storage, and analysis of data as well as the transmission of data to other levels of the healthcare system. The document outlines these standard operating procedures to be followed by all relevant stakeholders to ensure that data is appropriately handled and optimally used to improve healthcare service delivery. As such the department of health mandates that hospital management should ensure the implementation of these standard operating procedures.

5.2.5 The National Digital Health Strategy 2019–2024

Literature has shown that healthcare systems around the world continue to struggle with issues such as a dearth of healthcare practitioners. As is evidenced throughout this thesis, the South African healthcare system experiences the same challenges. Most of these healthcare systems are turning to technology as a possible solution to mitigate some of the challenges. Digital health has therefore become a viable path for making healthcare feasible, with the concomitant need for the development of digital health strategies. South Africa is no exception; in 2019 the Department of Health promulgated the National Digital Health Strategy (NDHS) 2019–2024. Several factors necessitated the development of such a strategy. The most pressing issue is the shortage of healthcare workers that affects most healthcare systems. Consequently, national governments have the task of developing a digital health strategy that is able to channel the power of technology in the health sector to address the shortage of healthcare practitioners as well as the sustainability of the healthcare system. All this is mentioned in the South African NDHS.

According to the DoH (2019), the NDHS document aims to contribute towards achieving the goals of yet another important government document – the National Development Plan Vision 2030. The strategy promises "better health for all South Africans enabled by person-centred digital health" (DoH, 2019:17). This strategy was developed on the back of the lessons learnt from the implementation of the eHealth Strategy 2012–2016. Some of the lessons include "strengthening governance structures, creating robust integrated platforms for development of information systems, [and] the use of a common unique identifier for patients interfacing with the health system at various levels" (DoH, 2019:8). The driver for the development of this strategy in the South African context was to "support the healthcare sector priorities as articulated in the National Development Plan and in line with the current NHI transformation imperatives towards Universal Health Coverage (UHC)" (DoH, 2019). The NDHS embodies strategic principles that include person-centred, expanded healthcare access, innovative solutions for sustainable impact, a digital healthcare workforce for economic development, and a holistic government approach (DoH, 2019).

5.2.6 The National Health Insurance (NHI) Green Paper (2011) and White Paper (2015; 2017)

NHI is seen as an important development for South African democracy as it aims to redress inequities in the healthcare service. The Bill aims to achieve this by implementing transformational policies towards establishing universal healthcare coverage for the South African population. In essence, the aim of the NHI Bill is to promote access to healthcare services among all citizens, irrespective of their ability to afford the services. The South African government aims to roll out the Bill in three phases over a 14-year period (Mayosi et al., 2012). The NHI Bill is premised on the principles of ensuring the right of health for all, entrenching equity, social solidarity, and efficiency and effectiveness in the health system in order to realise universal health coverage (McIntyre, 2012).

5.2.7 Other documents reviewed

Other policy documents that the study reviewed included the Integrated ICT Policy, National Health Normative Standards Framework for Interoperability in e-Health in South Africa, the National Development Plan (NDP) 2030, *South African Health Review (SAHR)* 2019, and 'Health and healthcare in South Africa – 20 years after Mandela'. The Normative Standards Framework for Interoperability in eHealth in South Africa was developed in 2014 as an extension to the National Health Act, and guides the healthcare system in the country in a new era of HIS development. The NDP was published in 2012 to enable the government to redress issues of poverty and reduce inequity by 2030 (DoH, 2012). The NDP aligns with the United Nations (UN) sustainable development goals for 2030 (UN, 2015). The policy

acknowledges that the public healthcare system is not able to meet the demand or even sustain the quality of healthcare services unless it first strengthens its delivery of primary healthcare services and at the same time broadens its district healthcare programmes.

Other important documents reviewed are 'Health and healthcare in South Africa – 20 years after Mandela'. The article, 'Health and healthcare in South Africa – 20 years after Mandela' offers a reflection of the South African healthcare landscape post 1994, highlighting healthcare challenges, and trends in health, wealth, and healthcare practitioners, while giving a glimpse of the prospects of the landscape (Mayosi & Benatar, 2014). The SAHR document presents an analysis and assessment of the progress made and challenges faced in the South African healthcare system towards achieving universal healthcare coverage. In the document, the authors highlight proposed recommendations for improvements in specific areas. Table 5-1 presents a summary of the documents analysed in this study.

Table 5-1: A summary of the description of the documents

Document	Description	Authors
National Health Act, 61 of 2003	The National Health Act, 61 of 2003, intended to provide a framework to standardise the South African healthcare system.	Dept of Health (2003)
eHealth Strategy (2012–2016)	The eHealth Strategy provides a patient-centred roadmap for eHealth initiatives in South Africa.	Dept of Health (2012b)
mHealth Strategy (2015–2019)	A sub-set of the eHealth Strategy, the mHealth strategy provides a roadmap for greater uniformity in the development and use of mobile technology.	Dept of Health (2015)
Health and health care in South Africa – 20 Years after Mandela	Gives historical background of the healthcare sector and healthcare service delivery post 1994 in South Africa.	Mayosi and Benatar (2014)
District health Management Information System (DHMIS) Policy 2011	The DHMIS policy provides an official regulatory framework for the DHMIS under the National Health Act, 61 of 2003, which empowers the minister to establish the legal framework for health information systems.	Dept of Health (2011)
Achieving high-quality and accountable universal	The SAHR document presents an analysis and assessment of the	Rispel et al (2019)

health coverage in South Africa	progress made and challenges faced in the South African healthcare system towards achieving universal healthcare coverage.	
NHI Green Paper (2011) and White Papers (2015, 2017)	The NHI Green Paper and White Papers promote access to healthcare services among all citizens, irrespective of their ability to afford the services.	Dept of Health (2011)
National Digital Health Strategy for South Africa 2019–2024	The strategy will contribute towards the South African National Development Plan Vision 2030 of "Information and Communications Technology (ICT) that underpins the development of a dynamic and connected information society and a vibrant knowledge economy that is more inclusive and prosperous".	Dept of Health (2019)
National Development Plan 2030	The NDP aligns with the United Nations (UN) sustainable development goals for 2030.	Dept of Health (2012a)

In the next section, thematic analysis and a narrative critical analysis of the described documents are presented. The discussions in this section draw on the work of Ruhode's (2016) thematic analysis of government policy documents.

5.3 Thematic Analysis of Policy/Strategy documents

In qualitative studies, document analysis is carried out in a manner that allows the researcher to elicit meaning from and gain insight into the contexts of the documents while developing empirical knowledge (Corbin & Strauss, 2008). The researcher approached the exploration of these documents with the previously discussed perspectives in mind (context, text and consequence). Thematic analysis techniques were employed to identify emerging patterns from document texts. This analytic process is in line with Braun and Clarke's (2006) prescribed thematic analysis phases. This includes the process of researchers familiarising themselves with the texts in the documents and producing ideas to generate codes eventually grouped together to provide potential themes. These themes are then are revisited to confirm they reflect the associated code extracts from the document texts. In the final phase, the identified themes are refined by attributing clear definitions and names.

The approach the study took was to not only view the contents of the documents as just text, figures, images or tables, but also view them in terms of what role the promulgation of these documents plays in influencing social interactions within the healthcare system. Subsequently, themes were generated from the interpretation of the (data) texts in order to form meaning. For example, from the analysis process, the study uncovered the interaction of the major stakeholders in the healthcare system and the extent of their involvement in various aspects, such as drafting or implementation of policy/strategy documents at the operational level of the healthcare system. Another emerging aspect of the analysis of these documents was the effects of the various interrelationships in the healthcare system that influenced the delivery of healthcare services. The outcome of this approach allowed the researcher to group the appropriate features addressed into major themes (purpose and motive, strategic initiatives, benefits/values, evaluation and monitoring, as well as resource infrastructures) as indicated in Table 5-3.

As mentioned in the introduction to the chapter, the study approached the analysis of the policy/strategy documents from three different perspectives (context, text and consequence). The three perspectives are based on a well-known conceptual policy analysis framework by Taylor et al. (1997). The conceptual framework has been further developed by authors such as Bell and Stevenson (2006) and Busher (2006). The conceptual framework describes the three perspectives as: (i) the *context of a policy* refers to the forces/powers and values that have given rise to the need for the policy to be established. This perspective relates to the socio-political environment of a country and as such requires that the antecedents of the policy/strategies be understood. This is inclusive of the issues and pressures that result in the need for the policies/ strategies. For example, in the South African context, a document like the National Health Act, 61 of 2003, was promulgated as a result of socio-political pressures to address the inequities in the healthcare system created by the apartheid system. The second perspective: (ii) *policy text*, is described in the framework as the contents of the policy/strategy documents. Analysis from this perspective requires the researcher to subject the analysis of the texts from the documents with rigour. Bell and Stevenson (2006) posit that the contents of the documents need to be interrogated to uncover the reasons for the way a document is structured and framed.

It is therefore incumbent on the researcher's discretion to pose questions relating to the purpose and values that underpin the creation of the policies/strategies. This allows a researcher to look beyond the texts and draw inferences from the meanings. It is this in-depth detailed textual analysis that Silverman (2006) claims constitutes qualitative studies. The last standpoint of this analysis: (iii) *policy consequence* is described by the framework

as relating to the manner in which a policy/strategy is implemented – in other words, the evaluation of policies/strategies in practice (Kilmister, 1993). This is determined by the way in which the users (implementers) of the policy/strategy interpret it. In the analysis of the policy/strategy documents, it is vital that researchers gain an understanding of the effectiveness of the procedures documented to give consistent guidance on how the policy/strategy should be implemented (Saraisky, 2016). In addition to this, Alexander (2013) notes that during the analysis of policy/strategy documents, it is important to look out for signs of issues or challenges that may impede the implementation of the policies/strategies. The issues or challenges may be in the form of organisational structures, people, or processes.

5.3.1 Coding procedure in the analysis process

The coding procedure involved the researcher initially reading through the policy/strategy documents. This enabled her to gain an understanding of the structure of the policies/strategies while generating the study's related constructs such as motives, purposes, etc., of the implementation of HIS in the public healthcare sector. Employing a deductive approach to the analysis, she scanned the policy/strategy documents for key words such as 'public participation' or 'consultation'. In the search for key words within the text, policy/strategy documents were scanned using ATLAS.ti software. The key words included 'healthcare service delivery planning', 'accountability', 'improved healthcare services', 'leadership', 'management', and 'quality'.

Figure 5-2: Word frequency representation of policy/strategy documents

Figure 5-2 depicts a word cloud representation of word frequencies in four of the policy documents (mHealth, eHealth, the National Digital Health Strategy, and the DHMIS policy) of the most mentioned words. From this diagram it is evident that the context of these documents was health. The researcher's interpretation is that this affirms that the majority of these documents were formulated with the intention of addressing healthcare in the country. After analysing 10 documents, 35 open codes were created as illustrated in Table **5-2**. Other ATLAS.ti outputs for the analysis of documents are shown in Appendix J.

Table 5-2: Open codes generated for document analysis

Code Generated	Code Generated
1.Allocation of resources	19.Health data/information
2.Appropriateness	20.Health services
3.Beneficiaries of policy/strategy	21.Healthcare system performance
4.Benefits of technology intervention in healthcare	22.ICT infrastructure
5.Challenges within the healthcare system	23.Improve access to healthcare services
6.Decision-making process	24.Improve health outcomes
7.Drive for policy/strategy development	25.Integration of systems
8.Drive for technology intervention	26.Interoperability
9.Funding sources	27.Monitoring and evaluation of technology intervention outcomes
10.Motive for policy/strategy document	28.Governance and management
11.Motive for technology interventions	29.Objective of the policy/strategy
12.Patient centred	30.Policy/strategy benefit
13.Purpose of document	31.Quality of healthcare services
14.Strategies for technology intervention implementation	32.Roles and responsibilities
15.Strategy of the implementation of the documents	33.Rules and regulations
16.Support for healthcare practitioners	34.Skilled workforce
17.Support for ICT infrastructure	35.Stakeholder involvement
18.Technology challenges	

5.4 Emerging Themes from the Analysis

The analysis process revealed that in most of the documents, the main agenda was how to provide and address health issues in the country effectively, whether addressing issues around universal healthcare coverage or improving efficiency and effectiveness in the delivery of healthcare services. The analysed policy/strategy documents provide the healthcare system with direction on how to address some of the critical issues surrounding health. For example, the need for more integrated healthcare services in the country drives the implementation of technology interventions and consequently the Department of Health is mandated to provide policies and strategies to guide the successful implementation of

such interventions. In the next sub-sections, the chapter discusses the themes that emerged from the analysis of the documents. Table 5-3 provides a summary of the dominant themes that emerged from the document analysis.

Table 5-3: Emerging dominant themes from document analysis

Themes	Description	Focus
Purpose and motives	The emphasis of this theme was on whether the policy/strategy documents had clearly defined reasons for the proposed changes the policy/strategy would bring, and whether the objectives were specific, measurable, achievable, realist and timely. What were the drivers for the development of the policies/strategies? (i.e., external or internal).	**Improve access to quality healthcare services**
Strategic initiatives	The emphasis of this theme was on whether the proposition in the documents fits in with the healthcare sector needs and other wider strategies and priorities in the healthcare system.	
Perceived benefits/value	The emphasis of this theme was on the perceived benefits or values the propositions in the documents brought. For example, what financial and non-financial (i.e., quality, safety and health) outcomes are expected? Has evidence been provided for the expected effectiveness? Whom does this change benefit and how?	
Monitoring and evaluation	The emphasis of this theme was on how the impact of the proposition in the documents was/would be monitored, measured assessed.	
Resource infrastructure	The emphasis of this theme was on the required resources and infrastructures available or unavailable to support the implementation of the changes at all levels of the healthcare system.	

5.4.1 Purpose and motive theme

The emphasis of this theme was on the motivation for and purpose of the development of each document analysed. The theme also focused on whether these were specific, measurable, realistic and achievable. The findings reveal that the changes or the intended changes effected by the policies, strategies and Acts were to some extent in response to the need to redress the legacies of the previous healthcare system. For example, in many instances, the policies and strategies were formulated to fulfil the mandates of the National Health Act, 61 of 2003. The Act was developed to address the inequities in the healthcare

system in terms of universal healthcare coverage. In another example, the core purpose of the eHealth strategy was to enable the healthcare system to leverage the opportunities eHealth presented by providing a roadmap for attaining a well-functioning HIS. This was in support of the broader national transformation of the healthcare sector (DoH, 2012b). At the same time, the purpose of the strategy was as result of the differing levels of maturity of the e-health systems across the country's healthcare system. The manifestation of these differences was seen in some of the previous initiatives by the Department of Health not reaching completion owing to issues such as inadequate planning, management and lack of funding (DoH, 2012). A good example of such a case was the initiative of telemedicine that failed to survive past the piloting phase, with the Department of Health having to suspend the implementation (Leon et al., 2012).

Another example of the purpose theme is the mHealth Strategy, published in 2015 by the Department of Health with the reasoning that the document would be an integral part of healthcare service delivery. This was so that patients were empowered with "information, improving access to health services and real-time data management to assist in addressing the current inefficiencies in service delivery" (DoH, 2015:6). The purpose of the NHI Bill was to ensure the right to health for all, entrenching equity, social solidarity, and efficiency and effectiveness in the health system in order to realise universal health coverage (McIntyre, 2012). The NHI Bill is central to the structural changes taking place in the healthcare system currently, and is set to affect how healthcare services are funded to ensure equitability. As such, Slabbert (2011:33) notes that the objective of the NHI is to put measures in place for a funding mechanism that ensures "the creation of an efficient, equitable and sustainable health system". Similarly, Bernitz (2014:75) argues that all citizens would have an opportunity to receive healthcare services regardless of their employment status and ability to contribute to the NHI fund.

From the analysis of the documents, the researcher observed that although the documents contain clearly articulated motives and purposes, these are in some cases more generic terms. Whether the objectives and goals of the documents are attainable depends on the monitoring and evaluation done during and after the implementation of the policies/strategies (Masilela et al., 2014). The findings across all the documents reveal the presence of interests (i.e., societal interest groups or political interests). For example, one of the strategic principles that the National Digital Health Strategy (2019–2024) embodies is that it is person centred. What this means is that the strategy's interest is focused on individuals in terms of access to information using digital platforms. The findings also reveal that there are certain external factors that inform the development of these documents. The external factors in this instance include widespread use of mobile technology in the case of

the mHealth strategy, technology advancement in the case of the eHealth strategy, or national (NDGs) or global sustainable development goals (SDGs). According to the DoH (2019), the NDHS was developed not only as a result of lessons learnt from the implementation of the e-health strategy, but also as result of the “proliferation of mobile devices”. Another revelation from the findings was the intention of the Department of Health to improve governance in the healthcare sector, paying special attention to increasing public participation in healthcare reforms, enhancing accountability, and to some extent eradicating corruption in the healthcare system of the country.

5.4.2 Strategic initiative theme

This theme emerge from the perceived expectations that the policies and strategies present in the healthcare sector. Expectations such as improved integrated healthcare services, data management and so forth. The researcher observed that each document, especially the policy and strategy documents, in addition to the title, had a start and end date of implementation. Within that stipulated date were the scope and definitions of the documents, evident in all the documents analysed. Following the definition of the scope of each document, key deliverables were given; however, the researcher observed that some objectives were very abstract. Another key finding based on these themes was the relationship of the content of these documents to the strategic objective of the national health system of improving healthcare service delivery. In all documents there are proposed milestones/tasks for each policy/strategy and its contribution to the overall strategic objective of improving healthcare service delivery in the country.

The emphasis of this theme was on whether the proposition in the documents correlates with the healthcare sector needs and other wider strategies and priorities in the healthcare system. All the documents analysed in this study were positioned within the local and/or broader national strategic goals and objectives to meet the healthcare system’s needs. For example, documents such as the eHealth, mHealth, NDHS and the NHI are all aligned with the strategic objectives of the National Health Act, 61 of 2003, and the National Development Plan (NDP) 2030, published in 2012 with the aim of eradicating poverty and reducing inequity by 2030. The South African NDP plan aligns with the Sustainable Development Goals (SDGs) 2030 published by the United Nations (UN, 2015). The documents analysed in this section are all embedded in this plan. As such, the strategic priorities reflect on a national rather than a local level, which is less articulated in the documents.

5.4.3 Benefit/value theme

The focus of this theme was on the perceived benefits or values of the propositions in the documents. Although not clearly articulated, the documents describe the perceived benefits/values in most cases in terms of the positive outcomes resulting from their implementation. The benefits or value of these documents were predominantly in terms of cost saving or the improvement of quality in the delivery of healthcare services. The benefits/values are consistently viewed in terms of financial implications. In other documents the benefits/values are expressed in terms of improvements to be made to the healthcare service delivery, specifically to patients. An example to this is the mention of the MomConnect mobile application that is being used to improve the support maternal health and child healthcare services. The mHealth strategy outlines areas in which the strategy should provide benefits, including in leadership and governance, patient rights, clinical support services, and operational management, among others. In the NDHS document, there is mention of digital health beneficiaries, who include patients, citizens, healthcare workers, and healthcare managers.

Key examples of the expected benefits or values of the NHI White Paper are outlined as key mechanisms relevant (directly or indirectly) to specific individuals in the healthcare systems. The benefits/values include the following:

- ✓ The NHI Bill is expected to provide benefits for community healthcare workers in ward-based outreach programmes in households, with the intention of promoting health, and in the process identifying those members of the community who need preventive, curative or rehabilitative services. From a broader perspective, this is expected to improve health outcomes. The perception of decision makers thus is that the NHI initiative does bring with it some value to the healthcare system.
- ✓ Another example is the perception that a Bill such as the NHI, if implemented successfully, will enable the integration of health programmes. The expectations here is that the overall value of this policy is to improve the well-being of the country's young adults and children.

In relation to the NHI White Paper, the researcher did not find evidence of adequate evaluation of the impact of these interventions and the associated costs and constraints these initiatives impose on the healthcare system. Another example of the perceived value or benefit of the implementation of a policy document such as the DHMIS policy standard operating procedures: Facility level (DoH, 2012), is the belief that the document will enable adequate use of DHMIS in hospitals in a manner that will encourage a standardised process

in the collection, capturing, collation, storage and analysis of healthcare data. The assumption is that this will eradicate the issues data duplication and quality.

5.4.4 Monitoring and evaluation theme

The emphasis on this theme was on how the impact of the proposition in the documents would be monitored, measured or assessed. Obviously, it is important to monitor and evaluate e-health initiatives in a healthcare context, given the financial investment by the Department of Health, and by extension, the national government. Across all the documents there is mention of evaluation and monitoring of the implementations of the various policies; however, such evaluation and monitoring are superficial. Evaluation and monitoring of these policies should result in changes to practice within the healthcare system. However, as highlighted across this study, despite the existence of these policies, there are continuous challenges, such as lack of interoperability and fragmentation in implementation of HISs in public healthcare facilities across the country. Another example is the challenges of data quality across the public healthcare system despite the existence of the DHMIS policy standard operating procedure. This gives an indication that there is a gap whether in the implementation of such documents or in the evaluation of its impact and redressing those gaps.

Apart from monitoring and evaluation of the implementation of these policies, further monitoring should involve investigating how the changes relating to HIS implementation in healthcare facilities impact healthcare practitioners' daily work activities. This should include monitoring the occurrence of expected desired (or undesired) outcomes, as well as unexpected desired (or undesired) outcomes. For these reasons, monitoring and evaluation of the implementation of policies in the healthcare sector should be appropriately tailored to improve initiatives, with plans to describe how the evidence generated will inform future initiatives in the sector.

5.4.5 Resource infrastructure theme

The emphasis on this theme is on the required resources and infrastructures available (or unavailable) to support the implementation of the changes at all levels of the healthcare system. One of the major challenges the Department of Health faces in the implementation of policy or strategies at the local level of the healthcare system includes historical issues (legacy systems in most public hospitals), and inadequate resources, among others (Littlejohns et al., 2003). It is therefore essential that adequate resources are put in place to ensure that the healthcare system realises the potential of the policies/strategies. For example, having adequate training and support programmes for healthcare practitioners on

the use of the HISs integrated in their work activities have the potential to improve health outcomes directly or indirectly.

Most of the policy documents provide for infrastructure development and management, including physical infrastructure; however, the realities at the lower levels of the healthcare system do not reflect this, especially in resource-constrained environments. In the NHI White Paper, the government commits to investing in the growth and development of infrastructure across the public healthcare sector. The commitment prioritises safety, ensuring that healthcare services are universally accessible to every individual in the country. While the emphasis on infrastructure development in healthcare facilities is important, there should be a balanced approach to the implementation, ensuring that community-based healthcare facilities are not omitted. In other words, healthcare settings that are well resourced are in a better position to embrace the changes advocated by the policies. This is opposed to healthcare facilities in resource-constrained settings that may struggle because of the added pressure.

Table **5-4** presents some text extracts from the documents in relation to the themes that emerged from the analysis of those documents.

Table 5-4: A sample of text extract for selected documents

Document	Text Extract	Analysis of text	Themes
National Health Act, 61 of 2003	"To provide a framework for a structured uniform health system within the Republic, taking into account the obligations imposed by the Constitution and other laws on the national, provincial and local governments with regard to health services; and to provide for matters connected therewith" (p. 3).	This text indicates the intention or purpose for which this Act was promulgated, which was to redress the challenges of inequities in the healthcare system	Purpose/Motive
eHealth Strategy	"An integrated and well-functioning national patient-based information system, based on agreed upon scientific standards for interoperability." "Achieving a well-functioning national health information system with the patient located at the centre."	The policy is intended to improve the efficiency of clinical care, produce the indicators required by management, and facilitate patient mobility The new eHealth Strategy provides a clear roadmap for achieving its purpose	Purpose/ Motive Benefit/value Strategic initiative
NHI White Paper 2017	"National Health Insurance (NHI) is a health care financing system that is designed to pool funds to actively purchase and provide access to	The NHI has the potential of radically transforming the architecture of the	Strategic Initiative

	quality, affordable personal healthcare services for all South Africans based on their health needs, irrespective of their socioeconomic status. NHI is intended to move South Africa towards Universal Health Coverage (UHC) by ensuring that the population has access to quality health services and that it does not result in financial hardships for individuals and their families" (p. 3).	public healthcare sector into a more integrated, equitable and cost-efficient healthcare system	Purpose/Motive Benefit/value
DHMIS Policy	"To ensure uniformity in the implementation and use of the DHMIS, a need exists for the development of an overarching national policy with associated processes, and standard operating procedures (SOPs), norms and standards" (p. 6). "… to formally standardise the implementation of the DHMIS and create uniformity across the country; and … to clarify the roles and responsibilities of each level of the health system in DHMIS implementation. The policy will contribute significantly to improving the availability, quality and use of health information for efficient and effective planning and management of health programmes, as well as enhancing the coverage and quality of health services to improve health outcomes" (p. 15).	The text from the policy document is an indication of the Department of Health's commitment to a unified and integrated use of technological solutions in the healthcare system	Strategic initiative Purpose/ motive
mHealth Strategy	"… the proposed National Electronic Health Record system; the proposed National Health Insurance; the roll-out of a national electronic medical record system for monitoring anti-retroviral treatment for HIV/AIDS" (p. 12). "This strategy follows the need-driven approach used in the over-arching eHealth strategy within which it is embedded" (p. 9).		Strategic initiative

5.5 Critical Discussion of the Findings

Health policies in South Africa were developed from the need to redress the inequities and inefficiencies in the healthcare system (Schneider et al., 2007:294). Shi and Singh (2005:9) contend that healthcare systems are often influenced by external factors such as "political climate, economic development, technological progress, social and cultural values, physical [context] and population characteristics (demographics and health trends)". Thus, the

effects of the interaction among the factors have some sort of implications in achieving quality healthcare service delivery. Similarly, Kickbusch, et al. (2008) posit that the status of a population's health and equity are influenced by a multitude of factors outside the usual scope of a healthcare system. The implementation of policies/strategies that address the social determinants of health are often hampered by the complexities of devising effective policies/strategies (Exworthy, 2008). An example that illustrates the complexities of devising legislation is that of the National Health Act, 61 of 2003, primarily developed to address issues related to inequities in the healthcare system. However, almost two decades after the promulgation of the Act, the country still contends with equity issues in the delivery of healthcare services in public healthcare facilities (Booysen et al., 2018).

5.5.1 Policy/strategy Implications in the healthcare systems

As mentioned in the introductory section of the chapter, the analysis of the documents was approached from three different perspectives: context, meaning of text, and consequences the other two perspectives have on broader contexts of healthcare service delivery. The context perspective is highlighted in the section on the description of the documents. In describing the documents, the researcher was able to uncover the contexts in which each document was compiled. For example, the National eHealth Strategy was developed under the context of providing a roadmap for the development and implementation of an e-health initiative in the country. The second approach was for the researcher to gain perspective on the terms in the documents. For example, the use of terms such as 'aims and object'; 'sustainability' and 'benefit/value'. The study sought to gain an understanding of what these terms meant in the context of the documents. What the researcher concluded from this was that the various connotations are problematic for the individuals who are expected to interpret and implement these policies/strategies at the lower levels of the healthcare system and have a significant impact on the success (or failure) of the policies/strategies.

This section shifts the focus of the discussions to the consequences these polices and strategies have on the broader context of public healthcare service delivery. As already established throughout this thesis, the healthcare sector is more than just the delivery of healthcare services; the sector also includes policies, strategies and procedures. These national policies and strategies in any healthcare system are important in the coordination of various activities by the vast number of stakeholders in the system, and enable the healthcare systems to realise interoperability. Consequently, these policies/strategies need to facilitate adoption and implementation, and be innovative. At the same time, other government regulations need to be at the same level of technology. The maturity of collaborative efforts between these policies/strategies and practice (at healthcare facility

level) is essential if a healthcare system is expected to demonstrate a more relevant and accurate reflection of a country's public health status (Jansen et al., 2010).

Scholars such as Patel and Rushefsky (2014), and Clinton and Sances (2018), contend that there is considerable political influence in healthcare policy making in many countries. Jansen et al. (2010) argue that the policy-making process should be based on knowledge and results. However, its realisation is impacted by three factors: (i) the high volume of healthcare data across the healthcare system that challenges the evidence-finding process. Because of the numerous factors that influence health outcomes, the policy-making process requires many types and sources of data, adding to the complexity. (ii) The limited evidence of monitoring and evaluation of public healthcare policies/strategies with clear outcomes and performance indicators. (iii) The one-way exchange process of information between policy makers, researchers and healthcare practitioners (Jansen et al., 2010). For policies and strategies to make meaningful impacts in the healthcare system, these three factors have to be addressed.

Drawing from the analysis of the documents, the researcher observes that all the policies and strategies analysed have a strategic objective of improving the quality of healthcare services delivered and subsequently improving the quality of the county's health outcomes. Peabody et al. (2006:1296) suggest that governments can measure the success of the quality of improvement as a result of the policies/strategies by their ability to "raise the average level of health and reduce variations in quality". The authors categorise policies/strategies into two groups:

- ✓ Those that directly or indirectly influence healthcare providers' behaviours by altering the structural conditions of the healthcare organisation as well as financing of healthcare, or that involve the redesign of existing healthcare systems.
- ✓ Those that target healthcare providers' behaviour directly at individual or group level.

In the context of this study, it is clear that health policies and strategies in South Africa fall under these two categories. For instance, the DHMIS policy altered the way data at all levels of the public healthcare system is managed (that includes the people responsible for the activities). The NHI policy, when fully implemented, will change the design of public healthcare funding in the country. Although not analysed owing to irrelevance to the study's topic, there are health policies and strategies that govern healthcare practitioners, be these at individual or group level. Such policies include the National Policy on Nursing Education and Training (2019) and Policy Guideline on the Requirements for Practice of Medical Professionals in South Africa (2018).

The realities on the ground (in healthcare facilities), especially in resource-constrained environments, reveal that although the healthcare policies and strategies in South Africa are 'perfect' on paper (in theory), there is a gap in the alignment of theory and actual practice. Peters, Tran et al. (2013:8) argue that for future healthcare interventions such as HIS implementation to be successful under the guidance of health policies/strategies, policymakers must move towards "context-specific and evidence-informed decision making to make 'what is possible in theory a reality in practice'". An example of the negative implications of poor policy implementation is evident in the weakness of the DHIS in public healthcare facilities that called for the urgent need for not only the DHMIS policy to be adequately implemented, but also the eHealth Strategy.

5.6 Summary of Chapter 5

The chapter provided a thematic analysis of policy documents in the public healthcare domain that influence healthcare service and HIS implementation. The chapter provided in-depth descriptions of each document, highlighting the intentions, interests, aims and objectives of the documents in the healthcare domain. For example, the National Health Act, 61 of 2003 largely served as a springboard for other policy/strategy documents in terms of providing a roadmap for improving the quality of healthcare services in public healthcare facilities. Other documents, mainly pertaining to the status of healthcare services in South Africa, were discussed. The thematic analysis process of the documents, including the coding procedure, was delineated. This led to a discussion on the themes emerging from the analysis. These themes reflect aspects such as the purpose of and reasons for the documents, and how these themes influence the broader healthcare system.

6 CHAPTER 6 – CASE-ANALYSIS PROCESS

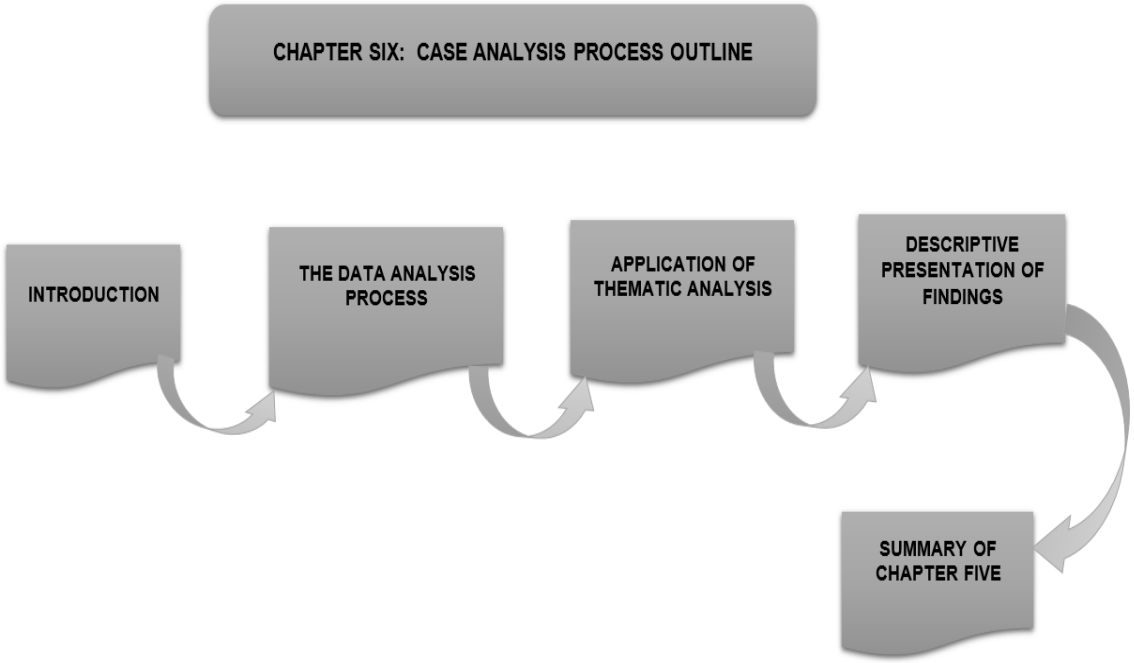

Figure 6-1: Chapter 6 outline

6.1 Introduction

This chapter presents a narrative and descriptive discussion of the findings from the first phase of the multi-layered analysis of the study. The findings in this chapter are therefore extrapolated from the exploratory case-study design phase and draw on the first two steps of the six-step framework of Bygstad and Munkvold (2011). The presentation of the findings is built on emergent categories and themes from the analysis of the interviews and observation empirical data. Case descriptions and analysis, according to Wynn and Williams (2012:796), allow for some “explication of events” (i.e., case descriptions allow the researcher to explain events that take place in the empirical case) associated with a system’s use. In the context of this study, a case description is used to explain HIS implementation and use to facilitate the healthcare service delivery process in public hospitals, by employing everyday concepts in the context. The study employs a descriptive process to provide in-depth insight into the public healthcare service delivery landscape in South Africa in healthcare facilities in resource-constrained environments.

This chapter draws on Wynn and Williams’s (2012:797) argument that from a case description, one can uncover underlying mechanisms that function as a “foundation for

understanding what really happened in the underlying phenomena". The research problem of the study comprises the root causes of the challenges that plague the implementation of HIS in the public healthcare system. These challenges include a lack of integration among existing systems, fragmentation of systems due to a lack of coordination, a lack of interoperability, and the implementation of HIS in silos. These challenges have had major implications for delivery of healthcare services, and have contributed to an already problematic public delivery system.

This chapter attempts to address the challenges raised in the research problem by first presenting a descriptive narrative of the findings based on the key investigative issues that guided the study. To illustrate this, the study is divided into five sections, starting with Section 6.2 that discusses the data-analysis process, detailing the procedures. This is followed by Section 6.3, outlining the thematic analysis process as applied in this study. In Section 6.4, the chapter discusses from a critical realist perspective the emergent information based on the key issues of investigation. Section 6.5 concludes the discussion in Chapter 6.

6.2 Data Analysis Process

In this section of the chapter, the discussions centre on the analysis process of the empirical data. The process involved the researcher's interpreting the data through the thematic analysis process. In the first step, the researcher arranged the data from the interview and observation transcripts into similar keywords in relation to each issue of investigation. For example, in the first issue of investigation, the researcher wanted to understand the status of healthcare service delivery in public healthcare facilities. To arrange the data from the interview and observation transcripts, the researcher related each response to keywords such as turnaround times, workloads, and morale. In accordance with the critical realist ontology, the researcher began the interpretation of the data by searching for semi-predictable patterns in the empirical data. For critical realists, this process is known as searching for 'demi-regularities'. These patterns were then coded in relation to the researcher's interpretation of their meanings. In qualitative data analysis, data are described through the use of their context (i.e., text). During the analysis process, the study adopted the constructs of the ActAD framework as an analytical lens though which meaning was given to the texts described.

6.3 Application of Thematic Analysis

The thematic analysis technique was employed in this study as it is widely used in qualitative research as a "method for identifying, analysing and reporting patters [or themes] within data" (Braun & Clarke, 2006:83). This technique allows the researcher to repeatedly

search through the empirical data set in order to identify patterns that emerge from the data. The emerging patterns then become categories for analysis (Fereday & Muir-Cochrane, 2006). The study recognised other techniques of analysis such as discourse analysis, content analysis, and grounded theory analysis. Although any analysis technique could have been applicable to the analysis of data in this study, the researcher opted for thematic analysis for its vigorous nature. According to Myers (2009:175), “My personal view is that there is no such thing as one approach that is better than all the others. Rather, each analysis approach has its advantages and disadvantages.” Therefore, it is for researchers to apply their knowledge in finding a fitting analysis technique for their work.

One of the many key aspects of the thematic analysis technique is the use of codes in the text description process (Miles & Huberman, 1994). The authors note that the use of codes makes it easier to retrieve and organise the data” (Miles & Huberman, 1994:57). For example, during the transcription process, the researcher used specific codes such as accessibility, ease in functioning, and employee satisfaction. These codes were tied to certain texts that were seen as relevant to the issue of investigation. In thematic analysis, themes are said to capture fundamental aspects of the empirical data associated with the interview questions and the issue under investigation. As such, the technique provides important ways of enriching the account of the empirical data (Fereday & Muir-Cochrane, 2006). A theme may evince strong meaning in one set of data, but at the same time little meaning in another set of data. It is therefore critical that researchers apply clear judgement in determining what they consider themes in their analysis (Braun & Clarke, 2006). In certain instances, a researcher may have predetermined themes and codes, depending on the mode of inference. The predetermined themes and codes may be based on existing literature or a theory that guides the formation of data-collection questions (Braun & Clarke, 2006). In such instances, the analysis is described as a theoretical thematic analysis.

For this study, theoretical thematic analysis was applied as the study employed the constructs (motives, goals, mediators and tools) of the ActAD framework in the analysis. It applied the thematic analysis guide by Braun and Clarke (2006) as illustrated in Table 6-1.

Table 6-1: The six phases of thematic analysis (Braun & Clarke, 2006)

Phases	Description of the process
Familiarising yourself with your data	Reading and rereading of the data, noting down initial ideas.
Generating initial codes	Coding interesting features of the data.
Searching for themes	Collating codes into potential themes, gathering all data relevant to each potential theme.
Reviewing themes	Checking in the themes work in relation to the coded extracts (level 1) and the entire data set (level 2).
Defining and naming themes	Ongoing analysis to refine the specifics of each theme and overall story the analysis tells; generating clear definitions and names for each theme.
Producing the report	Selection of vivid, compelling extract examples, final analysis of selected extracts, relating of the analysis to the research question and literature.

Applying the six-stage process of thematic analysis in the analysis of the empirical data in this study involved transcribing all the interviews with the 21 respondents (see Appendix G for sample). Thereafter the researcher read through each transcript to familiarise herself with the data while noting initial ideas as they emerged. This was done with reference to the observation field notes that were made before, during and after the interview sessions with participants. In the next step, the researcher refined the initial set of ideas by generating a list of possible codes. This was done in a spreadsheet that allowed the researcher to link the possible codes of each investigative issue to the interview questions. The next step was for the researcher to collate the identified codes into potential categories while aligning them with potential themes, and at the same time checking that the themes were in relation to the coded extracts. Appendix H presents a sample of this process. The researcher repeated this process until the dominant themes emerged, as discussed throughout this chapter and the next.

The next section presents the descriptive findings of the data-analysis process, based on the study's key investigative issues. To protect the respondents' confidentiality, pseudonyms are used.

6.4 Descriptive Presentation of Findings

This section of the chapter draws on the thematic analysis process to outline the emerging findings which are presented under the issues of investigation. The findings are divided into five descriptive outlines, starting with the current status of healthcare service delivery in public hospitals in sub-section 6.4.1, followed by the status of HIS implementation in public hospitals in sub-section 6.4.2, the purpose of HIS implementation and its subsequent use in the hospital is discussed in sub-section 6.4.3, and the role of HIS in the public healthcare service delivery process follows in sub-section 6.4.4.

6.4.1 Status of healthcare service delivery in public hospitals

In this objective, the study sought to gain an in-depth understanding of the prevailing public healthcare service delivery landscape. The background to the research problem discussed in Section 1.2 gave a brief indication of the status of public healthcare service delivery in South Africa. The aim of this objective was to unpack the interplay of the healthcare service delivery processes, the work activities within these processes, and the role of the actors involved in the delivery process. The section begins by outlining the typical public healthcare service delivery processes, using Nelson Mandela Academic Hospital as the empirical case. To achieve this, the activities within these processes are also highlighted and how the different actors carrying out these activities interact to achieve an outcome. The goal here was to understand the various elements in the public healthcare process, the relations these elements form within the service delivery process, and how these relations mirror the status of healthcare service delivery in public hospitals in resource-constrained environments. The study conceptualised the term ‘healthcare service delivery process’ as a sequence of activities essential to the delivery of care services.

6.4.1.1 Healthcare service delivery process at the hospital

Data reveals that the public healthcare service delivery process can be classified into two processes: *clinical* and *administrative.* The combination of these two classifications constitutes a complete healthcare service delivery process. The administrative process is a generic process that is not tailored to a specific healthcare condition, but facilitates the clinical process in various service delivery contexts. The clinical process, on the other hand, is directly linked to the act of patient care and is executed based on the diagnosis made by medical or clinical doctors who, using their knowledge and expertise, interpret a patient-specific condition before treatment commences.

As a result of the facilitation process of clinical processes by the administrative process, various service interaction types are created by the service actors (healthcare practitioners)

involved in the processes. For example, a doctor and a laboratory clerk interact when laboratory tests are ordered as noted by one respondent, stating that “as medical doctors we order for [a] lab test for patients if I want to investigate a patient’s condition further. So we fill in paper work for this and send them to the labs” (GYNO). Another example of a service interaction is when an information manager interacts with a patient registration administrator to gather relevant medical information such as on the outbreak of a disease. These service interactions are independent of actors’ motives and patients’ needs at a particular point in time during the healthcare service delivery process. It is therefore crucial that service interactions operate without conflict should one wish to achieve adequate delivery of healthcare services to patients.

To determine the healthcare processes at the hospital, all three groups of participants were asked to describe their roles at the hospital. This determined whether a participant was in an administrative or a clinical role. For example, in administrative roles, participants included the director of ICT services (both at the hospital and DoH provincial offices) who is responsible for overseeing the management of all ICT infrastructures and services, both at the hospital and at provincial levels (TP.ITS; NM-EC); patient record managers who oversee the registration and archive process at the hospital (PRS_M; C-M); nursing area managers who oversee the nursing staff at various hospital units (AMS); and administrators/clerks who do the capture, storage and distribution of data across the hospital and provincial and national system (W-C). Doctors and clinicians mainly had clinical roles at the hospital. The purpose of identifying these roles was also to obtain different views of the status of public healthcare services.

The study used the term ‘service delivery context’ to refer to the point of service delivery at the hospital. This ranged from the first point of care, usually at registration, where the patient receives a clinic card/file, to the last, when the patient is discharged from hospital. The units included the following: registration, general surgery, obstetrics and gynaecology, internal medicine, paediatrics, radiology, pharmacy, laboratory, clinic, and billing units. **Figure 6-2** depicts the current flow of the healthcare service delivery process at the hospital. It displays the flow of patients from their first point of entry at the hospital to receive care to when they are discharged.

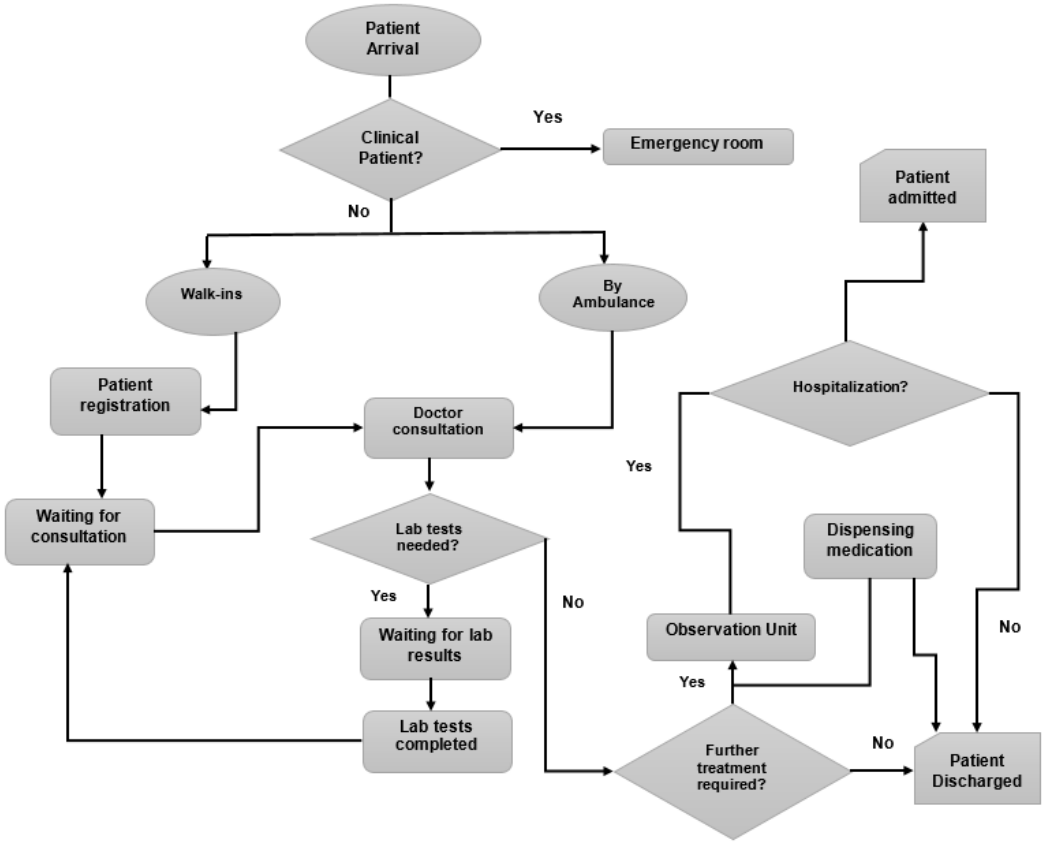

Figure 6-2: Patient flow healthcare service delivery process

Using the flow of the healthcare delivery process, the next sub-section examines the healthcare work activities involved in each of the healthcare processes. Categorisation of work activities within healthcare service delivery processes is depicted in **Figure 6-3**.

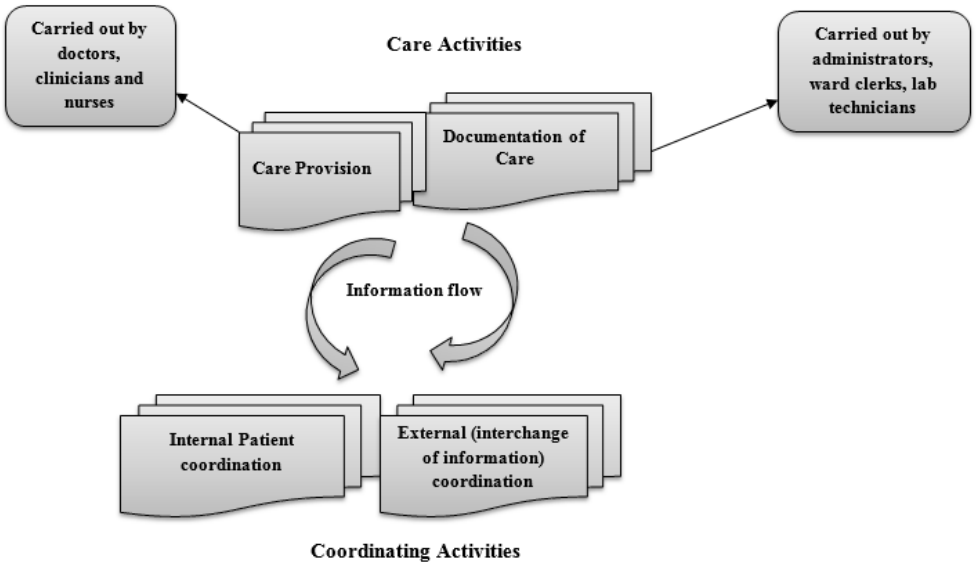

Figure 6-3: Activities within the healthcare service delivery process

Within the two classifications of healthcare processes discussed in sub-section 6.4.1.1, participant's' work activities were categorised into either ***care*** or ***co-ordination activities*** as illustrated in Figure **6-3**. Co-ordination activities are linked to the administrative process and involve patient co-ordination and the interchange of information external to the hospital. Patient co-ordination involves organising patient care activities and sharing medical information among all actors involved in the provision of care to a patient with the goal of achieving adequate healthcare service delivery. For example, once patients are registered and receive a clinic card, the nurses prepare them for consultation with the appropriate doctors, depending on their condition. One of the participant's responses indicates this activity: "We admit surgical patients, others come already operated on, [and] other we prepare them here at the hospital for being operated on, [and] after that we nurse them so as to prevent complications" (AMS).

Internal co-ordination of information involves managing the interchange of clinical information from different service contexts (units) in the hospital for decision-making purposes. For example, "Once the ward clerks capture patients' files they bring them to me, then I send them to management" (AMS). The external dissemination of information is fed into the national health system database. A participant indicates that "the Ministry of Health ideally should be able to collect information from all public hospitals to keep track of health issues and should there be an outbreak of some kind, the ministry has that information" (DMA). Yet another participant also noted that "the information that we get from the labs is sent to the national health laboratory system". These activities are administrative and enable the decision-making process in the public healthcare system based on the information collected from lower-level healthcare facilities.

The care activities involve the provision of care at the hospital, carried out mainly by medical doctors and consulting clinicians. This involves assessing the patient, prescribing medicine, and advising patients on health issues. This takes place within hospital units or departments (service provision context). Care documentation activities go hand in hand with care activities, with most healthcare practitioners indicating that it is a necessity in the delivery of care.

6.4.1.2 Work activities within the healthcare service delivery process

Work activities stem from the broader categories of care and coordination discussed in the previous sub-section. This section discusses the activities within each of those categories. Under the care provision category, there are two categories: (i) clinical activities and (ii) generic hospital activities.

6.4.1.2.1 Clinical work activities

A clinical work activity in this context is a set of work procedures carried out by doctors and clinicians, and in some cases by nurses in the process of care service delivery. These activities have the shared service objective of improving patient health status. They also have a shared means of performance, in other words, how the activities are carried out in the various service provision contexts (units) across the hospital. Interviews took place with purposefully chosen participants from most of the units within the hospital with a direct involvement in the delivery of healthcare services. From the medical/clinical healthcare activities, participants such as doctors, clinicians, and nurses were interviewed. When asked to describe their daily work activities, responses from the internal medicine unit included: “My main activities at the hospital involve assessing patients who come to the hospital. I also do the ward rounds review and update the patient file to reflect the current status” (Doc-CL). Another participant from the orthopaedic unit stated: “I deal with issues that concern bones, so that means that when we get patients we assess their injuries, diagnose them, prepare prosthetics and rehabilitate the patient” (DMA). Other work activities included consultations: “As a doctor, part of my duties is to address the concerns of patients when they consult with me about their health and well-being, such as nutrition and hygiene” (GYNO). Findings indicate that participants in this category also carry out peripheral administrative activities such ordering laboratory tests (GYNO; Doc-CL).

Service actors who carry out non-clinical work activities to support this activity include nurses, managers, administrators and clerks. These actors have different roles and responsibilities of non-clinical work, depending on which unit they assigned to. Generally, their work activities seem to be similar, including assessing patients, documenting, which includes updating the in-patient care plan for the day, charting assessments, and writing patients’ progress reports (AMS; PR-N; EN-N; RN-N). The order and the intensity of activities vary depending on the unit where the nurse is working, for instance, “Because of the condition the patients are in here we have to monitor and document the patients’ condition almost on an hourly basis” (PR-N). Findings also indicate that service actors like nurses carry out activities such as specimen collections from patients, educating patients and their family members, administering medicine to patients, and making calls to doctors when the condition of patients changes, requiring the doctor’s attention (PR-N; EN-N; RN-N).

6.4.1.2.2 Generic hospital work activities

The generic work activities at the hospital involved service actors in administrative positions such as nurses, hospital managers, ward clerks, case managers, network technicians, and ICT directors. Although the activities vary depending on their roles, the service objective of facilitating clinical activities is shared. For example, ward clerks' main work activities involve capturing patients' medical data and filing records (W-C). Administrators at the registration unit capture patients' biographical information and open case files when a patient arrives at the hospital (PRS-M; C-M). Laboratory clerks capture laboratory tests as requested by doctors. Area nursing manager's' activities involve supervision of other service workers in their units. "I make sure that the nurses are equivalent [ratio] to the patient so that there is no shortage; the comfort of the patient is priority" (AMS). These activities are not tailored to a specific healthcare condition; however, they facilitate the clinical activities in various units (service delivery context). Other activities such as "in my department we do supporting, maintaining, planning and implementing [IT] projects" (TP.ITS), form part of general activities that are carried out as part of supporting activities that enable the healthcare delivery process. Patient billing activities and procurement of medical equipment also comprise generic activities. As these activities (clinical and general) interconnect at various service contexts, several service interaction types are created, giving a picture of a complex healthcare service delivery process.

Having detailed the healthcare process and activities within the delivery process, the next questions under this objective looked the historical background of public healthcare service delivery in South Africa. The primary source of data was interviews; however, document analysis was also used as secondary data. To get a sense of the history of healthcare services, participants were asked to reflect on their experiences of working in public healthcare facilities. Data reflect that healthcare service delivery has seen an improvement over the years, with some respondents stating, "I was employed by the Department of Health in 1988, from my experience we have generally come a long way since then; in some areas we have improved since technology was brought in" (AMS). Another participant also indicated improvement in stating, "We have seen a lot of improvements in this hospital ever since we changed the way laboratory tests are done, which has helped the patients and doctors as well" (PRJ-M). However, the public healthcare service delivery still faces challenges such as long queues and waiting times for patient admissions, with one participant noting, "Although there has been an improvement, we still see patients waiting along the corridors" (GYNO).

6.4.1.3 The interplay between care and administrative activities

A positive interaction between the care and administrative activities within the healthcare service delivery process is vital. As noted earlier, the administrative activities facilitate the care activities at the hospital and therefore should be adequate to ensure that the clinical activities are optimally delivered. A key effect emerging as a result of the interplay between the two healthcare activities is the complex nature of the services offered. Because of the complexities of the work activities, often there is a breakdown in communication and collaboration among the healthcare practitioners. This effect may be as a result of other causal factors that will be discussed later. The consequence of a lack of adequate communication or collaboration between the healthcare practitioners is that the patients are often disadvantaged, with longer waiting periods, or forced to endure repetitive processes which result in inadequate healthcare delivery.

The complexities are further exacerbated by individual motives across the two work activities. If an individual is slack as a result of lack of motivation, this affects how others carry out their work, especially if they are dependent on one another's outcomes. The key factors that influence the smooth functioning of healthcare practitioners in a complex healthcare service delivery process include a shared understanding of the healthcare goals, access to relevant information, knowledge of available resources, and proper allocation and coordination of work activities. To ensure patient safety in the delivery of care, it is required that all stakeholders in that process carry out their work activities effectively and efficiently, with the common goal of improving health outcomes. It is only through this that a satisfactory outcome can be reached for the benefit of the patient. Another solution to this problem would be effective leadership and management to facilitate and coordinate the work activities of both clinical and administrative activities, instead of having each team working in a silo. This ensures that healthcare services are better accessible to patients.

6.4.1.4 Summary of findings on the status of healthcare service delivery

Data revealed that the public healthcare service delivery has seen great improvements over the last decade, despite the challenges that the healthcare system still faces. For example, responses from the participants indicate *advancement in medical treatment, technological solutions, and healthcare infrastructure* (DMA; TP.ITS; GYNO; PRJ-M). However, the progress has been overshadowed by persistent challenges within the healthcare service delivery process that indicate that the sector is yet to live up the expectations of the country, given its robust and resource-rich status. These include *slow turnaround times* of the service delivery process that result in long patient queues at the hospital (PRS-M; GYNO; PRJ-M). Findings also indicate that the turnaround time in some sections of the hospital

has improved as a result of the use of technology. For example, one participant mentioned that “previously a patient would wait for a very long time for lab test results, but now it is faster” (PRJ-M). Another participant also stated that “the process of consulting with a patient is now quicker” (DMA). However, the mere presence of technological infrastructure does not translate to improved healthcare service delivery. As one participant noted, “We have all these computers here but they are not functional or not connected to the hospital network” (GYNO). Yet another example of non-functional tools is HIS systems that “have not been working for months” (GYNO), within no action taken to resolve the issues.

Another challenge emerging from the findings is *shortage of resources* or *inadequate supply of resources* (both of medical equipment and human staff), as one of the participants mentioned: “We need more doctors and nurses at the hospital” (AMS). Also mentioned was the inadequate supply of medical equipment (Doc-CL; GYN; DRO). The supply of such equipment by the hospital or Department of Health is essential in the healthcare delivery process. Another indication of the dearth of resources was mentioned by a participant who stated: “You find that sometimes we don’t even have things like gloves to allow me to do my work properly, you are unable to” (AMS). Another participant, a doctor, also noted a lack of medical equipment, stating: “The hospital sometimes does not have enough beds so patients end up sleeping on the benches” (GYNO). Another indication of the shortage of a healthcare workforce was noted by one participant: “At the hospital we only have one specialist” (GYNO). Yet another participant stated, “I am the only one in the entire hospital working on this. I am also sub-contracted to other hospitals in the region” (PRJ-M).

Another key finding from this objective is *poor leadership and inadequate management.* The centrality of leadership and management in the healthcare service delivery process was evident in various responses, including assertions that “the hospital needs a leadership that listens to its employees and addresses issues raised” (GYNO). Another participant mentioned, “If management knew about the changes of [the patient registration system], then perhaps they would assist in getting the additional parts” (PRS-M). The participant further asserted that “lack of their [management] involvement leaves us to do everything” (PRS-M). In essence, it is vital that active leadership and management in the various service delivery contexts and in the hospital in general are demonstrated.

Lack of accountability is another issue facing healthcare service delivery. One of the participants noted, “You find that people who are supposed to be at work either don’t bother coming or come in very late, this is because nobody holds you accountable, whether you pitch or not” (GYNO). Yet another participant stated that “I don’t know if they are negligent or unbothered. People are not applying their minds while doing their duties. That tells me

they do not care" (PRJ-M). Such negativity towards work ethics at the hospital is detrimental to the healthcare delivery process. One doctor noted that "because someone is not doing their job, I must either wait or find another option" (GYNO). The lack of accountability in this case is reflected at both management and healthcare workforce levels.

Another finding from this objective is the issue of competency: *inadequate skills* of healthcare practitioners within the service delivery process. One participant argued that the training institutions do not carry out their mandate adequately, stating that "during this era of training colleges or institutions, focus is on theory rather than practice. And we experience challenges with new recruits they are not equipped" (AMS). Another show of incompetence is seen in general activities, where the application of knowledge and skills in the handling of patients' data and information is critical, as noted by a unit manager: "I don't know if they are negligent or unbothered because of the nature of our jobs such things [incorrect data capturing] should not be happening" (PRJ-M). As a result, the hospital has been sued for negligence, with large sums paid in compensation. This has placed further strain on healthcare service delivery. Technical support staff supposed to assist end users also noted a lack of training from hospital management and the Department of Health, with one participant stating, "Ideally training is supposed to be given, but they don't. We have requested quite a number of times to be involved in those systems" (Tech. P).

The implications are that these challenges/issues have compromised the ability of public healthcare facilities to deliver quality care services to the majority of the population, especially the populace in under-served contexts. As a result, healthcare service delivery in public hospitals is claimed to be in a deplorable state. Table **6-2** summarises the findings (themes) under the status of public healthcare service delivery. Further discussions from a critical realist perspective and more explanations are presented in Chapter 7.

Table 6-2: A summary of themes: the status of healthcare service delivery in public hospitals

Theme	Description
✓ Advancement in ICT infrastructure and technology use	The healthcare facility has seen an increase in the use of technology in the healthcare service delivery process.
✓ Improved access to healthcare services	More healthcare facilities and increased initiatives to improve access to healthcare service delivery (e.g. formulation of health policies and strategies such as the National Health Act, 61 of 2003).
✓ Shortage of resources	Short supply of medical resources and healthcare workers, especially in under-served contexts (such as the empirical home)
✓ Slow turnaround times in workflow processes	There is still evidence of long queues at the healthcare facility. Some healthcare activities have longer turnaround times attributed to, among other issues, a shortage of healthcare workers.
✓ Litigation issues	As a result of an increase in medical errors, missing files, etc.
✓ Lack of adequate infrastructural support and malfunctioning medical equipment	Mention of medical machines that have been non-functional for months. Computers lying around with no connectivity.
✓ Low morale and dissatisfaction among healthcare practitioners	There is a lack of motivation among doctors and nurses, especially to work in under-served contexts

In the light of the findings on the status of public healthcare service delivery, the next investigative issue (objective) was to determine the status of HIS implementation and use in public healthcare facilities. The findings of this objective are presented in the next sub-section.

6.4.2 Status of HIS implementation and use in public hospitals

In order to determine the status of HIS implementation and use in public hospitals, the researcher conceptualised the terms ‘implementation’ and ‘use’. After a review of the literature, the researcher deduced that implementation in this context is the process of defining how information systems should be designed and developed to meet a context’s intended purpose. At the same time, and the focus of this study, the implementation process should ensure that the information system is operational and subsequently optimally used.

‘Use’, on the other hand, is viewed as end users in a particular context, putting to use technological tools to accomplish various activities.

The public healthcare sector in South Africa has experienced considerable advancement in technology initiatives since the dawn of its democracy. However, as highlighted in the background to the study’s research problem in Section 1.2, the sector experiences challenges in justifying the ROI of the implemented HIS. Findings from the empirical data also show these initiatives include investment in technological solutions that are embedded into the healthcare service delivery process, by automating some of the work activities in the processes. These initiatives of the Department of Health and individual hospitals are to improve the delivery of healthcare services. All technological solutions are encapsulated in this study as HISs. This next sub-section reports on findings on the status of the implementation and subsequent use of these HISs in the public healthcare sector. However, the study narrows the focus to healthcare facilities within resource-constrained environments.

To determine the status of HIS use, the researcher, during the interview process, searched for indications of awareness and understanding of the purpose of information systems implementation and its use. The assumption was that for the participants to use the system, they had to perceive the value of the information systems in their work activities. The researcher also examined whether the systems were useful in achieving the healthcare practitioners’ work objectives, the level of use or non-use of the systems by the participants, and whether the participants found the systems easy to use or not. Firstly, to determine the status of HIS implementation and use at the hospital, the researcher needed to ascertain how the manual paper-based process of delivering healthcare service was perceived by the participants in the study at all levels. Sub-section 6.4.2.2 presents the findings on the awareness of existing technology interventions amongst healthcare practitioners. In sub-section 6.4.2.3 the findings on participants’ perception of technology interventions in the healthcare service delivery process is presented. Sub-section 6.4.2.4 presents the findings on the participants’ experiences with the existing technology interventions at the hospital.

6.4.2.1 Participants’ perceptions of the manual paper-based system at the hospital

Findings from the three groups of participants reveal conflicting views of the manual paper-based system at the hospital. These differences in perception are evident from the two healthcare processes, clinical and administrative. In the clinical healthcare process, participants such as doctors, whose work activities are mainly not automated, are of the view that the manual paper-based system is not in any way inefficient (Doc-CL; DRG; DRO). For example, these participants disagreed that manual paper-based processes

resulted in more time dedicated to administrative activities, with one doctor stating: “I spend less time writing up patient files. So I don’t see a problem with doing that” (Doc-CL). This can likely be attributed to the fact that some doctors and clinicians do not perceive the urgency of making detailed notes on patient files; in most cases this is done by nurses and other administrative actors in the process, like ward clerks. However, some doctors view the manual paper-based system as outdated and inefficient. “Some of these processes need to be automated so that we can have a record of patient information at hand [and] spend less time looking for information”. (GYNO). This school of thought is associated with the younger generation of doctors who are more likely to welcome technological change in the clinical healthcare process. This is evident when one doctor notes that “you will find that the young doctors, our interns, are the ones who are interested in technology” (Doc-CL). Yet another doctor noted some resistance from the older generation who “insist on paper” (GYNO) to carry out some of the already automated work activities.

Findings reveal that participants who carry out administrative activities perceive the manual paper-based system as inefficient. These perceptions are most likely attributed to their work activities involving high administrative workloads that are often repetitive and time consuming, given the nature of the environment. As one member of the nursing staff stated: “It takes time to write this paperwork. Also, the papers can easily be lost” (AMS). Another participant mentioned that “the manual process leads to duplication of reports” (PR-N), which can be misleading and “costly” (PRJ-M), as in the case of laboratory tests ordered multiple times for the same patient at the same time. Because of the frequency of demand for patient information, the administrative actors perceive the manual system to be very tedious at times. In addition to the responses from the interviews, the researcher observed that written reports and files are mostly heaped in piles with no form of archiving, which begs the question of how secure those files are. Participants in the administrative process raised this concern, mentioning that the manual process, where paper is produced and not secured, has resulted in the hospital facing litigation (PR-N; AMS; ER-N). This often happens when files are accessed by unauthorised persons. In most cases the hospital is unaware the files are missing until a case is brought against the hospital.

Another finding with regard to the manual process at the hospital is the need for a parallel manual paper-based system, even in cases where systems are automated. This can be attributed to the fact that the healthcare practitioners are tasked with recording multiple aspects of patient data, such as patient history, medication, observations, and laboratory results on a frequent basis. As a result of this repetition, some clinical actors prefer a manual process rather than an automated one. The researcher also observed that clinical actors conditioned to work in a non-automated environment are more likely to resist new

automated workflow processes that require a patient's data to be assessed and captured onto a computer system. The researcher therefore wished to ascertain the degree of awareness of existing HISs at the hospital. The findings reveal that despite evidence of the availability of technological tools at the public hospital, manual paper-based systems are still widely used in healthcare service delivery. Table **6-3** presents the dominant themes emerging from the analysis of participants' perception of the manual paper-based system at the hospital.

Table 6-3: Themes linked to the manual paper-based process

Themes	Categories
✓ Time consuming and cost ineffective	Manual patient admission process that involves data capturing can be time consuming Bottleneck dataflow in the healthcare service processes
✓ Poor health records management	Limited storage space at the hospital
✓ Poor data quality	Manual data capturing is prone to human error
✓ Duplication of data	Multiple times patient data is captured

Based on the findings, it is evident that the hospital still uses manual paper-based systems to deliver most of their healthcare services. As a result, the study sought to determine the level of awareness of HISs at the hospital and how that impacted healthcare work activities. This is presented in the next sub-section.

6.4.2.2 Participants' awareness of existing healthcare information systems

To determine the level of awareness from all three groups (doctors, nurses and administrators) of participants, they were asked to reflect on whether they were familiar with any healthcare information systems within their work activities. What emerged was that participants' knowledge and understanding of healthcare information systems begin with the meanings they attach to a particular technology in their line of work. There was consensus among participants, both in the administrative and clinical processes, that healthcare information systems include ICT tools such as hardware, software, networks, mobile phones, etc. Participants used the terms 'system(s)' and 'technology' interchangeably, therefore the researcher took into consideration such factors while asking the questions. For example, some participants in the clinical process understood healthcare information systems to be ICT tools such as desktop computers, laptops, mobile phones,

and software. However, when prompted further on their work activities, such as ordering patient laboratory or radiological tests, there was an admission of awareness of HISs such as the laboratory information system and the PAC system (GYNO; Doc-CL; DRO; DRG). One doctor noted, “Yes, sometimes we use these systems to order patients’ blood tests and receive the results on our mobile phones” (DRG). Another doctor also stated, “We receive notifications from the labs with patients’ test results on our cell phones. That is the only time I use technology” (Doc-CL).

Findings revealed that participants within the administrative process had a high level of awareness compared with those within the clinical process, owing to their nature of their work activities. Participants within the clinical process had minimal experience of the HIS at the hospital as they seldom used it. Participants within the administrative process gave clear descriptions of their knowledge of existing systems, including Delta 9™, Rx Solution, PAC and NHLS (PRS-M; PRJ-M; TP.ITS; NM-EC). The participants also noted the purpose of the systems and had positive perceptions of their usefulness and benefits. This gave a clear indication of the level of awareness and knowledge of the systems. Figure **6-4** illustrates the existing HISs implemented at the hospital.

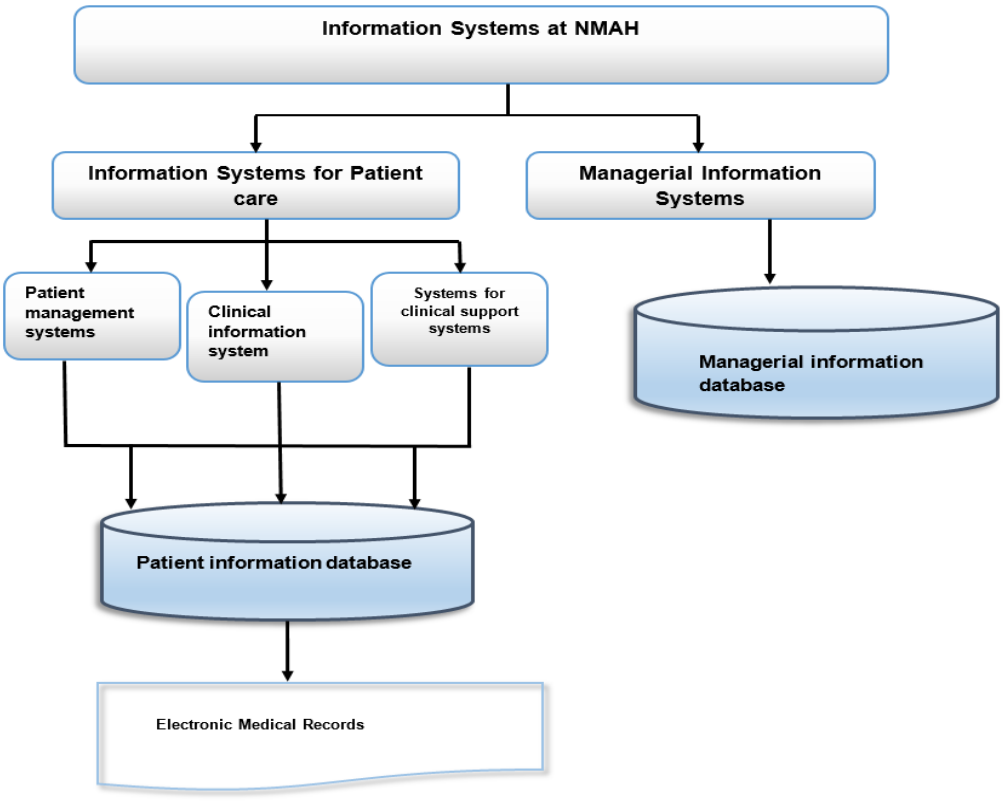

Figure 6-4: Existing healthcare information systems at the hospital

6.4.2.3 Participants' perceptions of healthcare information systems

Findings from the respondents revealed that all three groups of participants perceived that the HISs, regardless of how they perceived them, were or would be useful in their work activities. Participants expressed the wish to have manual systems automated. The perceived usefulness of these systems was as result of the benefits the participants perceived they would gain from the use of the systems in their work activities. There was consensus across the three groups of participants that some of the benefits included timely access to patient information, cost effectiveness, and effective decision making. The manual paper-based process was perceived to be tedious and time consuming, and not cost effective (TP.ITS; PRS-M; PRJ-M; DMA; DRO). Despite their knowledge and perceptions of the benefits of HISs, some of the participants in the clinical process were unaware of what direct impact this had on their daily work activities. As one participant stated, "I honestly don't see how these technologies would work for me" (Doc-CL). On the other hand, some participants viewed benefits, such as having direct access to patient record information and the ability to use such information to provide better care based on informed decision making, as useful in the clinical process (GYNO; DMA).

These conflicting views may be attributed to the fact that the hospital lacks adequate support in managing some of HISs. This is coupled with the "lack of interconnectedness" (TP.ITS) of the existing HIS, and in some cases "lack of connectivity of some tools" (GYNO) to the hospital network. Findings reveal that these issues, in most cases, deter participants from making use of the systems, especially those that already see no value in the systems for their work activities. The researcher observed that these issues led to views that the presence of the HIS was disruptive, with one doctor mentioning, "Where will you place this technology? It will be in the way. The time it would take to type your report which takes long. Even something like a dictaphone will require that someone still types it out because the hospital insists on paper" (Doc-CL). This differs from the views of those participants who carry out administrative work activities. (PRS-M; C-M). They indicated that a system such as the Delta 9™ system they used was useful in their work activities of capturing, storing, and retrieving patient data.

The doctors and nursing staff (AMS; PR-N; ER-N; DRO; DRG) viewed the existing HIS as having limited usefulness in their work. This could be attributed to the fact that they use these systems for a small subset of patients (e.g., those that require laboratory tests, X-rays). Overall, decisions to implement and use HISs at the hospital are motivated by the ability of the systems to reduce administrative workloads associated with data capture, storage and retrieval of patient information, thus optimising productivity in the administrative

healthcare process (PRS-M; TP.ITS; PRJ-M). Another perceived benefit was cost management in the healthcare delivery process (PRJ-M). Whether these perceptions have any influence on use or non-use, is discussed in the sub-section that follows.

6.4.2.4 Participants' experience with HIS at the hospital

Findings reveal that user experience varied within the three sample groups. The administrators found the different systems *easy to use*. One manager in the registration unit mentioned that "I have not heard people in this unit complain about the system. It is easy to use" (PRS-M). Another participant from the orthodontist unit also echoed the same sentiment, stating, "This system it is very quick and easy to use" (DMA). However, some nurses found the technologies difficult to use, owing to factors such as lack of prior experience in using computers. One nurse noted: "Some of us were never trained on how to use these computers, so we find it difficult to use them" (N-NH). A participant from the laboratory section noted that sometimes they experienced challenges with data capturing from the clerks because some are not adequately "skilled to handle certain tasks" (PRJ-M).

Opinions as to whether the users perceived the system as slow varied, with the administrators emerging as those most frustrated by system performance. Findings also reveal frustration in respect of the availability of infrastructure at the hospital to enable the use of the systems. For example, "lack of network connectivity makes it difficult to use some of the systems here" (GYNO). Some computers were unused. As mentioned by one of the participants, "there are computers in our nursing stations but they are never used because [either] they are not working or not connected to the hospital network" (RN-N). Another complaint from the radiology unit was that the "software had not worked for almost four years now" (GYNO).

The study concludes that factors such as systems usability, performance, availability of infrastructure, and system design have the potential to define the user experience, thereby informing user attitudes towards system use or non-use. Participants' responses indicate their willingness to use existing technological solutions; however, the aforementioned factors impact their overall morale in the workplace. Public healthcare facilities have an opportunity to alleviate some of their resource constraints and reduce transactional costs by investing in technology to help better co-ordinate care and move all functions of public healthcare management into the service economy.

6.4.2.5 Findings of the status of HIS implementation and use

The findings show that there is a high level of awareness and relative acceptance of HISs by administrative staff; however, this is relatively low for clinical staff at the hospital. The

high level of awareness and acceptance are attributed to the positive performance expectancy associated with the perceived value of using HISs in their work activities. For example, the majority of respondents are knowledgeable about the implemented e-Health IS in the public hospital where this study was conducted because they are familiar with its purpose and potential benefits. Table 6-4 presents the dominant themes from the finding on the implementation and use of technology interventions that the hospital. The use of HIS ranges from minimal to non-existent among the clinical actors. This is evident mostly in the peripheral administrative activities in their work. Further evidence of minimal to non-existent use of HIS is the case where a number of doctors (during the interview sessions) did not recognise the existing healthcare information systems by name.

Findings also reveal that although there is limited use of IT/IS among the nursing staff, there was evidence of a willingness to use it. The non-use of ICT infrastructures within this group of participants was attributed to the limited or unreliable ICT infrastructure (such as non-functioning computers, scanners and printers, and poor network connectivity at the hospital). On the other hand, there was evidence of a high level of use of HIS by the administrative actors. This can be attributed the nature of their work within this healthcare process. What the study can conclude from these findings, is the need to embed healthcare practitioners' work activities into the structures of the implemented HIS to facilitate its use.

Table 6-4: Themes on the status of HIS implementation and use

Healthcare Information System Implementation	
Theme	**Description**
✓ **Availability ICT infrastructure**	The hospital has a number of HISs currently implemented for various uses in the healthcare service delivery process
✓ **Lack of systematic implementation process**	The hospital has quite a number of HISs implemented; however, none of the relevant participants could give a systematic process for implementation
✓ **Duplication of healthcare data**	There is duplication of data across the hospital as a result of lack of integrated systems
✓ **Lack of customisation of HIS**	Findings reveal a challenge with lack of "tailor-made" systems to fit work processes.
✓ **Poor coordination of existing HIS (leading to fragmentation)**	Most of the systems implemented in a silo, ad hoc manner
✓ **Lack of scalability capabilities**	Some systems do not allow flexibility

✓ **Training and support**	There is a sense of unmet needs for ongoing training and support after implementation of the technological solutions. A high dependency on external technical support
Healthcare Information System Use	
✓ **High level of awareness**	Majority of the participants were aware of the available HIS
✓ **Carry out healthcare work activities (clinical & administrative)**	Used in patient admission, communication of information, dispensing medication.
✓ **Decision-making process**	Information gathered across the hospital is fed to the DHIS system that allows for easy decision making.
✓ **Cost management**	HIS at the hospital, especially in the laboratory unit, is used to manage the cost of laboratory tests.

6.4.3 Purpose of implementation and use of HISs in public hospitals

This sub-section reports on findings on the purpose of the implementation and subsequent use of an HIS at the hospital. The study uses the term 'purpose' as the reasons for which an act such as implementation of an HIS and its use are created or exist. The intention here was to ascertain the reasons for the implementation and subsequent use of an HIS at the hospital. In respect of implementation, data were collected from two groups of participants (hospital managers and representatives from the provincial Department of Health). At the same time, the three groups of participants (doctors, nurses and administrators) were asked their reasons for using healthcare information systems at the hospital. From prior reading of literature, the researcher deduced that the patterns of HIS implementation are informed by people's perceptions of the supposed purpose the system will serve. As a result, the patterns of implementation could not be understood outside the context of perceived use of the system. Consequently, during the interview process, the study operationalised the term 'purpose', by identifying attributes in participant responses that suggested reasons for the implementation by hospital management and use by healthcare practitioners.

6.4.3.1 Rationale for HIS implementation and use at the Hospital

As discussed in sub-section 6.4.2, findings reflect that technology in the public healthcare sector of South Africa has increased in the last decade. The driving force of many of these technologies has long been understood to be the use of the healthcare information they

produce for decision making. Stemming from this understanding, findings reveal that the expectations of various stakeholders are that the ability of HISs to improve healthcare service delivery, led to the implementation of these systems at the hospital.

Table 6-5: Purpose of HIS implementation and use at the hospital

Purpose of healthcare information system implementation	Purpose of healthcare information systems use
✓ Management of patient information ✓ Cost management ✓ Improve quality of data captured ✓ Transparency and accountability in the healthcare process	✓ Quick turn-around time in certain healthcare activities ✓ Reduce bottlenecks in the healthcare process as a result of the burden in the health system ✓ Improve workflow processes ✓ Ease access to information to aid decision making in the healthcare process

6.4.3.1.1 Purpose of HIS implementation at the Hospital

Findings revealed that the major reasons for HIS implementation were largely attributed to the challenges of the manual paper-based system. For instance, *duplication of data* due to the influx of patients arriving at the hospital, and a *lack of easy access to information* by doctors to enable informed decision making, prompted the use of HISs. *Bottlenecks* in the healthcare system also were a major drive for implementation. Emerging motives for HIS implementation from participant responses included, *management of patient registration information*, improvement in data accuracy, cost management, and the overall management of fragmentation in healthcare activities. For example, at the hospital, the Delta 9™ system, which is a patient registration system, was implemented by management to improve the ***management of patient*** registration data at the hospital (TP.ITS; PRS-M). The expectation by hospital management was that the system would improve patient management from the unsatisfactory previous manual paper-based process. In another case, the laboratory unit of the hospital implemented the *electronic gate keeping* (EGK) system, with the expectation that the system would **ease the burden of cost** in that unit that had skyrocketed over the years. As one managing participant in the unit stated, "Expenditure for the laboratory services was increasing and uncontrollable and they had to find a system, a way of controlling that expenditure, you may say a cost-containment measure" (PRJ-M).

Other assumptions of the EGK system by hospital management that drove its implementation was its ability to ***improve accuracy*** in the way in which patient laboratory

data was handled. Previously, “there were a lot of these cases of [data] duplication” (PRJ-M). In addition, the expectation was that the system would reduce the waiting time for laboratory results (PRJ-M). The EGK system to some extent has decreased turn-around times for clinical tests, in that laboratory results can now reach doctors rapidly via their cell phones (GYNO; Doc-CL; DMA). Yet another system present at the hospital is the *Rx Solution* system; this system was implemented with the purpose of it ***managing the dispensing of medicine*** at the hospital (TP.ITS). The expectations of hospital management and the Department of Health were that this system would mitigate mismanagement of medicine prescription to patients and also manage the procurement process of medication at the hospital (TP.ITS). Other implementations include the PAC system in the radiology unit, expected to manage the process of capture, storage and viewing of X-ray images at the hospital (TP.ITS). The DHIS system was implemented for the purpose of tracking healthcare service delivery in the public healthcare sector.

Findings reveal that despite the individual motives at hospital level of HIS implementation, often decision making for adoption and implementation is driven by the national or provincial Department of Health. As noted by one participant, “interventions are always being propagated from the top; down here at the healthcare facilities we do not know anything about it” (DMA). Another participant also noted that, “You find that some of these systems/IT infrastructures come from the provincial department or national department for different reasons” (TP.ITS). This suggests that the current top-down approach to implementation of technological solutions without justification of how the solutions will facilitate the work activities at the operational level, may result in consequences such as lack of use or misuse of the systems.

6.4.3.1.2 Purpose of use of Healthcare Information Systems at Hospital

With regard to use or non-use, emerging motives were mainly the perceived usefulness and benefits of the system. Findings revealed that most participants who carry out administrative duties associated the use of HIS with accelerating and easing patient admission, for example, and therefore were likely to make use of the systems. As one participant mentioned, “A patient comes, I stand them in the scanner, information is sent to the miller, the milling machine mills the leg of this patient, then the information is sent to the lamination room, lamination is done, [within] two hours of the patient’s arrival, the socket is ready. All this is done through a computer system and is more effective” (DMA). As a result, “this reduces the cost and patients’ time during the whole process because everything is digitalised” (DMA). It is therefore apparent that the positive perceptions of usefulness and performance expectations of the systems drive the motives to use them in this instance.

Another finding with regard to the purpose of HIS use was the perception that HIS would enable a quick turn-around time in certain healthcare activities, such as patient admission and laboratory processes. This would result in the other reason for HIS use, a lack of easy access to patient medical information to aid in informed decision making in the healthcare process.

Findings also revealed that participants' motive to use the systems were influenced by factors such as constant availability of HIS at the hospital. Another emerging motive for use was the perception that the use of technology in the healthcare sector was an indication of modernity (DMA; GYNO; PRS-M) and technological advances. "The whole country is moving towards that" (GYNO). Yet another participant indicated that "our health systems are supposed to be connected like the banks, the integration of information" (DMA). Findings revealed positive perceptions of the expectations of the implementation and subsequent use of HIS at the hospital. The system was seen as complementing other existing components within the complex healthcare service delivery process by acting as an integrator that enables collection, storage and sharing of healthcare information. The ultimate goal is to improve the flow of patients in the healthcare service delivery process. Regardless of the motives for implementation or use or non-use, there are several context-based mediators that enable or impede the implementation and subsequent use of the system.

6.4.3.1.3 Use or non-use of healthcare information systems at the hospital

This sub-section reports on the findings of the significance the three group of participants attach to the existing HIS and how this relates to the use or non-use of the systems. This is in relation to the perceptions discussed in sub-section 6.4.2.3. From the findings, it is revealed that most use of the systems occurs in the administration of the healthcare service. In the clinical process, there was limited reporting of use of the system by actors. This reflects the perceptions of clinical actors in sub-section 6.4.2.3. This could also be attributed to the fact that the hospital does not have clinical information systems implemented.

Examples of use at the hospital included at the registration unit, where participants interviewed make use of the Delta 9™ *system* to carry out their activities. As noted by one of the participants, "Here at the registration unit we use the system for patient registration" (PRS-M), which involves capturing patient biographical information, or whether the patient is an in- or outpatient (PRS-M; TP.ITS; C-M). The system is also used for "billing and procurement" (PRS-M). Case managers use the system to generate reports, "for example, how long a patient has been in the hospital and for what reason" (PRS-M).

Another use of HIS was at the pharmacy, where pharmacists make use of the *Rx Solution* system “which is a pharmacy system” (TP.ITS) that manages the dispensing of medicine. The *Electronic Gate Keeping (EGK) system* (PRJ-M) is used by doctors and laboratory clerks. The majority of the doctors interviewed were enrolled in the NHLS database and indicated that they had made requests for laboratory tests through the system at some point (Doc-CL; DRG; DRO; GYN). The doctors would then receive the results on their mobile phones. Another indication of use by the doctors was in the radiology unit, where radiologists use the PAC system to capture, store and digitally share images and relevant clinical reports within the hospital and outside (TP.ITS). However, there was an indication of minimal use of this system by other doctors because of software glitches, as noted by one participant: “There was a software glitch here at the hospital to view X-rays and then it stopped working” (GYNO).

What is revealed from the findings indicates that the use or non-use of HISs by the participants in the clinician process category is dependent on their perceptions of the system’s relevance to their work activities. For example, one of the doctors interviewed did not find the HIS to be relevant to his work activities, and noted, “I don’t see how these technologies would help in my line of work. I deal directly with patients” (Doc-CL). The participant further noted that “to me, these technologies would slow down the process. If we were to stop and type a patient file for example, that takes time and I need to see a lot of patients” (Doc-CL). This could be an indication that the doctor perceives HIS as more disruptive than enabling, hence lack of use. The indication is that the manual paper-based system is preferable in this instance: “It’s just easier to write the notes down in a file” (Doc-CL). This can be attributed to the nature of the work the doctor does at the hospital.

In contrast, those doctors interviewed, who made use of the HIS, attributed their reasons for use to the peripheral administrative activities they carried out in the clinical process. Although minimal, those administrative activities justified their need to use some of the systems relevant to their work. As noted by one doctor, “We could have systems that are connected to networks so that you just fill in patient information and you store it so that even for your referrals, your colleague from other hospital just needs to punch in the folder number and see what was done” (GYNO). Another participant attributed the use of HISs to their perceived effectiveness and the benefits of system, noting: “You know what we do now? A patient comes, I stand them in the scanner, and then that information is sent to the miller, the milling machine mills the leg of this patient, then the information is sent to the lamination room, lamination is done. Within two hours of the patient’s arrival the socket is ready. This was not possible in the manual system; all this is done through a computer system and is more effective” (DMA).

What emerged from these findings is that despite the use of HIS by some participants in their daily work activities, the parallel use of the manual paper-based system (PRS-M; GYNO, AMS; PRJ-M) at the hospital still persists. As a result, the majority of participants perceived that this double process adds to their already burdened workloads (PRS-M; GYNO; DMA, AMS; PR-N; DRG). This in turn, determines use or non-use of HIS to facilitate healthcare service delivery. The emerging findings on factors that influence the use or non-use are presented in Table **6-6**. These are further discussed through the abduction and retroduction process in Chapter 8.

Table 6-6: Factors that influence the use or non-use of Healthcare Information Systems at the hospital

Theme	Categories
Technical factors	✓ Functionality of the system ✓ User skills/competencies ✓ Usability of the system ✓ Constant availability, accessibility and relevance ✓ Embeddedness of work activities into the structure of HIS
Institutional factors	✓ Advocacy for use and support ✓ Adequate change management ✓ Clarity of system's purpose in the workflow process
Behavioural (human) factors	✓ Reluctance to use ✓ Perceived usefulness of the system ✓ Perceived benefit/value of the system in work activities ✓ Perceived effectiveness of the system in the workflow processes

The next sub-section reports on the findings that relate to the role of HISs in healthcare service delivery.

6.4.4 The role of healthcare information systems in the delivery of public healthcare services

This sub-section reports on findings related to the role which healthcare information systems play in the delivery of public healthcare services. The focus of this investigative issue was on the perception of the participants with regard to the use of technology interventions to carry out their daily work activities. An objective that this issue of investigation met was to establish whether the current implementation of technology interventions in public healthcare facilities fits the context of the participants' work activities (whether in an enabling or inhibiting role). Based on the findings in the previous sub-section,

the technology interventions are mainly used for administrative purposes as opposed to clinical activities. What the findings revealed was that there was evidence of manual paper-based processes still occurring in the administrative healthcare process. This reveals that the healthcare facility runs two parallel healthcare delivery processes. In some units they were still using the manual process, while in other sections a combination of a computer-based process and manual process was used. This is despite the hospital's having a capable ICT infrastructure in most units.

The administrative activities, as already established, mainly support clinical activities in the delivery process. As such, the role of technology intervention in the administrative healthcare process is taken as that of enabling the smooth operation of activities that ultimately ensures a favourable experience for both clinical staff and patients. The findings from the other investigative issues discussed in preceding sections alluded to the role of healthcare information systems in public healthcare facilities in South Africa. The next sub-section gives a clearer indication of the specific roles emerging from the empirical data as well as from document reviews.

6.4.4.1 Findings on the role of healthcare information systems in the delivery of healthcare services

To support the healthcare service delivery work activities, the information systems or technological solutions at the healthcare facility comprise both paper-based and computer-based systems. Most applications used at the hospital can be found in the generic hospital activities settings, the outpatients, or in isolated hospital wards. In line with the care and coordinating activities, information systems at the hospital facilitate the delivery of healthcare services at all levels of the healthcare system. Some of the general roles that technology interventions play in any organisational context include facilitating the planning and management processes, as well as recording information and monitoring performance in various operational processes. The findings reveal that a fundamental role that technology interventions play in the delivery process of healthcare services is that of *quality enhancement.* The findings reveal that this role is absolutely key to running an efficient and effective delivery process, otherwise what would the point of utilising technology?

Many of the documents reviewed pertaining to technology interventions in the healthcare domain mention quality enhancement as key. For example, the e-health strategy document mentions that the strategy seeks to provide a roadmap for enhancing quality in the delivery of healthcare services by using technology. Other initiatives such as the NHI programme and DHMIS policy are efforts by the government to enhance quality in the delivery of healthcare services. Quality enhancement in the delivery process can be achieved in data

capturing, improving the turnaround times in public hospitals, and better disease surveillance in the country. Despite these being the major roles of HISs in the public healthcare sector, the outcomes of the healthcare service delivery process in many public healthcare facilities do not indicate that these roles are optimally achieved.

Another emerging dynamic role of healthcare information systems at the hospital is in the *timely movement of clinical information* across the hospital and the public health sector as a whole. For the government of South Africa to be able to make informed decisions on aspects such as resource allocation or management of disease outbreaks, timely health information needs to reach the relevant authorities. This seems to align with the purpose of implementing the technology intervention in the first place. Integrated healthcare services allow for easy flow of information across the healthcare system. However, the findings reveal that there is disjointed communication from the lower levels of healthcare to the national level. Owing to poor data-collection methods, resulting in poor quality of data and information, there is often misleading or inaccurate information filtered to the broader national framework. What the study deduces from these findings is that the full potential of healthcare information systems is not realised, which can be attributed to a lack of interconnected systems.

Findings also reveal that the use of healthcare information systems played a major role in mitigating human error in the capture of data and reporting of healthcare information. In other words, healthcare information systems play a role of *healthcare process* or *operational improvement.* This increases efficiency by reducing instances of duplication of patient data, increasing productivity and simultaneously testing the capacity of the delivery process of healthcare services. Although this should be the case, findings from both document reviews and empirical data reveal that the healthcare delivery process in public hospitals is still marred by litigation problems due to human error, such as inaccurate data capturing. Findings suggest that HISs at the facility are primarily used to support the coordination of care activities through information sharing across different units/departments. What the findings also reveal is the importance of information sharing across the delivery system in the hospital. However, what can be deduced from the findings is that the full potential of these systems to support other critical care activities in the healthcare delivery process of integrated care are not being fully realised. This can be attributed to the implementation determinants of these systems.

Other significant roles the empirical data revealed were that HISs facilitate communication and collaborative efforts among healthcare practitioners through sharing relevant information. Also, the systems play a role in facilitating the gathering, storing and reporting

of healthcare data and information. An example of a system that does this is the electronic medical record system used at the facility. Table 6-7 provide a summary of the various roles implemented HISs play at the hospital.

Table 6-7: Role of various HISs in the delivery processes of healthcare services

Healthcare Information Systems	Role in healthcare service delivery at the facility
Patient administration/ management system (*Delta 9™ system***)**	The role of this system is to supply demographic and other statistical data such as medical payment to the patient information database. It is from this that other systems, such as the Rx Solution in the pharmacy unit, derive data, thus ensuring easy flow of patients through the healthcare delivery process. Basically, the system **enables *quick turnaround times, eradicates data duplication, and improves efficiency in the healthcare delivery process***
Order-entry management system (e.g. *electronic gate keeping system, Rx Solution system and PAC system***)**	The role of these systems involves acting as a means of communication between healthcare practitioners and the tools for planning, initiation and execution of processes or tasks. For example, these systems enable transactions started in one module to go across to another module and be carried out. A doctor placing an order for a patient lab test goes through the EGK system which is fed to the laboratory unit of the hospital. The doctor then receives feedback either by mobile phone or gets printouts of the result. Essentially, these systems enable ***timely collaboration*** between different units in the hospital.
Decision-making and reporting system (DHIS system)	The role of this system in the delivery of healthcare services is to produce and distribute reports to healthcare management at various levels for decision making. For example, surveillance of disease outbreaks. The DHIS's major role is ***routine data/information management*** for ***decision making*** and ***surveillance of disease outbreaks.***

Findings from this section reveal gaps in the postulated benefits and value of technology intervention in the various roles they may play in the delivery process of healthcare services in public healthcare facilities. For example, the perceived benefit or value of many technology interventions is the idea that the technologies will manage or reduce the inflation

of cost in public healthcare settings. However, this has yet to be adequately demonstrated empirically in the public healthcare sector. This can be attributed to the lack of robust evaluation mechanisms of their impact on the healthcare service delivery process and overall health outcomes. Taking into consideration the limited empirical evidence in relation to improvements in cost effectiveness and patient outcomes in the healthcare service delivery process, the study argues for accelerated monitoring and evaluation of the implementation process and subsequent use of HISs. The study recommends that the evaluation and monitoring measures should be evaluated against a comprehensive set of methodologies. As such, the monitoring and evaluation process should be characterised by context-based mediators likely to enable or inhibit the implementation and use of technology interventions.

6.5 Summary of the Descriptive Presentation of Findings

The chapter presented descriptive findings on the status of the public healthcare service delivery landscape in South Africa. Data from the study show that the public health sector has seen an increase in the implementation and use of technology in the delivery process of healthcare services. Findings from the three groups of participants show that there are disparities in the beliefs of the usefulness of HIS in terms of operations in the delivery process of healthcare services. The majority of positive beliefs of usefulness come from actors who carry out administrative work, whereas the findings from the clinical actors portray conflicting views of the usefulness of HIS in their work activities, therefore minimal to no use occurs. This could be attributed to the work activities of the clinical actors. The chapter also noted findings on factors that influence the implementation and subsequent use or non-use of systems in the delivery of healthcare services. The factors that enable HIS implementation are identified, as well as those that encourage (or discourage) use. Limitations in respect of these factors, however, play a negative mediator role to HIS implementation and subsequent use or non-use.

7 CHAPTER 7 – DISCUSSION OF FINDINGS: CRITICAL REALIST PERSPECTIVE

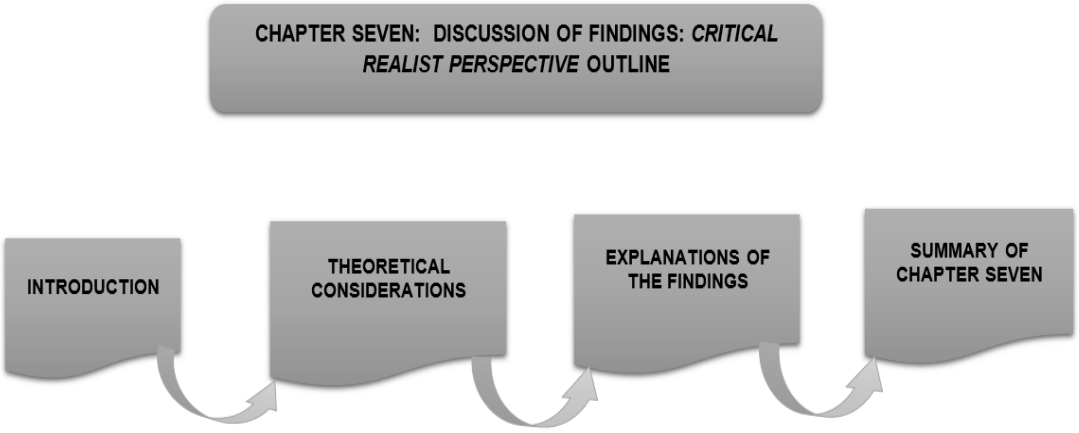

Figure 7-1: Chapter 7 outline

7.1 Introduction

The preceding chapters (five and six) gave a narrative description of the empirical findings (*demi-regularities*) emerging from the analysis of responses from the empirical case and document review. The findings emanated from the main objectives of the study. These included to: (i) understand the existing status of public healthcare service delivery; (ii) examine the status of HIS implementation and use for healthcare service delivery; (iii) determine the purpose of implementation and use of HIS in the delivery of public healthcare services; and (iv) determine the role of HIS in the delivery process of healthcare services in public hospitals in resource-constrained environments. The intention of this chapter is to offer a critical realist perspective of the explanations in relation to the findings emerging from the analysis of the empirical data. The explanations this study presents, the researcher believes, contribute to the body of knowledge in the field of healthcare informatics.

In this chapter, the discussions centre on elucidation of the findings reported in Chapters 5 and 6. They draw on the key elements of the ActAD model, built on the principle of activity theory as an explanatory theoretical lens within the critical realist paradigm. The study finds

that the two concepts (ActAD and critical realism) complement each other in forging philosophical reasoning, yet a practically attuned framework, for understanding the context-based factors that possess causal powers that may influence the public healthcare service delivery as well as the implementation of HIS in public healthcare facilities. Through literature, the study established that the individual explanatory powers of both the ActAD model and critical realist perspective are limited if either is neglected. However, a combination of both explanatory powers enhances the arguments of this study.

To highlight the complementary relation between these two concepts, the study establishes that the ontology of critical realism fosters explanations through causal mechanisms and powers, real structures and tendencies. This implies that a critical realist ontological stance does not just offer descriptive predictions around the phenomenon under investigation, but digs deeper. Similarly, the ActAD model offers ways of gaining in-depth understanding and explanations relating to the context of the phenomenon under study. A combination of these two explanatory stances makes the arguments and findings of this study much more solid. To illustrate this in the context of the study, the setting (in terms of organisational structure, leadership and management) of a domain such as public healthcare may influence the implementation and use of HIS for public healthcare service delivery to transform health outcomes. At the same time, certain generative mechanisms may trigger the events that occur in the setting, such as constraints of resources which could also inform the implementation and use of HIS.

Critical realists perceive that the methodology in the stratified ontology is the key to providing a way for such explanations to take place. Building on this, critical realists argue that human knowledge (empirical findings) captures a very small part of deeper reality, and therefore there is a need to go beyond the empirical data only (Bhaskar, 1998). The act of going beyond the empirical data allows a researcher to engage in an explanatory and causal analysis. These arguments make the critical realist paradigm useful for analysing social problems and suggesting emancipatory solutions, as in the case of this study. This background underpins the discussions in the sub-sections that follow. The explanations and causal analysis are based on the findings from the investigative issues (objectives). Table 7-1 presents the stratified ontology of critical realism and its respective analytical methods as discussed in the chapter.

Table 7-1: Mapping realists to analytic method (Bygstad et al., 2016)

Critical realism Domains	Analytical Methods
Empirical	Identification of events and key entities in the case
Actual	Abduction and Retroduction
Real	Abduction and Retroduction

The next section reports on the causal explanations of the findings reported, based on the key investigative issues that ground the study to arrive at an effective conclusion. In the first step, the section presents a theoretical redescription of the events using the ActAD framework.

7.2 Theoretical Considerations – ActAD Model (Theoretical Redescription)

To frame the study's theoretical stance, the researcher was guided by the five basic underlying principles of the ActAD model. These principles as applied in the study include the first principle of an object-oriented activity system. In the case of this study, the healthcare service delivery process is taken as the prime unit of analysis in relation to a network of other activity systems, such as the implementation of HIS as is the case of this study. The second principle is that an activity system has multiple voices (actors). In the case of this study, these were healthcare practitioners in the delivery process as well as other stakeholders with a say in the process, such as leaders and managers. The third principle states that an activity system is a result of historical activities that are typically formed over a period of time. The interpretation of this principle in the current study examines the historical aspects of the South African healthcare system that has undergone several changes since 1994. The historical aspects of an activity system have the potential to influence activities in the system. The fourth principle scrutinises the fundamental role of contradictions in the activity system as sources of change and development. The study interprets this concept as the realities experienced as opposed to the expectations of an activity system. For example, while healthcare information systems are expected to facilitate certain healthcare processes, in reality these expectations are not met. This can be attribute to several context-based mediators that have causal powers to create the perceived contradiction. Contradictions in a work activity systems are seen as instigators of change in the system.

The firth principle of the ActAD model refers to the possibilities of transformation and the reconceptualisation of the objects and motives in the activity system (Engeström, 2001). The study interprets this as the transformation brought about by inhibiting and enabling mediators in the activity system. These mediators have the ability to transform the manner in which activities are carried out in the activity system. The outcomes of the transformation process may be desired or undesired. A closer investigation of these principles reveals that they possess similar traits of the critical realism paradigm. The principles are relatively broad with regard to the methods of application. They provide an overarching frame and conceptual tools of enquiry; in essence the principles provide exploratory guidance rather than rigid rules.

The study employed the ActAD framework as a theoretical analytical tool for the object-oriented system (healthcare service delivery process). This process is referred to as the *abduction process* (also known as theoretical redescription). The abduction process for critical realists elevates the level of theoretical engagement beyond broad descriptions of the empirical entities, at the same time acknowledging the theory of choice is fallible. This theoretical perspective, according to Danermark (2002) and Sayer (2004), points to causal factors that go beyond individual choice, shape activities in a particular way, and may explain the outcomes. Thus, arguments are that critical realism enables the general understanding of technology interventions as mediators for organisational change (Volkoff et al., 2007). In keeping with the critical realist philosophy, the researcher understood that ultimately the study would either confirm, refine, or refute this model to better explain the reality of the phenomena under investigation. The ActAD model reminds us of the importance of mediating conditions that shape the form of work activities in context (Korpela et al., 2004; Mlitwa, 2011). The study highlights several findings tied to the objectives of the study. The next sections present causal explanations of those findings through the abduction process within the realism of the stratified ontology of the critical realist paradigm.

7.3 Explanation of the Findings

Based on the ActAD model, a work activity system incorporates activities carried out by several actors with a common purpose (also referred to as an object) that is shared by others or a community. The description of a work activity system portrays it as a complex, highly mutable situation, dependent on and subject to value conflicts (Bødker et al., 2004). Translating this in the context of this study, healthcare service delivery as a work activity system can also be seen as highly complex because of the various activities that are interconnected while carried out by various actors who all have the common purpose of improving the health outcomes of patients. The ActAD model dictates that work activities

are mediated by context, conditions, tools and rules. In the context of this study, activities within the healthcare service delivery process are mediated by technology interventions, rules, the healthcare setting, and other phenomena, such as policies. The transformation of a shared object in the work activity system into specific outcomes has a predetermined timeframe. This means that in a healthcare service delivery system, the transformation of healthcare service delivery activities into improved health outcomes takes place over a period of time (since the restructuring of the national healthcare system post 1994). The outcomes of the transformation process the healthcare system has undergone are influenced by context-based mediators that produce observable or unobservable events that are experienced.

The conglomerate nature of the activities within healthcare service delivery system as the work activity system in this study, makes it highly complex, and thus subject to change depending on enabling or inhibiting conditions that are subject to value conflicts from actors and the context (environment). Mursu et al. (2007) postulate that the interplay between the enabling and impeding conditions (mediators) within an activity system determines the nature of how the activities are carried out, and the outcomes. The nature of the outcomes (whether desired or undesired) and activities are dependent variables in the work activity system, while the mediators are considered independent variables in the activity system. With reference to the stratified ontology of critical realists, the activities are what is seen (the empirical), while the mediators sometimes can be seen as events in the actual domain. Essentially, the actual informs the empirical. Mursu et al. (2007) refer to mediators as strategies, procedures, perceptions, intentions, tools and skills. Mediators, within the concept of the ActAD framework, explain the relationship between a dependent and an independent variable. For example, the independent variable can be seen as healthcare policies, while the dependent variable can be seen as healthcare outcomes.

The discussions in this section reflect on the observable events experienced both at the empirical and actual levels of the stratified ontology of the critical realist paradigm. Further in chapter 8, the discussion on the real domain will focus on the generative mechanisms. On the actual domain, these events occur whether or not they are observed or experienced, whereas on the empirical domain the events are observable and experienced. In other words, these are events understood from human (participants') interpretations. The next sub-section presents the explanations that may lead to an understanding of the findings. It is possible to explain the findings of this study as factors that impact healthcare service delivery in public hospitals; however, to do so would be epistemic fallacy – a failure to consider deeper causal structures occasioning the events as experienced/observed in the

empirical and actual domains. This is the fundamental basis of the critical realist paradigm which underpins this study.

7.3.1 Discussions of findings on the status of public healthcare service delivery

The study approached the findings under the investigative issue of healthcare service delivery as illustrated in Table 7-2 as outcomes. The occurrence of these outcomes (observable or unobservable) is believed to be the result of mediating factors/conditions caused by other mechanisms that either enable or inhibit the activities within the healthcare service delivery process, which in turn transform into the outcomes. A summary of the mediating conditions that might explain the outcomes under this investigative issue is presented in Table 7-2.

Table 7-2: Mediating factors that influence healthcare service delivery

Enabling mediators	Inhibiting mediator
✓ Adequate availability ICT infrastructure	✓ Shortage of resources
✓ Adequate health policies and strategies	✓ Lack of accountability and transparency
✓ Increased access to healthcare services	✓ Inadequate skills and knowledge
	✓ Poor leadership and inadequate management
	✓ Low morale and dissatisfaction of healthcare practitioners

The study examines each mediating factor and discusses how it might explain the outcomes in this issue of investigation. The Constitution of South Africa declares that it is every citizens' right to have access to quality healthcare services. The healthcare system therefore has an obligation to see to it that every citizen has access to quality healthcare services. To this effect, Maphumulo and Bhengu (2019) suggest that improvements in quality should be reflected in areas such as error reduction in data capturing, quick turnaround in the delivery of care processes, and cost effectiveness in the delivery process, among other areas. Based on the findings under this issue of investigation, patients who visit public hospitals and clinics still experience challenges in the delivery system of healthcare services. These challenges include long queues as a result of slow turnaround times in the delivery system, public hospitals and clinic still experience health inequity in areas such as resource distribution (Omotoso & Koch, 2018). These contradictions that are part of the ActAD model constructs may be the result of the generative mechanisms discussed in the next chapter.

Using the empirical hospital as a case, the study's investigation into the current status of healthcare services revealed several outcomes that can be attributed to what is experienced in the healthcare service delivery system. However, these outcomes do not fully reflect the mandate of the national government of providing quality healthcare services. Table 7-2 illustrates some of the mediating factors in the delivery of public healthcare. The study takes the stance that these mediators may offer explanations for the current status of the delivery of public healthcare services. The outcomes are therefore the dependent variables, while the mediators are the independent variables in this setting. The mediators are classified into two categories – enabling and inhibiting mediators. The enabling mediators are those that have a positive impact on the delivery of healthcare services, such as availability of adequate health policies and improved ICT infrastructure, among others. Inhibiting mediators, on the other hand, have a negative influence on the activities in the healthcare service delivery process. For example, an inhibiting mediator like a shortage of healthcare workers puts a strain on the delivery process. The implication of these mediators is in the transformation process of healthcare activities that produce outcomes that are experienced in the work activity system. In this instance also, the work activities in the delivery system are dependent on the mediators and other elements in the activity system, whereas the mediators remain as independent variables.

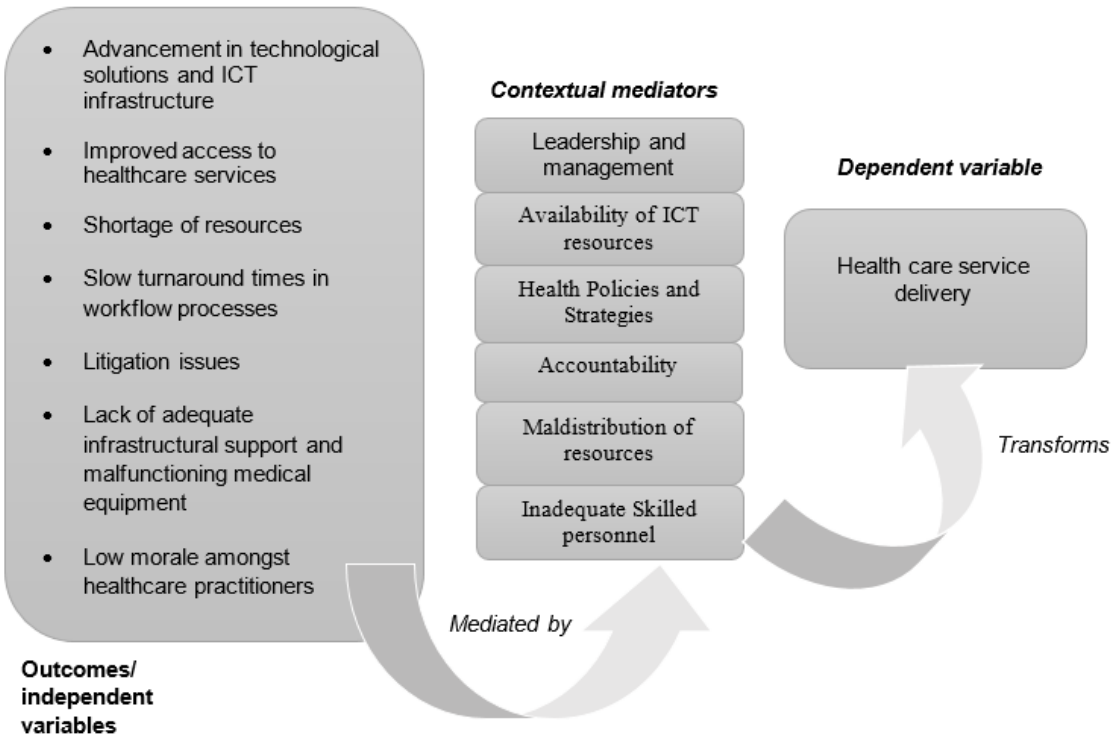

Figure 7-2: The effects of the mediators of healthcare service delivery outcomes

Figure 7-2 depicts the interrelationship between the independent and dependent variables in the delivery process of healthcare services. This relation is further discussed in the following section from a critical realist perspective. Although literature across the health informatics field contains various studies involving factors that influence the delivery process, these studies seldom offer causal explanations of those factors and their relations to the dependent variables. As previously mentioned, drawing on the stratified ontology of the critical realism paradigm, the study offers possible explanations for the causal relationship between the dependent and independent variables. The study argues that the desired outcome of improved healthcare requires a positive interplay between the independent and dependent variables. The transformation of the shared purpose through the mediation process enables the activities by the different actors in the process to result in a desired outcome. The opposite of this result into undesired outcomes is mediated by the effects of the inhibiting mediators.

A critical discussion of the relationship between the independent variable and dependent variable and the effect of this relation using mediators follows.

7.3.1.1 Advancement in technological solutions and ICT infrastructure

As revealed in the background discussions to the study, the public healthcare sector in South Africa has seen major improvements in ICT infrastructure in many of its healthcare facilities. As such, technology interventions have become integral part of the enabling tools in the delivery of healthcare services in the country (Watkins et al., 2018). The implementation and use of these technological solutions are highly dependent on, among others, a supporting ICT infrastructure, in which the healthcare sector has seen great improvements. In some ways the advancement in technological solutions has yielded positive results in terms of improving service delivery. For example, activities such as patient registration no longer involve long queues. However, there is still evidence of inefficiency and ineffectiveness in the healthcare service delivery system caused by human error in capturing data or duplication of processes. An outcome such as the advancement of technology in the public healthcare sector is mediated by mechanisms such as *health policies, frameworks and strategies* developed by the national government in a bid to provide unified roadmaps for the delivery of improved healthcare services in public healthcare facilities.

Some of the available technology intervention-related strategies in the South African healthcare sector include the mHealth strategy, 2015–2019; the eHealth strategy, 2012–2016; and the national digital strategy for South Africa 2019. Another example of a policy is the District Health Management Information System (DHMIS) 2011. All these policies and

strategies have been developed with the aim of creating an enabling environment for the integration of technological interventions into the healthcare service delivery system. The goal is to facilitate universal health coverage in the country while improving the quality of public healthcare services.

However, as the findings depict in this study, the implementation of these technological solutions has not always yielded expected outcome in terms of improving access to quality healthcare service, reducing errors in data capturing, improving turnaround times in the delivery of care processes, and enhancing cost effectiveness in the delivery process, among other areas in public hospitals in under-served contexts. This can be seen as contradictory in the healthcare service delivery process work activity system, where despite the policies, frameworks and strategies in place, there are disparities in their translation at the operational level (hospitals and clinics) of the healthcare system. Drawing on the ActAD model, these conflicts have a major role in the development and change of activities in an activity system. Often contradictions have historical roots with structural tensions within the work activity system. For example, in the South African healthcare system, the public healthcare sector was underfunded with limited resources. Contradictions might not produce disturbance and conflicts exclusively, but may also produce innovative solutions to change the activities. For instance, the disparities of translation of policies from paper into actual implementation may inhibit the achievement of the mandate of the healthcare system, which is to improve healthcare service delivery.

Perhaps a major source of tension is the inability of many in positions of management and leadership in public healthcare facilities to translate these formulated policies and strategies into actions on the ground. In other words, there is a gap in translating national policies at operational levels. This results in outcomes such as inadequate infrastructural support in some public hospitals, such as the empirical case in this study. Across the public healthcare sector, where these policies and strategies have had a positive impact, they have translated to improved healthcare service delivery. This is because of an adequate ICT infrastructure and technological solutions such as HISs as mediating factors shaping the way in which healthcare practitioners carry out their work activities, resulting in outcomes such as improved workflow processes, and ease of communication and collaboration which could improve healthcare service delivery. Another outcome reflecting the current state of healthcare service delivery is shortage of resources, and this is addressed in the next sub-section.

7.3.1.2 Shortage of resources

Healthcare systems around the world are confronted with challenges of, among others, increased life expectancy, rapidly advancing healthcare technology, the convergence of health and care needs, the high cost of healthcare, the fragmentation of healthcare services, and a mismatch of healthcare workforce versus demand for care, especially in under-served contexts. Most of these are evident in from the empirical findings of the study (Rigoli et al., 2019).

Other mediating factors are resources in the work activity system; these include both material (e.g., medical equipment) and human resources. A resource-constrained environment influences how actors in that particular setting carry out their activities. As the findings portray, lack of material resources such as medical equipment can hamper the manner in which a particular activity is carried out. As result, the quality of healthcare service delivery is compromised, leading to an outcome such as prolonged turnaround times. The study's findings also reveal that a shortage of resources is further mediated by *maldistribution of resources* across the two tiers (private and public) of the healthcare system. Maldistribution of resources can also be mediated by poor leadership and inadequate management skills in a broader context. Findings from documents reviewed indicates that the challenge of maldistribution of resources across the sector could also be as a result of causal mechanisms such as rapid urbanisation (Turok, 2012; Tomita et al., 2017) experienced in many of the South African provinces.

Arguments are that the sudden influx of people from rural to urban areas forces many government facilities such as hospitals and schools to function beyond their intended capacity (Maphumulo & Bhengu, 2019). As a result, the overcrowding in public hospitals in turn leads to a shortage of resources in public healthcare facilities. In the public healthcare sector, the shortage of human resources is mostly experienced at the clinical level, the forefront of patient care (Coovadia et al. 2009:821; Voget, 2017). As a key mediator of work activities in the activity system, a shortage of resource impedes the various work activities in the healthcare service delivery process. For example, a participant mentioned that owing to a shortage of material resources they are "…unable to work properly…" (AMS). Other participants also mentioned limited access to medical equipment (Doc-CL, GYNO, and DRO). The supply of such equipment by the hospital or Department of Health is essential in the healthcare delivery process in carrying out work activities effectively. Across the literature there is evidence of extreme disparities in healthcare resources, infrastructure and care service distribution (Hirschowitz & Orkin, 1995; Coovadia et al., 2009; Van Antwerpen

& Ferreira, 2016; Omotoso & Koch, 2018). Conversely, an adequate supply of resources is essential for improved healthcare service delivery.

The implications of a shortage of resources with regard to human resources in activities such as patient admission, often result in longer turnaround times and long queues in public hospitals, as was the case in the empirical case. On the other hand, the implications of a shortage of material resources, such as beds, result in patients being turned away from hospitals. These examples are inhibitors of the goal of improving access to quality healthcare services to the population. The lack of provision of critical resources hampers the ability of healthcare practitioners to carry out their work activities optimally (WHO, 2008; Buykx et al., 2010). These implications have devastating health outcomes that sometime result in high mortality rates in the country. As result, the goal of achieving the key objective of providing a quality healthcare service is further hindered. Maldistribution of resources can also be mediated by factors such as poor leadership and inadequate management.

Another perspective of the shortage of human resources in the public healthcare sector can be attributed to the sector's failure to produce an adequate number of skilled healthcare practitioners. This could be linked to maldistribution of existing personnel (Coovadia et al., 2009; Ataguba & McIntyre, 2012; Holtz & Elsawy, 2013). The argument therefore is that the interplay between the enabling and impeding conditions (mediators) within an activity system, determines the nature of activities and the outcomes. The nature (desired or undesired) of outcomes and the activities are therefore dependent variables, while the mediators are independent variables. More often than not, these issues around the shortage of resources have compromised the ability of healthcare facilities, such as in the empirical case, to deliver quality healthcare services to the populace (Coovadia et al., 2009; Schaay et al., 2011; Ataguba & McIntyre, 2012). Another inhibiting mediator in the work activity is the inadequate supply of material resources such as medical equipment (X-ray software), resulting in prolonged queues at the hospital or referrals to other facilities (Mokoena, 2017).

7.3.1.3 Leadership and management capabilities

From the management perspective, findings reveal that *leadership and management skills* are major mediating factors in the healthcare service delivery work activity system. Document reviews revealed that quality improvement of healthcare processes requires leaders and managers who can manage uncertainties while the same time fostering cultural and behavioural changes in the actors (Hardacre et al., 2011; Chen et al., 2013; Mosadeghrad et al., 2013). Leadership, according to Tingvoll et al. (2016), is a long-term process of influencing actors in a work activity system towards achieving the shared object

in the system. The leadership and management set goals and strategies, and enhance commitment to and compliance with the stated objectives, while promoting a culture of collaboration in the organisation (Martin & Learmonth, 2012; Arroliga et al., 2014).

Empirical findings revealed evidence of poor leadership style and inadequate management skills which may explain the outcomes of the status of public healthcare services at the hospital. For example, during the interview sessions, the researcher observed that there were frequent changes in management, resulting in insufficient time to plan and implement long-term goals. Consequently, the instability of management undermines leaders' power and influence in the healthcare system, which is vital to leadership. This can have negative implications on activities within the work activity system, with adverse consequences on the outcomes of the healthcare delivery process. For example, participants of study stressed that "the hospital needs a leadership that listens to its employees and addresses issues raised" (GYNO). Another participant mentioned that due to a lack of management involvement in their work activities and the technological tools they employ, often the need to address certain things are neglected (PRS-M). In essence, it is vital that there is a demonstration of active leadership and management in various service delivery contexts and in the hospital in general. Across literature, findings show that inadequate management in public hospitals is reflected in a lack of vision and clear goal setting (Carney 2009; Pillay-Van Wyk et al., 2016).

In some instances, poor leadership style and inadequate management skills can be attributed to the transformation process the healthcare system in South Africa has undergone since the dawn of democracy in 1994 (Franks, 2014). The transformation in this instance can be seen as structures in a critical realist paradigm that have related objects that constitute entities with causal powers, such as the introduction of practices and policies (Burger & Jafta 2010; Burger et al., 2016). As side from creating an enabling environment for technology use in the healthcare sector, policy interventions such as the National Health Act, (Act 61 of 2003) and the NHI bill have targeted reduction in the socio-economic inequities in various capacities in the healthcare system. For instance, since 1994 the country has witnessed the ending of user fees in primary healthcare level. This was further extended to allow users from poorer households and thereafter introduction of Government Employees Medical Aid Scheme (Chopra et al., 2009; Ruff et al., 2011). The publication of the NHI bill will see majority of the South African population access universal healthcare coverage. These initiatives can be viewed as a positive transformations in the healthcare system. Adequate leadership and management skills in healthcare service delivery involve the ability to identify priorities, provide strategic and tactical directions to the various actors

within the delivery process, and be able to demonstrate commitment across the system to drive the priorities that would lead to improved healthcare services (Reich et al., 2016).

7.3.1.4 Transparency and accountability

The growing demand around the world for integrated healthcare service delivery brings about the need for transparency and accountability to mitigate adverse events in the delivery process (Genovese et al., 2017). The study conceptualises accountability as the obligations of individuals within an organisation to provide information about, and/or justification for, their actions to others (Brinkerhoff, 2003). Similarly, Hall et al (2017) referred to accountability as the methods by and manner in which an individual or collective group justifies and accepts responsibility for their activities. In the context of healthcare, the study conceptualises accountability as the act of all stakeholders in the work activity system taking responsibility for their actions, ensuring that they are competent to carry out allocated tasks, and always putting the patients' interests first. Genovese et al. (2017) argue that the concept of healthcare practitioners' responsibility has long been tied to medical malpractice. However, the authors further note that the concept of accountability in healthcare should rather focus on all conditions essential to the delivery of healthcare services, including the rational use of resources (Genovese et al., 2017). As a mediating condition in the work activity system, accountability has significant implications for the healthcare system.

In healthcare, governing bodies (such as the Department of Health) are in a position to mandate healthcare facilities to meet certain objectives or goals. The governing bodies must then demonstrate their willingness and capacity to hold relevant individuals to be both responsible and accountable in delivery of care services. Accountability in the healthcare service delivery process is vital; healthcare deals with delicate matters and therefore should be handled as such. Accountability is applicable to both management and operations in healthcare facilities. At the management level, accountability involves ensuring the availability of adequate resources and tools, and generating evidence on performance across the delivery of the healthcare services process. Accountability is also evident in the workflow process, through clear work activity directives. Lack of accountability is mediated by poor leadership and inadequate management, reflected in a lack of clear goals or objectives, a lack of measurement and monitoring of goal achievements in public healthcare institutions, and an inability to enforce consequences for healthcare facilities and individual actors if achievements regarding goals are not satisfactory (Carney 2009; Denis, 2014; Pillay-Van Wyk et al., 2016).

Lack of accountability is attributed to many of the negative outcomes in the work activity system in this study, focusing attention on the need for commitment to accountability. The

implications of a lack of accountability in workflow processes are observed in the manner in which healthcare facilities and practitioners carry out their work activities. Some of the participants noted that due to a lack of accountability, "…work ethics [at] the hospital" was a constant issue (GYNO). Yet another participant attributes lack of integrity in the operations such as capturing and collecting patient data in some units at the hospital was likely due to a lack of accountability. The participant noted that "people are not applying their mind while doing their duties, I don't know if they are negligent or unbothered" (PRJ-M). The implications of such cases in healthcare service delivery is that frequently patients do not receive the best healthcare. Another implication of the lack of accountability is an increase in litigation in the healthcare sector.

Building on these discussions, the study concludes that the current status of public healthcare service delivery in healthcare facilities in resource-constrained environments is a result of the points discussed above. The resulting relations between the independent variables that mediate contextual factors give rise to the outcomes as portrayed in this investigative issue. For instance, the display of poor leadership in the delivery system inhibits how work activities are carried out, eventually impacting the outcome of service delivery. The question this study further probes is what are the causes of mediators such as poor leadership and inadequate management skills in the healthcare sector? This can be attributed to the country's transformation process (post-apartheid) as previously mentioned. However, one cannot overlook factors such as the lack of incentives for healthcare practitioners to work in under-served contexts, low morale among healthcare practitioners, lack of collaborative efforts, and inadequate preparation for leadership and management roles. These factors are often perceived as 'other' and not vital to healthcare practice (Daly et al., 2014). These mechanisms directly or indirectly influence work activities, which in turn transform into outcomes.

7.3.1.5 Competency in the healthcare system

Competency among healthcare practitioners is fundamental in achieving improved healthcare service delivery. The study adopts Epstein and Hundert's (2002:226) definition of competence as "the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values and reflection in daily practice for the benefit of the individual and community being served". With this definition in mind, the argument is that qualified and motivated healthcare personnel are essential for improved healthcare service delivery. As a mediating factor, competency in healthcare also has negative or positive effects on work activities in healthcare service delivery at all levels of the healthcare system. The implications of inadequate skills in the delivery process of healthcare services.

For example, inaccurate data capture by some administrators at the hospital leads to repetitive processes and therefore long turnaround times. Findings also revealed that professional skills and competency affect work attitudes, including commitment from top management.

The discussions under this investigative issue highlight the contextually based mediators that may explain the observable events in the delivery of public healthcare service. Drawing from the ActAD model, these context-based mediators influence the actors' motives to carry out their work activities. The transformation of this results in outcomes (desired or undesired) as shown in the findings in sub-section 6.4.1.5. These factors are also mediated by underlying mechanisms that trigger observable or unobservable events. Following the discussion of the context-based mediators in the healthcare service delivery process, the next sub-section discusses the outcomes of implementation of HIS in a healthcare setting.

7.3.2 Discussion of findings on the status of HIS implementation and use

In this sub-section, the study discusses the outcomes associated with the current implementation of HIS in public healthcare settings. These outcomes are based on the study's findings, as well literature sources. As mentioned in earlier chapters of this thesis, the term 'implementation' is conceptualised as the process of putting or integrating interventions within a setting. The study argues that the contextual factors/mediators within the implementation process of these systems to some extent determine how the frontline users use them. The findings (outcomes) of both HIS implementation and use are discussed in sub-section 6.4.2.5. Drawing from the ActAD model and the critical realist philosophy, the study identifies and explains the contextual mediators of the HIS implementation and use.

A review of literature (discussed in Chapter 2) demonstrates that the public healthcare sector in South Africa is one that boasts the latest technological solutions implemented for the main purpose of improving the quality of healthcare services for the majority of the population that use public hospitals. The benefits associated with these information systems include the ability to reduce documentation in the manual paper-based process, increase the efficiency of workflow in the healthcare delivery process, facilitate better integration across the functional silos, provide real-time access to patient medical information, reduce costs, and increase turnaround times. However, the sector has struggled to realise these benefits, especially in public hospitals in resource-constrained environments of the country (DoH, 2011; Cresswell et al., 2016). The study therefore deduces that for effective monitoring and evaluation of healthcare service delivery to occur,

healthcare systems require “functional health information systems capable of producing real time information for decision making” (DoH, 2012b:5).

Drawing from the ActAD model, the failure of the public healthcare sector to fully realise the benefits presented by these technological solutions can be attributed to mediating factors that influence their implementation and subsequent optimal use. Fundamental to achieving improved healthcare service delivery in public hospitals is having an adequate implementation process of HIS. This, the study argues, provides a solid foundation for the generation of quality healthcare data, timely transfer of healthcare information from one level to another, and improved turnaround times of care services. This can be achieved by firstly understanding healthcare practitioners’ needs in the delivery process, considering HIS design and functionality to fit their intended purpose, and being aware of the manner of implementation. Addressing such conditions may lead to enhanced integration in collecting, processing and reporting health information required for improving the effectiveness and efficiency of healthcare service delivery. An important element in achieving this is through improved leadership and management skills at all levels of the healthcare system. Therefore, a robust implementation of integrated HISs is seen as the foundation for improving the healthcare service delivery system.

The next sub-section addresses the outcomes of the implementation of HIS and the context-based mediating factors that may have resulted in such outcomes. These mediating factors are said to transform the HIS implementation activities that produce the observable outcomes presented as findings.

7.3.2.1 HIS implementation at the NMA Hospital

Outcomes associated with the current HIS implementation practices in public hospitals such as the empirical case in this study are illustrated in Table 6-4. Employing the constructs of the ActAD model, the study argues that the outcomes in of current HIS implementation practices, are dependent variables that are mediated by context-based factors. This factors possess causal powers that can trigger transformation of the HIS implementation activities. The outcomes of this transformation process generate either observable or unobservable events in the delivery system. The constructs and principles of the ActAD model provide the researcher with an opportunity to gain in-depth insight into the observed event (empirical findings). Undesired outcomes in the implementation of HIS in the healthcare system, such as limited interoperability between several systems, lack of coordination and inadequate integration are mediated by context-based mediators (Mars & Seebregts, 2008; DoH, 2012; Weeks, 2013). Other notable undesired outcomes of the implementation activities include a plethora of technology interventions implemented in silos and often not scalable

(Stansfield et al., 2008). **Figure 7-3** depicts the interrelationship between the independent and dependent variables in the activity system of HIS implementation. The diagram also depicts how these context-based mediators shape the implementation activities into outcomes that are observed or unobserved.

These outcomes allude to the presence of inadequacies in the existing HIS implementation activities and practices. The inefficiencies are believed to be mediated by context-based mediators that can offer causal explanations of the outcomes observed and experienced. Key mediating elements in HIS implementation activities are the misunderstandings that exist among leaders and managers about the needs of healthcare practitioners, and the design or functionality of technology interventions that facilitate workflow and end-users' work routines. The negative implications of these mediating elements transform the activities that shape the outcomes of HIS implementation.

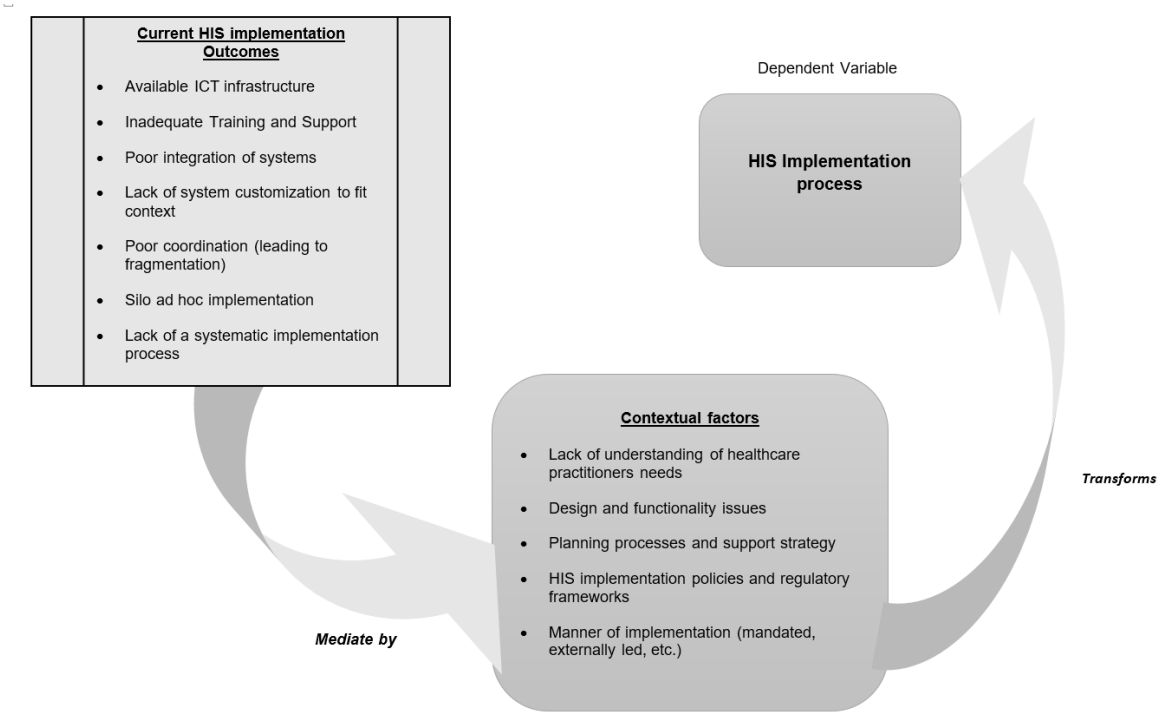

Figure 7-3: Mediating factors that shape the form of HIS implementation

The discussions that follow centre on the mediating role healthcare organisational structures possess that have causal powers that shape HIS implementation in public healthcare settings. Figure 7-3 depicts these context-based mediators that influence the implementation activities discussed in the next sub-section.

7.3.2.1.1 Implementation policies and regulatory frameworks

Healthcare facilities, and by extension the Department of Health, together referred to here as healthcare organisations, play a critical role in ensuring facilitating conditions for the implementation of HIS. The majority of the mediating factors in this section are the result of the environment created for HIS implementation by various organisations. For example, the study's findings revealed that many of the HIS implementations in public hospitals were as a result of the policies, strategies and regulatory frameworks initiated by the national government of South Africa.

Technology implementation policies and regulatory frameworks are seen as key mediators for the implementation of the HIS in the healthcare sector. These policies and strategies influence the purpose and how the implementation of technological solutions takes place within healthcare settings. Findings reveal that the South African government currently has a number of strategies in place for the healthcare system that should inform the implementation of the majority of HISs. Examples include the mHealth strategy, 2015–2019; its objective is to leverage the existing mobile footprint in South Africa to empower patients with healthcare information, improved access to healthcare services and the management of real-time data. The mHealth strategy informed the implementation of mobile initiatives such as momConnect, a platform for pregnant women. Others include the eHealth strategy 2012–2016, the District Health Management Information System (DHMIS) policy formulated in 2012, and the National Digital Health Strategy for South Africa, 2019 – 2024.

The primary focus of these policy/strategy documents centres on improving access to quality healthcare service delivery by integrating technological solutions into the delivery process, thus enhancing healthcare service delivery. However, despite having these reforms in place, the national healthcare system is still marred with HIS implementation challenges such as those outlined as outcomes in the findings section. The study concludes that a possible explanation for this is the apparent disconnect in translating the policies' or strategies' 'text' into practice at operational levels of the healthcare system. For example, the researcher observed that participants involved in the HIS implementation at the hospital were unable to offer substantial comments on the contents of a policy such as the DHMIS document. The study reveals a lack of awareness by different stakeholders at the operational level of the healthcare system, reflecting a degree of disconnection between the stakeholders that should be responsible for implementing the policy goals and the policies/strategies themselves. The disparities of what is on 'paper' and what is happening on the ground were also noted by participants (PRJ-M, TP.ITS, PRS-M and NM.EC).

The implications of inadequate translation of these policies and regulatory frameworks are mentioned across literature in the form of HIS implementation failures (Weeks, 2012). A disconnect in translation of policy documents at operational level of implementation perhaps could offer explanations for the challenges the HIS implementation at the hospital still faces, such as *poor coordination* and *therefore fragmentation of the system*; *lack of interoperability between different systems* and *poor information management capabilities*.

7.3.2.1.2 Planning processes and support strategy

Another factor that mediates HIS implementation activities into the observed outcomes is the need for adequate planning and support strategies for the implementation process. Planning for the implementation of any technological solution in the healthcare sector requires that there be an assessment of the setting (healthcare facility). As noted by one participant, this is to determine "whether it is right for the environment" (TP.ITS). Yet another participant noted that an important question that should be raised before the implementation of new intervention is "are we [the hospitals] ready, can we [hospitals] afford it?" (DMA). The interpretation here is that the settings where the systems are to be implemented should be assessed for relevant adequate resources such as ICT infrastructure and skilled personnel before implementation begins. This, coupled with factors such as political will from the hospital management (DMA) to support the process long term would create an initial facilitating environment for implementation. Although there is empirical evidence of some sort of planning taking place before HIS implementation in healthcare facilities, it is not clear to what extent it is seen through. Or the degree of impact it has on the HIS implementation outcomes.

The aspect of leadership appears vital in the planning process of a new intervention and supplying the support structures required for it; with a respondent emphasising that "without leadership, nothing is going to happen" (PRJ-M). Adequate planning and support in the implementation of HIS in public hospitals are closely associated with mediating the effects of performance expectancy that later affect usage behaviour by actors in the work activity system. The importance of planning and support in the HIS implementation process as a mediating factor during implementation cannot be overemphasised, as it involves management clearly identifying where the bottlenecks are in the healthcare service delivery system so that they can be addressed for future implementations of HIS. This is crucial, and speaks to another mediating role of community and healthcare organisations, which is the importance of understanding and clearly articulating the purpose of or need for the systems to be implemented.

7.3.2.1.3 Purpose of the systems and need for healthcare practitioners and workflow processes

There is a need for better interpretation of policy documents from theory to practice at the operational level of the public healthcare system. Consideration should be given to the extent to which healthcare facilities are required to restructure their workflow processes to infuse technology interventions optimally in healthcare activities. As discussed in previous sections, the study identifies two healthcare processes, clinical and administrative. It is imperative that the integration of technology interventions should be done in both processes. As such, management and leadership roles become more vital. This includes the ability of those in leadership and management positions having capabilities to understand the benefits and limitations of technology interventions. This would require the establishment of reasonable goals for technology interventions, exhibiting strong commitment to successful implementation technology interventions, and formulating and distributing IT strategies to relevant healthcare practitioners. Lastly, an understanding of how these technology interventions align with the existing healthcare workflow processes is paramount. To support all these, adequate availability of resources defines whether short- term and long-term healthcare goals are achieved.

Without clear articulation of the need for (purpose of) these systems, in most cases they result in sub-optimal use and fragmentation within the healthcare service delivery system. As suggested by some participants in the empirical case (TP.ITS; NM-EC) and in related literature, the importance of understanding the purpose of or need for the systems to be implemented is evident. The implication of these mediating factors is the lack of scalability in the implemented systems. As the hospital is continuously experiencing an influx of patients, or new versions of applications become available, the systems should have the ability to adjust their capabilities to meet the demand for healthcare services. Another example of a lack of clearly defined reasons for implementation is the lack of integration of systems that leads to inadequate data flow between them (Meyer et al., 2005). This can be addressed by understanding the purpose and role of such systems well before implementation. The benefits of integrated systems include providing high performance in terms of quality and safety (Ghazi Saeedi et al., 2016). They provide convenient access to healthcare services and faster collaboration by disseminating useful healthcare information across the healthcare system at reduced costs. This in turn could translate to an improved healthcare service delivery process.

Another factor mediated by the community and organisation is leadership and governance in the implementation of HIS. It is vital that there is a demonstration of active leadership and

management (political will) in the implementation of HIS. The centrality of leadership and management in the implementation of HIS enables a conducive environment for implementation. The provision of resources is another factor mediated by the organisation and community in the implementation of HIS. Resources here include adequate ICT infrastructure (software, hardware, networking infrastructure) and skilled healthcare personnel. Change management in relation to training healthcare practitioners and managing expectations of users, if not addressed adequately, can influence the use or non-use of HIS. For example, participants mentioned that responsibility resorted on hospital management, together with the provincial or national Department of Health, to ensure that appropriate resources were available to healthcare practitioners to facilitate their work (GYNO; PRS-M; DMA; TP.ITS). This implies that the environment has to be conducive to enable the use of HIS. Another management mediating factor is clarity with regard to the purpose of technology intervention in the workflow process. The study deduces that this is crucial to understanding the need for use by all stakeholders involved in the healthcare service delivery work activity system.

7.3.2.1.4 Engagement of all stakeholders in the work activity system

The engagement of stakeholders in the implementation of HIS is yet another mediating factor in the HIS implementation outcome. This could be in the form of consultation with subjects in the work activity system to gather their inputs about their needs of or requirements for utilising the system to carry out their work activities. As one participant puts it, stakeholder engagement allows for the implementation of new technology interventions to be more open to what healthcare participants need (NM-EC). The result of this is that the new intervention are then “tailored to fit their work activities” (NM-EC). The importance of stakeholder involvement is also emphasised by another participant who noted that consulting different stakeholder during the implementation process allows stakeholders “…to make decisions by themselves” on how they want certain aspects of system to work for them (PRJ-M). The study deduce that there should be a period in the HIS implementation process where end users are given the opportunity to understand the purpose of the system and how it fits into their workflow processes. A lack of user involvement often leads to non-use by some participants as is evident from the empirical findings.

One of the implications of the lack of stakeholder involvement in the implementation process of a new intervention is that some end users would opt not to use the intervention as they are likely not perceive the value it has in their work activities. Friedman and Cornford (1989) contend the implementation of technology interventions depends largely on the involvement

of possible end users, how the prototyping of the technologies is performed, the analysis of the implementation settings, and change agents in the implementation activities. The involvement of end users is reiterated throughout the literature. For instance, Hwang et al. (2012) suggest that the involvement of users in the IS implementation process is crucial because they can indicate where the system could fail. The importance of stakeholder engagement is coupled with other mediators such as characterising the stakeholders, their roles, interests, perceptions, behaviours and relations within the work activity system. Understanding each of these mediators and their effects in the work activity environment enables implementation of HIS and subsequent use of healthcare service delivery as they influence the transformation of the activity into an outcome. The implications of a lack of stakeholder engagement in the implementation of HIS is lack of use or sub-optimal use in carrying out work activities.

Another benefit of or perhaps an opportunity for stakeholder involvement in the implementation process is the feedback mechanism that can lead to changes in design and development to fit the context and needs of healthcare practitioners. Other benefits include empowering end users to appreciate the value of HIS as a tool to facilitate the healthcare workflow process.

7.3.2.1.5 Monitoring and evaluation of the implemented HIS

Continuous monitoring and evaluation of the existing technology intervention is crucial so that systems can always react to current operational needs of end users and the hospital in general, thus ensuring the sustainability of adequate use of technology intervention to facilitate healthcare service delivery. User skills/competencies further influence use or non-use of HIS at the hospital. User competencies in this thesis imply the understanding, literacy and ability to put an HIS into effective use. As one participant put it, “Some of us here don’t use these computers because we don’t feel comfortable using them, we were never trained to use it” (EN-N). Healthcare practitioners who make use of healthcare information systems at the hospital have some level of training, hence find it easier to use the systems in their line of work.

The next sub-section discusses the findings on HIS use at the hospital and illustrates how the nature of and approach to HIS implementation informs use or non-use in facilitating healthcare service delivery processes in public hospitals.

7.3.2.2 HIS use in public healthcare settings (NMA Hospital)

Healthcare information systems use is in part mediated by the outcomes of the implementation process and in part by other mediators, as highlighted in this section. The

assumption is that for HIS use to take place, there must be some sort of awareness of its existence, an understanding of its purpose, and value attached to it before acceptance to use takes place. The findings as indicated in sub-section 6.4.2 suggest that there is a level of awareness of technological solutions at the hospital; however, that is not universal across the three groups of participants of the study. The administrative actors demonstrated high levels of awareness as opposed to the clinical actors. This can be attributed to the nature of their work activities (see sub-section 6.4.1.2) and their roles within the healthcare service delivery process.

The success completion of HIS implementation is achieved only when the HIS functions as an integral part of the healthcare system's workflow processes (Eder & Igbaria, 2001). This implies that the *embeddedness* of these systems into the work activities of healthcare practitioners is a crucial mediator. The implication of this mediator is that without embeddedness, there is likely to be resistance to use of the systems, as healthcare practitioners would perceive this as extra work. HIS implementation success is dependent on the user's commitment to use the system (Holahan et al., 2004). The ActAD model suggests that context, motives, nature of activity, and perceptions mediate HIS use to facilitate healthcare service delivery in public hospital settings. As postulated by Ynalvez and Shrum (2011), the HIS environment may improve; however, the effects on work activities depend on how individuals make use of the systems. This is in turn mediated by several other factors within the work activity system. **Figure 7-4** illustrates the relationship of the mediating factors and HIS use.

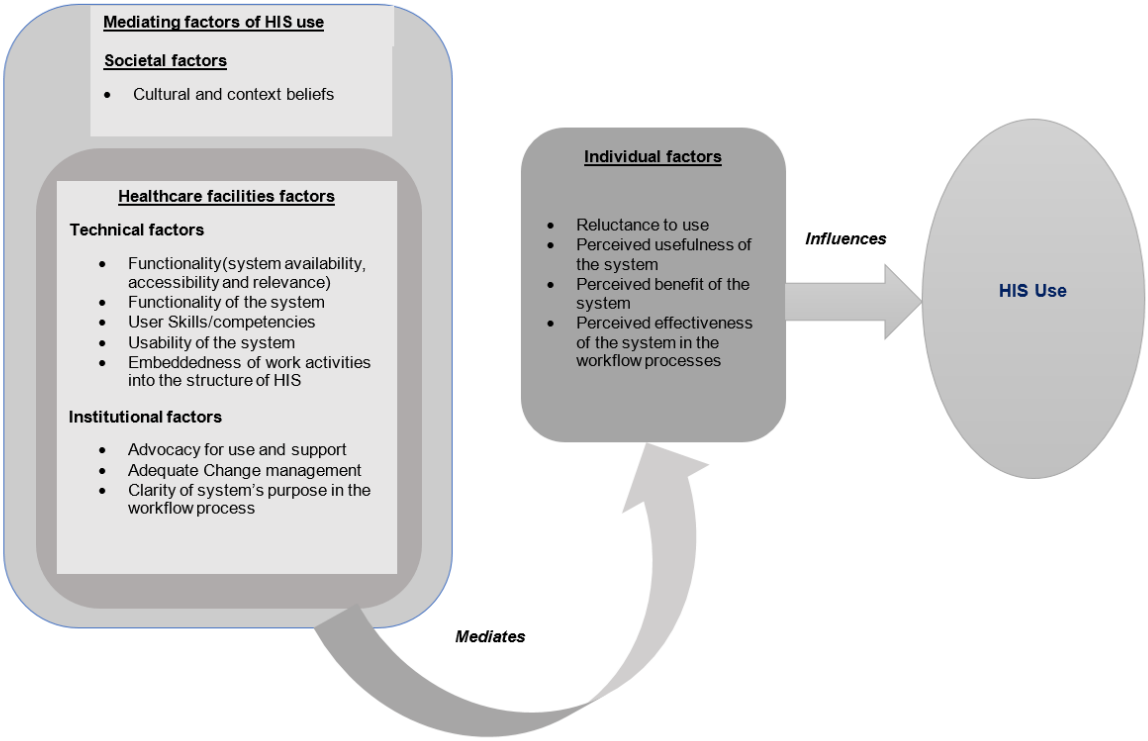

Figure 7-4: Mediating factors that influence HIS use

7.3.2.2.1 Technical factors

Technical mediators such as functionality of the system influence the use of technological intervention in a healthcare setting. In the context of the current study, a reliable system improves the confidence of end users in pursuit of operational objectives. As one participant from the hospital noted, "The hospital experiences a lot of network problems … [as a result] we do get a lot of frustrated users*"* (TP.ITS). Other technical factors that inform use of HIS include inadequate infrastructure (computers, software, printers) capacity. As noted by one participant, "All these wards need computers that are connected to the hospital's network" (GYNO). Yet another participant indicated that, "sometimes your need to print reports and the printers may not be working, therefore you can't do what you wanted" (PRS-M).

In addition, technical factors include uncoordinated systems at the hospital that force participants to duplicate processes. As mentioned by one participant: "If we could have systems that are connected to the network so that you just fill in patient information and you store it so that even for your referrals your colleague from another hospital just needs to punch in the folder number and see what was done" (GYNO). Poor technical support of networked systems is also an inhibitor of HIS use: when the support takes long to reach the end user, frustration leads to non-use. For example, one participant noted that "the X-ray

software at the hospital has been non-functional for the past six months, they [management] thought that IT was on it and IT gave up and they gave up, everybody gave up" (GYNO). Such cases across the hospital have led to most healthcare practitioners not buying into the idea of using HIS because the sustainability of these systems is not guaranteed.

As the findings reveal, given the significance of HIS reliability, continuous availability and functionality, the expectation therefore is for hospital management and the Department of Health to not only have ICT infrastructure in place, but also have appropriate measures in place to ensure few disruptions. Continuous monitoring and evaluation of the existing infrastructure are therefore crucial if hospitals wish to ensure the relevance of ICT so that systems can always react to current operational needs, end users, and the hospital in general, thus ensuring the sustainability of adequate use of HIS to facilitate healthcare service delivery. User skills/competencies also influence use or non-use of HIS at the hospital. User competencies in this thesis imply the understanding, literacy and ability to put an HIS into effective use.

The focus, however, should not merely be on the use of the system, but the ability to use the interventions adequately to optimise its functionality to fully realise the benefits. For example, as indicated by one of the managers in the laboratory unit, "sometimes when the clerks enter the doctor's request into the system you find that they make mistakes that they should not be making like capturing duplicate requests or capturing lab requests that are not made by doctors" (PRJ-M). Such a case is not a matter of a lack of utilisation, but a lack of efficiency in using a system. In the administrative process, patient management is cited as the main purpose for implementation and use. Data reveal a unanimous belief in the usefulness of HIS in the healthcare service delivery process among administrators. Goals and use in clinical processes are limited to sharing/communication of patient medical information. Limited technical support in some aspects discourages the use of HIS, hence healthcare practitioners at the hospital in some cases are unable to use the systems as often as they would like.

7.3.2.2.2 Organisational mediators

Mediators such as change management in relation to training healthcare practitioners, and managing expectations of users if not addressed adequately, can influence the use or non-use of HIS. For example, participants mentioned that responsibility resorts on hospital management, together with the provincial or national department of health to ensure that appropriate resources are available to the healthcare practitioners to enable the use of HIS in their work activities (GYNO; PRS-M; DMA; TP.ITS). This implies the environment has to be conducive to enable the use of HIS. Another management mediating factor is clarity of

purpose of HIS in the workflow process. Findings show that this is crucial in understanding the need for use by all stakeholders involved in the healthcare service delivery work activity system.

The findings revealed that HIS implementation and use outcomes (i.e., positive and negative perceptions) and the nature of HIS implementation (mandated, top-down, or externally led) shaped the context (i.e., lack of customisation, fragmentation variation of end-user training and exposure), mechanisms (e.g., degree of sense making, stakeholder engagement and awareness), and outcomes (e.g., degree of support, continuation and normalisation) for adequate use of HIS to facilitate healthcare service delivery in public hospitals. The manner of implementation often influences how the technology is utilised in a particular context. For example, across the literature, one of the critical problems in healthcare service delivery pertains to fragmented HISs. As a result, there is duplication of healthcare data across the healthcare system.

7.3.3 Discussions of findings on the purpose of HIS implementation and use

Across many sectors, including healthcare, the reason for the implementation of information systems is often attributed to the need to facilitate processes. This is no different in the healthcare sector, where technological interventions are implemented for the purpose of enhancing the quality of healthcare services (Rahimi et al., 2009). The expected outcomes of these technology interventions, especially in developing countries, are below expectation, as portrayed in the preceding subsections. The healthcare service delivery process is a work activity system that involves several work activities. In the context of this study, the use of technology intervention is one such activity. Actions within an activity system are often associated with intentions such as achieving specific goals and operations. Operations are carried out routinely to complete the actions under certain conditions. Under this investigative issue, the study sought to determine the motives behind the implementation and use of HIS at the hospital and how these motives inform implementation and use for healthcare service delivery. The findings in Table 6-5 (Chapter 6) illustrate the motives of the current HIS implementation and use for public healthcare service delivery at the empirical case.

In the next chapter, the study focuses on the underlying structures and mechanisms that produce the outcomes that are observable or experienced by the participants. These underlying structures may explain the current status of HIS implementation and use, which further clarify the state of healthcare service delivery at the empirical case. The chapter highlights the mediating factors producing the events that are experienced or observed. Drawing on the ActAD model, motives have the ability to transform human activity by

shaping the behaviour of users in the provision of healthcare services. These motives of HIS implementation and use are mediated by mechanisms that inform the manner of implementation and use. The identified mechanisms include *challenges associated with the manual paper-based system*, and in some cases, *pressure from external donors*, *institutional policies (rules) that mandate implementation*, and *performance expectancy* (including improvement of workflow processes and efficiency of service delivery).

Based on the outcomes in Table 6-5**,** the underlying institutional mediator of the motives for the implementation and use of HIS is attributed to the challenges of the manual paper-based system. These challenges that act as mediator for HIS implementation and use include the following: long turnaround times in the process of healthcare delivery, coupled with other factors such as a shortage of healthcare workers, often result in long queues in public hospitals leading to time inefficiencies and cost ineffectiveness; duplication of data across the healthcare system; poor data quality and Institutional rules demanding implementation of HIS in public hospitals as a way of improving healthcare service delivery. For example, the manual process of patient registration and retrieval of patient medical records is often very time consuming. As a result, the hospital, and by extension the Department of Health, introduced the patient registration system (Delta 9™) at the hospital.

Mediating factors to the outcomes of the purpose of HIS implementation and use include an awareness of the dynamic environment driven by technology by key decision makers in government. This is visible in the strategy documents that indicate the increase of mobile use as a mediator for the implementation of m-health technologies within the healthcare system. Authors note that the extent to which an organisation is responsive to new technologies will influence its tendency to adopt/implement new technology (Frambach & Schillewaert, 2002; Tarafdar & Vaidya, 2006:428). The main motives for technological solutions in healthcare are no longer just for cost effectiveness, but rather for the *strategic implications* these solutions have in healthcare systems. The main objective of the healthcare system is to provide access to quality healthcare services, thus the main driver for HIS implementation would be the benefits it offers, such as those indicated in the findings.

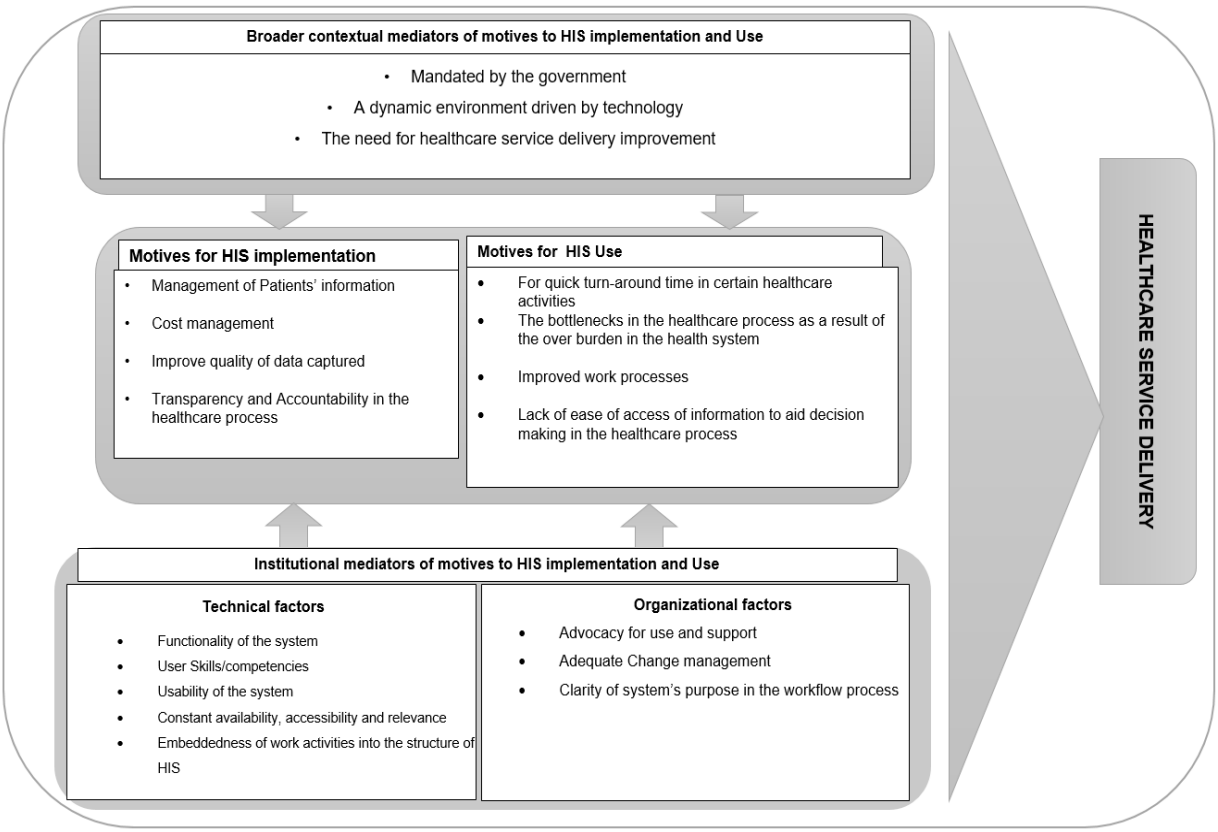

Figure 7-5: Relationship between context-based mediators and motives of HIS implementation and use

Figure **7-5** illustrates how the broader (healthcare system) contextual factors and specific institutional mediating factors influence motives for HIS implementation and use. This in turn influences the quality of the public healthcare service delivery process. As alluded to in the research problem, there is a persistent gap in realising the inherent value (ROI) of the implemented HIS in the public sector. As emerging from the data analysis, this can be attributed to the sub-optimal use of most of the systems implemented to execute work activities effectively. For example, one key broader mediating factor emerging from the findings is the *manner of implementation*; this has a positive or negative influence on how healthcare practitioners perceive the systems to be implemented, which in turn influences how they use them. The deployment of HIS because of external donor pressure, for example, is likely to face legitimate resistance to implementation and use. Further challenges of the current HIS implementation include the plethora of HIS pilots littered across the healthcare system that are not scalable.

As highlighted previously, key factors during HIS implementation are the planning process and support strategies. One of the negative implications of contextual mediators on HIS implementation and use is that if not planned and managed well, it may impact healthcare practitioners' optimal use. Also, less time allocated to planning issues such as

communicating and robust training impacts healthcare practitioners' ability to roll out new HISs effectively. Another point is that an implementation plan has to be shared openly with all relevant stakeholders who will use the new technology.

7.3.4 Implications of policy/strategy documents on healthcare service delivery and HIS implementation

Based on the findings, the study highlights some of the potential implications of healthcare policies and strategies on the implementation of HIS and use in public healthcare facilities in resource-constrained environments. Waldman and Stevens (2015:99) posit that even with good policies/strategies in place, their implementation can still be challenging. They contend that "policy is not sufficiently correlated with need". Policies, strategies, Bills and all other legislation play a vital role in the healthcare sector. As the findings from the analysis reveal, most of these documents were published to ensure mandatory uniformity across the healthcare system in the way in which healthcare services are delivered – whether in achieving equitable access to healthcare services as demonstrated by the National Health Act, 61 of 2003 or ensuring uniform implementation of technology in the healthcare sector as demonstrated by the eHealth Strategy. The findings from the document analysis also reveal that policy/strategy documents were developed to guide the healthcare processes across the healthcare system.

The study argues that inadequately implemented policies/strategies may hinder the implementation of e-health initiatives in public healthcare facilities, with serious implications for service delivery (Furusa & Coleman, 2018). Evidence of sustainable e-health initiatives such as HISs in public healthcare facilities is limited.

7.4 Summary of the Discussion of Findings

The preceding sections of this chapter touched on the outcomes of key investigative issues (objectives) of the study. The sections outlined the context-based mediating factors and the interplay between the enabling and inhibiting mediators to determine the nature of how the work activities are carried out and transformed to the observable outcomes seen in the empirical findings. What the study deduces is that the positive impact of mediating factors is attributed to the positive outcomes of an improved healthcare service delivery process. The negative impact results in undesired outcomes in the healthcare service delivery process. Figure **7-6** illustrates the relation between context-based mediators, work activities, and motives/goals that transform into a particular outcome (desired or undesired). This chapter also presented findings on the context mediators/conditions that generate the outcomes of HIS implementation and use in healthcare service delivery in public hospitals. Based on the critical realist ontology are occurrences in the actual domain, whereas the

outcomes are those events that are experienced in the empirical domain. The discussions also demonstrated the interplay between the independent variables (mediators) and the dependent variables (HIS implementation process and healthcare service delivery process).

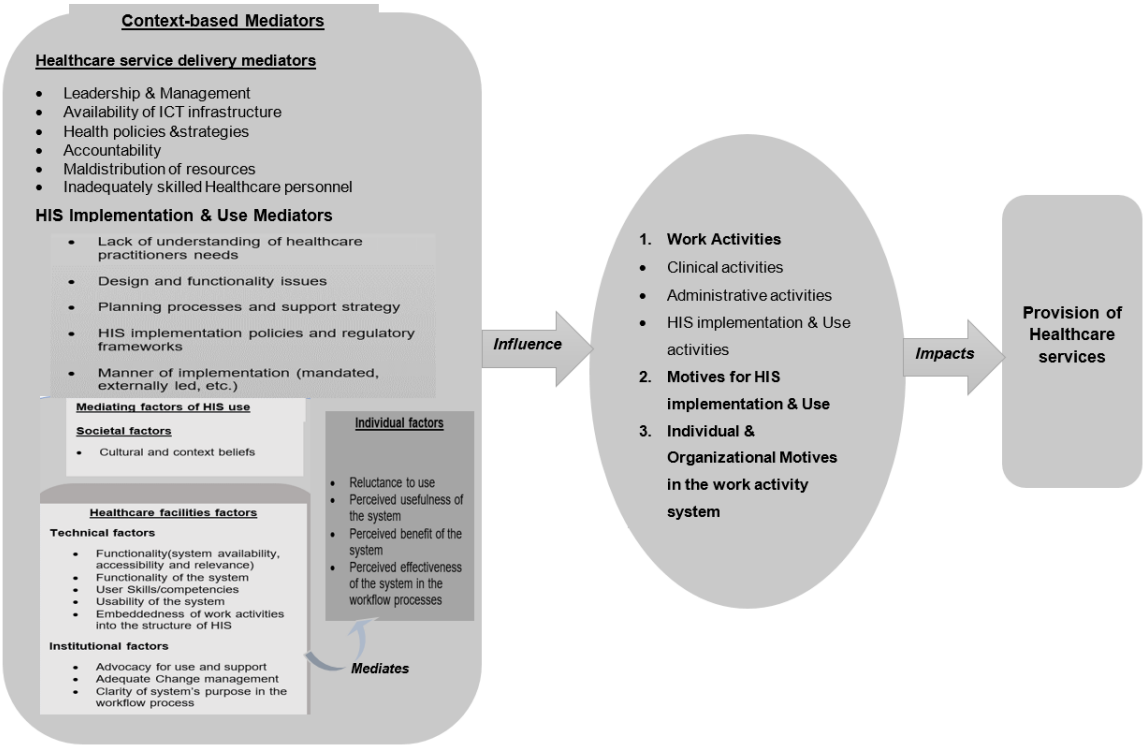

Figure 7-6: Relationship between context-based mediators, work activities and motives in the healthcare service delivery work activity system

This study emphasises the influence of context-based mediators, whether of HIS implementation and use or of work activities. By adopting a critical position, the study argues that the implementation of HIS in public healthcare facilities should not be understood to operate in isolation, and other factors should be considered. Considerations include mediating conditions influenced by contextual factors such as purpose of implementation, motives for HIS use, and leadership and management, among others.

In the next chapter, the study presents the generative mechanisms that operate in these conditions to generate the outcomes observed in the empirical findings. The study employs the constructs of the Normalization Process Theory to understand, identify and explain the generative mechanisms of HIS implementation in public healthcare service delivery. Generative mechanisms work in interconnected ways to enable or inhibit situations; however, Archer (1995) argues that analytical dualism can be used to untangle the mechanisms. As such, to abstract these mechanisms specific to the study's context requires the study to reflect on the conceptual framework while drawing on a theory in the

light of the preliminary empirical findings. This is the process of employing retroductive logic during data analysis to validate the mechanisms.

8 CHAPTER 8 – IDENTIFICATION OF CANDIDATE MECHANISMS

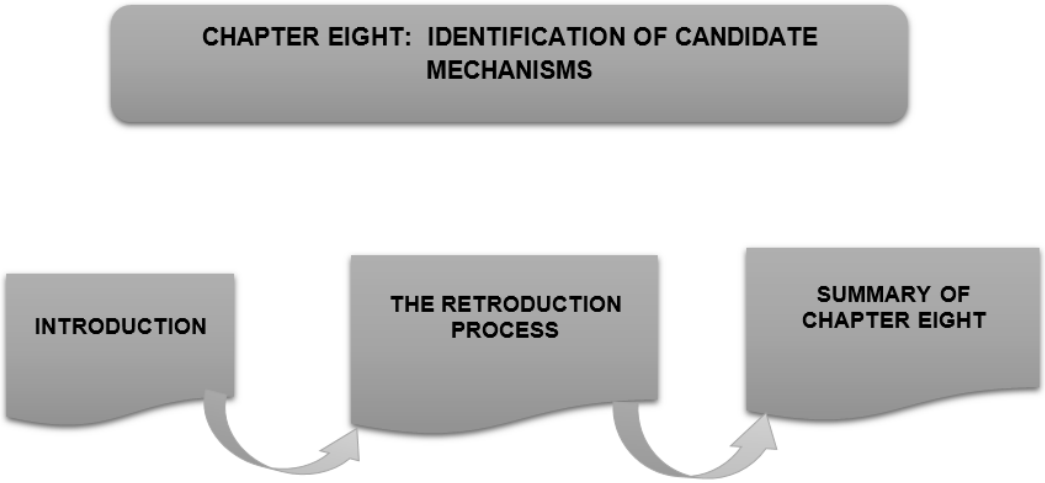

Figure 8-1: Chapter 8 outline

8.1 Introduction

This chapter presents discussions centred on the identification, characterisation and explanations of causal mechanisms that shape the outcomes of HIS implementation activities in the delivery process of healthcare services. To address this, the study employed a critical realist philosophical stance as the underpinning paradigm as it enabled the researcher to gain insight into the issues under investigation and the phenomena. For that reason, the approach in this chapter shifts from ontological to epistemological perspectives, where the relationship between mechanisms, events and empirical experiences is stressed (Bhaskar, 1978). These relations highlight the vital role causality plays in describing and explaining *how* and *why* mechanisms generate events. The focus of Chapters 5 and 6 was on the events that take place in the actual domain, and experiences in the empirical domain within the public healthcare context.

The focal point of the discussions in this chapter is on the real domain of the stratified ontology. The real domain subsumes the actual and empirical domain, and as such, is inclusive of mechanisms, relations, events and underlying structures. For critical realists, generative mechanisms that reside in the domain of reality are independent of the patterns of events. These generative mechanisms have powers to produce the events that exist in

the domains of the actual and empirical. The relations between the real, actual and empirical domains therefore generate behaviours in the social world, as such, it is in the actual domain (reflected in Section 7.3) that these events and behaviours occur while in the empirical domain experiences are had (as presented in chapters 5 and 6).

CR acknowledges the importance of context and the real domain is often perceived as a domain that depicts “complex interaction between dynamic, open, stratified systems, both material and non-material” (Mingers et al., 2013:796). These perceptions are attributed to the fact that causal powers and conditions have continuous interactions which cause constant change in a social system. As a result, it is difficult for a generative mechanism to produce the same kind of social events (Wynn & Williams, 2012). Another vital aspect of CR-based research is the element of interconnectedness, as in this study, where there is connectedness between the healthcare service context, work activities, and HIS as a tool. Consequently, researchers can only gain insight holistically through the exploration of the connection between the collective action of individuals rather than individual actions (Easton, 2010). It is based on the concept of interconnectedness that the explanation in critical realist studies on reasons for events’ occurrence in social contexts “depends on an account of how the properties and powers of the ‘people’ causally intertwine” (Archer, 1995:15). The study deduce that the outcomes of HIS implementation are dependent on the interactions among the implementation process, work activities and the healthcare setting. Sayer (1992) suggests that causal powers within the real domain are less likely to be ingrained in single entities, but rather in the relations between the social structures they form.

The main research question driving this study and underpinning it in the CR paradigm is: *Why the existing HIS implementation is not adequately facilitating public healthcare service delivery in healthcare facilities?* Therefore, it was fitting for the study to seek, epistemologically, the *how* and *why* mechanisms generating the events observed and experienced in the empirical and actual domain, which is the purpose of this chapter.

8.2 The Retroduction Process

The final stage of the study’s critical realist methodology is the *retroduction* process*,* which focuses on causal mechanisms. In the retroduction process, events are explained by identifying and hypothesising mechanisms and their causal powers that produce the observed or experienced events (Bhaskar, 1978; Sayer, 1992). Essentially, retroduction is putting context to reality, where the researcher is required to identify circumstance in the phenomenon under investigation without which the concept cannot exist.

In this chapter, mechanisms and their causal powers are identified, characterised and used to give explanations of the events they produce in the implementation process of HIS. After establishing the empirical findings (including customisation issues leading to inefficient use of HIS, lack of systematic implementation process, etc.), it was important to examine what social conditions cause these empirical trends to appear as they do. In the retroduction process, critical realists pose the following question in their investigation: "What is it about the structures which might produce the effects at issue?" In an attempt to address this question in this investigation, several aspects of the healthcare system as a social system, its physical structures and its surrounding setting, were identified from the empirical evidence and analysed from a theoretical perspective (Williams & Karahanna, 2013) (see Section 7.2). From a stratified ontology perspective, the retroduction process falls within the domain of the real, since generative mechanisms are not directly observable. It is therefore at the discretion of the researcher to devise relevant structures, generative mechanisms and their causal powers which may provide explanations for the observable events in the phenomenon under investigation (Bygstad, 2010; Zachariadis et al., 2013).

For critical realists, a hypothesis is formulated to enable the identification of and suggestions for possible structures and causal mechanisms for events that occur in social systems. The goal is therefore to make suggestions in respect of the structures and causal mechanisms that if they were to exist and be enacted in the suggested manner, would result in causal explanations for the observed events (Sayer, 2000). The retroductive process therefore requires that CR research: (i) clarifies the focal events from the empirical observations; and (ii) hypothesises causal powers, mechanisms and the underlying structures that produce the observed events. These two aspects provide a critical realist with in-depth insight into what things appear different, as well as how things could have appeared different. Based on these statements, retroductive methodology is employed for this study. Holistically, the retroduction process in critical realism is perceived as a methodology that "**d**escribe[s] the events of interest; **r**etroduce[s] explanatory mechanisms; **e**liminate[s] false hypotheses; **i**dentif[ies] the correct mechanisms" (Mingers et al., 2013:797). In short, it is described as the 'DREL' methodology.

Essentially what the retroduction methodology implies is that a detailed description of the events is fundamental to the identification of social structures, agencies and context-based factors that have causal relations. This, Wynn and Williams (2012) argue, serves as a base for gaining insight into the real happenings of a social event. Thereafter, empirically observed and identified experiences are selected then abstracted to enable a researcher to provide descriptions and explications of the events that occurred. From this point, the research activities move from the empirical to the actual domain. The study adopted the

ActAD framework as a theoretical framework to shape the theoretical description of those social events. This resulted in the findings on the context-based mediators/conditions that generate the outcomes of HIS use for healthcare service delivery. The next sub-section presents the next step of the retroduction methodology, which is to retroduce, to explain the mechanisms by inferring a cause or source.

8.2.1 Retroducing explanatory mechanisms of HIS implementation

In the next step of the retroduction methodology, an explanatory theory was employed to assist in identifying, characterising and explaining the mechanisms. Theoretical explanations are argued to play an essential role during the retroductive phase. Critical realists insist that “it is possible, [and] indeed necessary, to assess competing scientific theories and explanations” (Reed, 2005:1630). The perception is that this enables a comparative explanation that will reveal generative mechanisms and underlying structures that produce the principle events. As such, the retroductive phase of the critical realist methodology evolves around the process of thought trials that involve the act of constantly comparing iteratively, reflecting between literature sources, empirical data and the formulated hypothesis (Weick, 1989; Zachariadis et al., 2013). To this effect, Wynn and Williams (2012) posit that the retroduction process involves creativity, and researchers may propose the application of multiple theoretical explanations. Critical realist researchers are therefore encouraged to select theories that most accurately represent the real domain, given their existing knowledge.

Based on those arguments, the study chose to employ Normalization Process Theory (NPT) constructs and components to understand the HIS implementation and its generative mechanisms (May & Finch, 2009). NPT is defined as an “explanatory framework for investigating the routine embedding of material practices in social contexts” (May & Finch, 2009). Unlike the ActAD model that takes into consideration mediators (such as rules, beliefs, attitudes, etc.) in work activity systems, NPT is only concerned with individual or collective work activities in the implementation of an intervention. Thus, a combination of both theoretical frameworks provides the researcher with a holistic understanding of the issues under investigation. The term ‘normalization’ in this context is described as the act of embedding technology interventions or any other new practices in an organisation into daily work routines until they become the ‘norm’ (May, 2006). In NPT, the work involved in putting into practice a new intervention, in this case HISs, are enabled or inhibited by the operation of causal mechanisms that are expressed through human agencies.

The rationale for adopting NPT was its ability to enable researcher understand the implementation process of existing healthcare information systems at the hospital and the

extent to which the systems become ‘normalised’ or not in the healthcare service delivery context (May & Finch, 2009). For the purpose of this study, normalisation is understood as the process of embedding healthcare information systems into the daily work activities of healthcare practitioners. The study deduces that for optimal use (once an intervention has been routinised) of technological solutions, there has to be some kind of sustainable normalisation. This encapsulates the design, development and testing of interventions, through to their implementation, embedding and finally integration (May & Finch, 2009).

Drawing on the six-stepwise framework employed earlier in the analysis (Bygstad et al., 2016), theoretical redescriptive and retroductive processes are applied in this section and propose the generative mechanisms. On the basis of the abductive and retroductive modes of inference in the previous chapter and in this chapter, the study identifies generative mechanisms that produce HIS implementation outcomes such as poorly coordinated systems and lack of interoperability. The study breaks down the underlying mechanisms proposed into the four NPT constructs and their components. In the section, in addition to a discussion of the mechanisms, a discussion of the explanatory powers of the identified mechanisms is also presented.

8.2.1.1 NPT constructs and components

NPT categorises all the work activities in the implementation process according to four main interactive constructs: *coherence, cognitive participation, collective action* and *reflexive monitoring* (May & Finch, 2009). The four constructs are further divided into four other components referred to as ‘generative mechanisms’ because the aggregation of the various tasks under each of the components produces the outcomes from implementing an intervention. In other words, NPT postulates that for an intervention such as HIS to become routine practice (‘normalised’), there are activities that must be carried out.

These activities are characterised as generative mechanisms in the normalisation process of interventions in organisational contexts. Within the *coherence* construct, the activities include *differentiation, communal specification, individual specification* and *internalisation*. The *cognitive participation* construct activities include *initiation, enrolment, activation* and *legitimation*, while the *collective action* activities involve *interactional workability, relational integration, skills-set workability* and *contextual integration. Reflexive monitoring* activities involve *‘how is the work understood?’* According to May and Finch (2009), although the constructs and components describe different types of ‘work’ activities, they are correlated. What this means is that the constructs and the components constantly interact, with the potential to influence and change one another. The four interrelated generative

mechanisms and their explanations as they fit into the context of this study are shown in Table 8-1.

Table 8-1: Generative mechanisms in NPT (adapted from May & Finch, 2009)

The interrelated generative mechanisms			
Context	**Constructs**	**Generative mechanisms**	**Explanations**
The generative mechanisms are considered to be in dynamic interaction and are influenced by individual and wider, professional practice and organisational contexts	Coherence (individually and collectively)	*Differentiation* *Individual specification* *Communal specification* *Internalisation*	This mechanism relates to how work activities that define and organise the interventions in organisational contexts are understood, perceived meaningful and then invested in. This is in respect of the knowledge acquired, skills possessed, and behaviours of individual actors and actions required to implement it
	Cognitive participation	*Initiation* *Enrolment* *Activation* *Legitimisation*	This mechanism relates to the commitment required from individuals, as well as the degree to which those individuals are engaged with the new intervention. The questions that need to be addressed in this construct are: do individual participants view the new intervention as worthwhile and appropriate to bring about the intended outcome of the intervention?
	Collective action	*Interactional workability* *Relational integration* *Skill-set workability* *Contextual integration*	This mechanism relates to the work that will be required of participants to implement the intervention, including preparation and training. The question to take into consideration in this construct is how far existing work practices and the division of labour have to be changed or adapted to implement the intervention? At the same time, do participants perceive the intervention as being consistent with the existing norms and goals, the work place and overall organisation?
	Reflexive Monitoring	*Systemisation* *Communal appraisal* *Individual appraisal* *Reconfiguration*	This mechanism relates to participants' ability and intentions to perform formal or informal appraisals of the interventions. This is to evaluate the interventions' benefits for the participants collectively in alignment with organisational goals.

In the next sub-section, the constructs and components are discussed and a description is given of how the researcher interprets the mechanisms that evoke or produce the outcomes of the implementation of HIS in a public healthcare facility.

8.2.1.2 Explanation of NPT constructs and components as generative mechanisms

As discussed in Section 2.5 of the study, implementation of information systems is an organisational activity that involves a set of actions carried out by different stakeholders. These actions generally include an organisation's: (1) clarification of the intervention's problem and goal setting; (2) organisation planning activities; (3) implementation activities; and (4) use and development activities. The activities are shaped and informed by contextual factors discussed in the previous chapter and generative mechanisms that produce outcomes (desired or undesired). This sub-section discusses the NPT constructs as mechanisms that produce implementation outcomes in the actual and empirical domains.

From the analysis of the contextual factors in Chapter 6, the study identified that a fundamental factor in the implementation process of an HIS is the degree to which stakeholders in a particular setting 'make sense' of the information system. In other words, in the context of this study, sense making is the effort the stakeholders in a healthcare setting put into understanding or conceptualising the information system. Based on the findings, usually the users' understanding of a particular system will increase and evolve over time. It is therefore critical that users invest in the intervention from the onset of its implementation.

Drawing on the NPT, the activities involved in the process of understanding and defining the system (sense making) are referred to as ***coherence***. The study hypothesises that coherence is a mechanism in the implementation of HIS in public hospitals as it has causal powers that may enable or inhibit the implementation of HIS. This construct has four components (generative mechanisms) within it: *differentiation*, *individual specification*, *communal specification*, and *internalisation.* The study begins by describing each component and how it applies to the study. In the following paragraphs the study discusses how these generative mechanisms produce outcomes (observed or unobserved) in the actual and empirical domains.

I. ***Differentiation*** mechanism refers to the effort that people put into understanding how the methods, tools or practices of the new intervention differ from or are similar to the existing methods. This mechanism has causal powers that produce outcomes such as

lack of system customisation to fit healthcare practitioners' work activities, and poorly integrated information systems into the work practices of healthcare practitioners. All these outcomes inhibit HIS implementation for public service delivery. In order for healthcare settings to maximise the enabling effects of this mechanism, it would mean that stakeholders in that setting would be required to understand how the procedures of carrying out healthcare service delivery activities using HIS would differ from or be similar to manual paper-based processes. For example, at the hospital, doctors using the new laboratory information system (EGK system) would firstly be required to understand how the new process of requesting patient blood tests from the laboratory would differ from the manual process. At the same time, they would wish to understand how this new system interacts with other systems and protocols.

The degree to which differentiation is achieved during implementation is likely to influence how users of a particular system use it optimally to carry out their daily operations. Other contextual mediators/factors in the implementation of HIS may enable or inhibit healthcare service delivery. To elaborate further on the contextual factors, one of the outcomes observed in the actual domain and experienced in the empirical domain is the lack of customisation of the HIS at the hospital. The explanation of this outcome can be that it results from the inhibiting effect produced as a result of the relation between the generative mechanism differentiation and contextual factors such as a lack of understanding healthcare practitioners' needs. The study therefore argues that a high level of differentiation may produce an enabling outcome in the implementation of HIS. The other component in the coherence construct is communal specification.

II. ***Communal specification***: As a mechanism, communal specification involves work activities required to understand the purpose of the intervention. 'Purpose' here is used to describe the value the new intervention will have for each individual participant in the implementation setting. Because a work activity system such as healthcare service delivery involves several activities carried out by more than one actor, this mechanism emphasises the importance of having the entire group of stakeholders in a work activity system understand the purpose of the intervention being implemented. In the case of this study, all relevant stakeholders in the healthcare system would be required to understand the purpose of HIS in the healthcare service delivery system. The study hypothesis that the degree of communal specification in the empirical case is insufficient and as a result, generated inhibiting effects in the implementation of HIS. The healthcare service delivery process involves different work activities carried out by various actors with different skills and knowledge. These activities involve collaboration

among the various healthcare practitioners (clinical and administrative). Thus, the introduction of new technologies raises the aspect of new roles with regard to who does what. It is critical therefore to determine how each individual in the work activity system perceives the purpose or value of the system in their line of work.

For example, at hospital, when the new laboratory information system (EGK) was introduced, the project manager in charge of the implementation process outlined new ways of how laboratory tests were to be ordered through the new system. This included what needed to be done (new procedures), who had authority, and when they were authorised to do so. Participants were able to describe for themselves what value the system added to their daily work activities and therefore decided to invest value into the system. The impact of this in respect of the use of the system was that it positively enabled doctor and clinician work activity and positively transformed the turnaround times for laboratory results at the hospital. However, participants' understanding of the benefits of a system at times may differ from the intervention's intended benefits, as was in the case of the laboratory information system at the hospital. The intended purpose of implementation based on the empirical finding was cost management; however, individual participants may have had the perception that the benefit of the system was to reduce work load or improve accuracy and responsiveness. NPT postulates that if this difference is insignificant, then the assumption is that there would be a higher chance of achieving communal specification, thus producing enabling conditions for normalisation.

III. ***Individual specification*****:** In the same manner as communal specification, this mechanism, instead of analysing the understanding of the purpose of the system from a group level, focuses on individuals in that group. This is because a work activity system is composed of individual and collective tasks. It is therefore crucial for individuals to also have an adequate understanding of how the system adds value to their specific work activities. This will enable the allocation of resources and involve healthcare practitioners in training for additional skills, if needed. A good example of this is portrayed by one participant who felt technology did not add value to their line of work and rather complicated matters. As such it is crucial to identify and address such individual cases.

IV. The last component in the coherence construct is the mechanism of ***internalisation*** which looks at actions users of a particular system within a context carry out in an attempt to understand and interpret the intervention in relation to their beliefs and organisational culture. In the discussion of the contextual factors that mediate HIS

implementation, one of the mediating factor outcomes that emerged from the findings was the human behavioural aspect, and how that influences motives and goals in the work activity system. The culture of the organisation also has an influence on the manner in which the implementation of an intervention such as HIS takes place. For instance, an organisational culture that offers support or advocates for use of a particular intervention is more likely to have an easier transformation process than one that does not. Internalisation has positive or negative influences on the 'normalization' of new interventions. The study view this as an important generative mechanism at the hospital where leadership and management seems to lack when it comes to advocating for technological interventions.

With regard to this construct, the study deduces that these four components (differentiation, communal specification, individual specification, and internalisation) have generative mechanisms on the implementation of HIS in public hospitals. The study posits that in order to achieve greater levels of coherence during the implementation of HIS, relevant policy makers within government and the Department of Health are required to identify and address elements of differentiation and specification, both at individual and collective level, simultaneously taking into consideration the aspect of internalisation. They would then be able to mitigate the effects of the inhibiting causal powers and the same time leverage the enabling causal powers.

The implications of these mechanisms in the implementation process of HIS are that they produce outcomes such as *disparities in the theory and practice of HIS implementation policies and strategies* as observed in the South African context. It should therefore be of interest for implementers and policy makers at both hospital and government level to be aware of such mechanisms. The perennial questions that should be addressed during the planning or strategic decision-making phases of implementation of HIS are: *How is the benefit/purpose of the HIS understood and accepted by all stakeholders in the healthcare system? How does the HIS fit (integrate) into the healthcare work activities of practitioners and at the same time fit the healthcare setting?* The implications of not addressing such questions at this stage of implementation may result in inadequate use ('normalization') of HIS for public healthcare service delivery. Some of the outcomes that may also result in ineffective implementation are illustrated in Figure **7-3**. The mediators include design and functionality issues, a lack of understanding of healthcare practitioner needs, etc.

The next construct of the NPT is ***cognitive participation***, which describes the relational work undertaken by implementers and policy makers to engage participants in the new intervention and get their cooperation (May & Finch, 2009). In other words, the construct

suggests that individuals in a given setting where implementation of an intervention occurs ideally should identify the value of engaging with the intervention and continuously build on that. Cognitive participation in the new intervention therefore requires that the participants show a form of motivation for the process of incorporating the intervention into their work activities. These participants should do so by identifying ways in which explanations can be provided on how the new intervention would fit into existing tools and approaches appropriately. The components of this construct involve the identification of those involved in the implementation. The components are *initiation, enrolment, activation* and *legitimation.*

I. ***Initiation*** mechanism involves the identification of key participants who are capable of driving the implementation of an intervention. The initial tasks carried out here are the promotion of the intervention and raising awareness of the stakeholders involved. The main issues of concern with the initiation mechanism are in the process of *how* the key participants are usually involved, and *how* the selection process occurs. In other words, this can be interpreted as stakeholder engagement selection into the implementation process of a new intervention. The effects of excluding key stakeholders in the existing implementation of IS are felt across different sectors. Research on implementation of intervention therefore advocates stakeholder involvement. The process of stakeholder involvement begins with choosing the right people. A fair representation of implementers within different groups of the stakeholders in an activity system is crucial to the understanding of the dynamics of work activities in a complex system such as healthcare. A satisfactory selection of appropriate participants to involve in the implementation process of a new intervention requires that a thorough investigation of the healthcare work activities and the actors involved be identified.

   In the context of this study, a good example is what is currently being done with the NHI bill where various ‘imbizos’ (community dialogue) are carried out with community groups and hospital management. This can be viewed as a form of initiation where the government seeks the opinions of several stakeholders.

II. Another component in the cognitive participation construct is ***enrolment****,* which involves effort in recruiting participants who will implement the intervention and keep them engaged in the entire process. This process extends beyond identifying only key participants, but includes others who might be able to contribute significantly to the implementation process. In the case of this study, this was exercised by involving ‘observers’ from other countries with experience in the implementation of HIS.

III. Once the identification process is done, the ***legitimation*** work comes, where participants are still required to carry out some work of the implementation. It is

important that this is clearly outlined so that roles and responsibilities are known by all parties involved; this is done to avoid complications of conflict.

IV. The last component of the cognitive participation construct is ***activation*****,** which describes the continuing support work deemed necessary to sustain the use of the new intervention. Technical support and continuous user training are examples of how important this mechanism is in the implementation of an intervention such as HIS.

The third NPT construct is ***collective action****,* which describes the work involved in putting an intervention into practice. The emphasis of this construct therefore is on the work performed by people (individually or collectively) in operationalising a new technology in practice. This construct comes after there has been some sort of sense making of the new intervention and objects associated with it (coherence), and an undertaking with regard to the relational work of who does what during the implementation has been achieved (cognitive participation). Components in this construct include *interactional workability, relational integration, skills-set workability* and *contextual integration.*

I. The component of ***interactional workability*** addresses the question of how the new interventions affect existing working practices. For example, doctors at the hospital noted the additional work involved in retrieving information from their mobile phones as the laboratory system had no way of producing an exact match to the results ordered by doctors. This meant that a doctor had to go through multiple records to obtain the information they were looking for, which meant wasted time. This mechanism focuses on activities participants (healthcare practitioners) have to do to adapt to new ways of carrying out their work. The assumption is that participants will perceive that the intervention will necessitate a change of practice and the need for new skills required to implement it (Murray et al*.,* 2010). For example, in the context of this study, a successful implementation of HIS in public healthcare facilities will depend on the degree to which healthcare practitioners perceive that the systems will be consistent with their existing work practices or necessitate changes in the healthcare practice, or that the implementation will require additional skills. A fit between the new intervention and existing skill sets is key. Coherence (individually and collectively) of HIS implementation is therefore a major generative mechanism in the study.

II. ***Relational integration*****,** on the other hand, refers to forms of knowledge work that participants in a setting do to build and maintain accountability, confidence and trust in the intervention and in each other to implement it. In other words, the activities involved in incorporating change within existing relationships. Concerns such as trust, confidence and accountability may act as inhibitors or enablers of utilising healthcare

information systems in hospitals. For example, technology interventions in healthcare settings are seen as tools for increasing efficiency, which may initially encourage the use of these systems. However, lack of confidence and trust issues may inhibit use. It is therefore crucial that there be emphasis on relational integration as a mechanism during implementation of an intervention.

III. ***Skill-set workability*** as a mechanism describes the work of that goes into dividing and allocating resources so that the intervention can be implemented satisfactorily. This requires the division of labour in terms of who does what in the implementation process, and also deciding who has the 'power' to make decisions about resource allocation and work delegation. For this mechanism to be effective, consideration of the skills, knowledge, attitudes and capacity of staff is required. A successful intervention depends not only on individual or collective division of labour, but also on allocation of resources to support them. This mechanism produces outcomes such as shortage of resources (material or people), and inadequate competency among healthcare practitioners. A fundamental enabler of the implementation of HIS in public hospitals is the availability of an adequate and sustainable ICT infrastructure that lays the foundation for successful implementation. Despite evidence across literature of initiatives taken by the government to put in place ICT infrastructure, the hospital still lacked ICT infrastructure resources.

IV. The last component of collective action is ***contextual integration***. This component emphasises the work of integrating the intervention into existing structures and contexts. The work of contextual integration depends on the adequate availability of resources, and includes the provision of new resources or reallocating existing resources.

The study concludes that the components of coherence and cognitive participation influence, and are in turn influenced by, the activities of collective action. This transformation happens through shaping participants' behaviour in favour of the implementation of the new intervention.

The fourth construct of NPT is ***reflexive monitoring*** – this involves the work of assessing both the individual and collective value of the intervention. This leads to attempts to modify or reconstruct a practice to enable adequate implementation. The components of this construct include *systematisation, individual appraisal, communal appraisal and reconfiguration.*

I. The process of aligning external evidence with local priorities and practice is acknowledged within literature as an essential means of enhancing the compatibility of

the proposed intervention. This process is one of the components of reflexive monitoring referred to as *systematisation*. Within this study, the lack of regular procedures for monitoring the existing technology intervention at the hospital seemed to have a negative impact on implementation and normalization of those interventions. This can be viewed as underlying causal mechanisms that inhibit the use of technology interventions. A common occurrence across most developing countries in the habit of acquiring technology intervention from other context and not customize them to fit their own organizational needs.

II. ***Communal appraisal*** describes how the participants in a setting evaluate the interventions as a part of a group. For example, in the healthcare service delivery process, there are work activities that are interconnected between clinical and administrative activities. To appraise the benefits of any information system in that workflow would involve not only reflections from individuals but also from the entire group of people affected by the intervention.

III. ***Individual appraisal:*** It also involves the process of evaluating the value of an intervention, but unlike communal appraisal, this component involves individual participants in the implementation evaluating the value of an intervention for them.

IV. ***Reconfiguration:*** This component involves the work participants have to carry out to modify the intervention and themselves (in terms of adjusting their attitude towards the intervention, and skills and knowledge required to apply the intervention in their work activities) or adjust their context (including changing practice procedures, policies and infrastructures).

Each of these components of the NPT constructs are viewed as generative mechanisms with causal powers that trigger events that produce outcomes in the implementation process of technology interventions. As already established in section 3.3, generative mechanisms such as these describe in this section are entities that emerge from the relations formed by social, ideations or psychological structures (Fleetwood, 2005). These mechanisms can either manifest themselves explicitly or implicitly in the healthcare setting where the implementation of a technology intervention occurs. The argument therefore is that the casual powers that these generative mechanisms possess are as a result of the ever-changing state of the interactions within the healthcare system that produce the outcomes that are observed, unobserved and experienced. The effects of these generative mechanisms can produce desired or undesired outcomes in the delivery of healthcare services. In summary, what the study proposes is that for successful implementation to be realised, policy makers (both in government and the national department of health) should

not only look at contextual factors that enable or inhibit the implementation of HIS, but also take into consideration the underlying generative mechanisms that produce these contextual factors.

8.2.1.2.1 Causal relations between the constructs

The four constructs and their components follow the general format of an implementation process of an intervention. The following section describes the relation of the constructs from the study's contextual point of view. The implementation process of HIS in a public healthcare hospital such as the empirical case would involve the initial sense-making process of the technology to be implemented to the activities involved in preparing the healthcare facility for implementation. Outlining the operational work of implementation to the eventual evaluation of the technology's success and potential reconfiguration due to changes across the implementation, if needed, follows. **Figure 8-2** illustrates the relations between the four constructs and their components as generative mechanisms in the implementation process of an intervention.

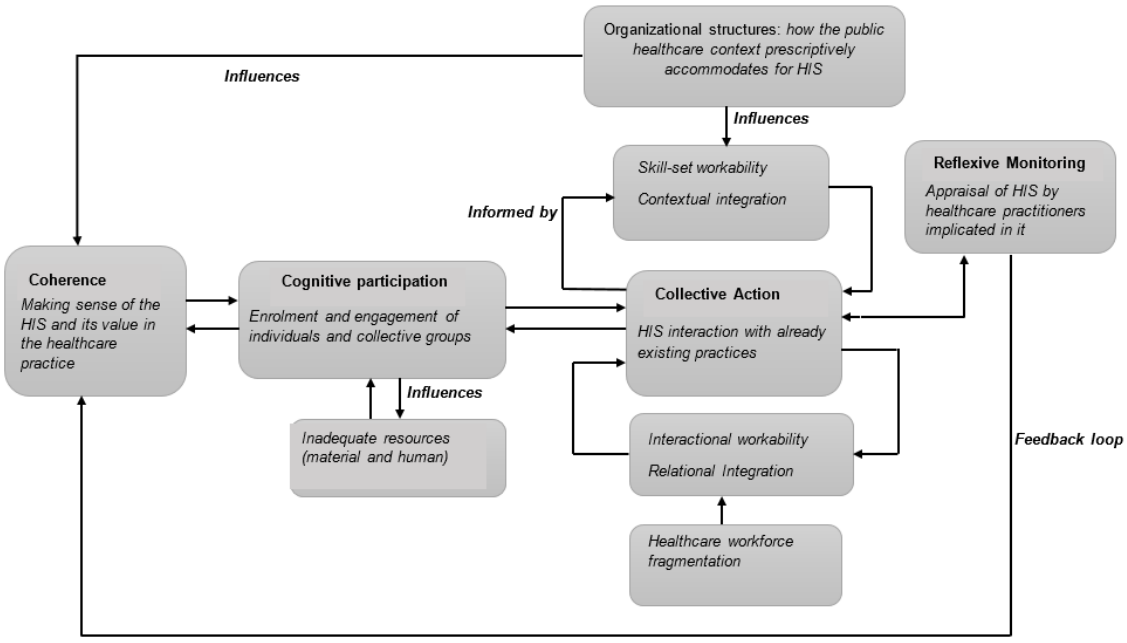

Figure 8-2: The relations between the four constructs and their components

Within the study, the level of awareness of HIS at the hospital varied between the groups of participants. The participants who carried out administrative activities at the hospital showed a higher level of understanding of the systems in terms of the benefits of the systems in their work activities compared with those who carried out clinical activities. Data also indicated that the perceived benefits of the systems outweighed the time and skills involved in changing the practices. For example, the administrative participants perceived

that the process automating patient registration had long-term benefits for their work activities, therefore they were eager to participate in training sessions. Within the study, there was an indication of variation in the level of coherence in different units at the hospital. There was a high level of awareness among the participants (such as administrators, case managers, ward clerks, etc.) who carried out administrative activities. On the hand, some participants who carried out clinical duties did not see the benefit of HIS in their work activities, with some viewing it as disruptive. This can be attributed to the fact that the participants valued different aspects of the available information systems.

Cognitive participation as a generative mechanism for HIS implementation is interlinked with the mechanism of coherence. It involves the work undertaken in settings where the intervention is being implemented to engage the potential users and get them to 'buy into' the new system. As the findings reveal, there is some sort of training during the implementation process of the new HIS. As noted by participants and document review, depending on where the systems come from (national/provincial department of health or hospital management), training is part of the implementation. However, neither document review nor interview data demonstrated that participants engaged consistently in the implementation of existing HISs at the hospital. This was evident as some of the participants, especially in the clinical process, showed little or no knowledge of HIS at the hospital. Data reveal that despite the appeal of different aspects of the system for various participants, there was lack of collective action. The mechanisms have powers in terms of causes, motives, considerations, choices and social interaction within a particular context. The powers are mediated by social and material structures (for examples, role expectations, tools, artefacts, etc.).

In summary, following the principles of retroduction, the study deduces that coherence, cognitive participation, collective action, and reflexive monitoring, together with their components, are the mechanisms within the implementation process of HIS that generate outcomes that in turn influence the implementation and use HIS. The study found the NPT constructs helpful in identifying problematic vulnerable features within the study's context, such as reflexive monitoring mechanisms of the HIS implementation in respect of processes involved in embedding a complex intervention such as HIS. In **Figure 8-3**, the study illustrates a stratified representation of how events occur in the HIS implementation within a healthcare service delivery context. In the figure, the social structure and its elements are mediated by contextual factors/mediators and generative mechanisms. This then evokes the events in the actual domain and experiences in the empirical domain.

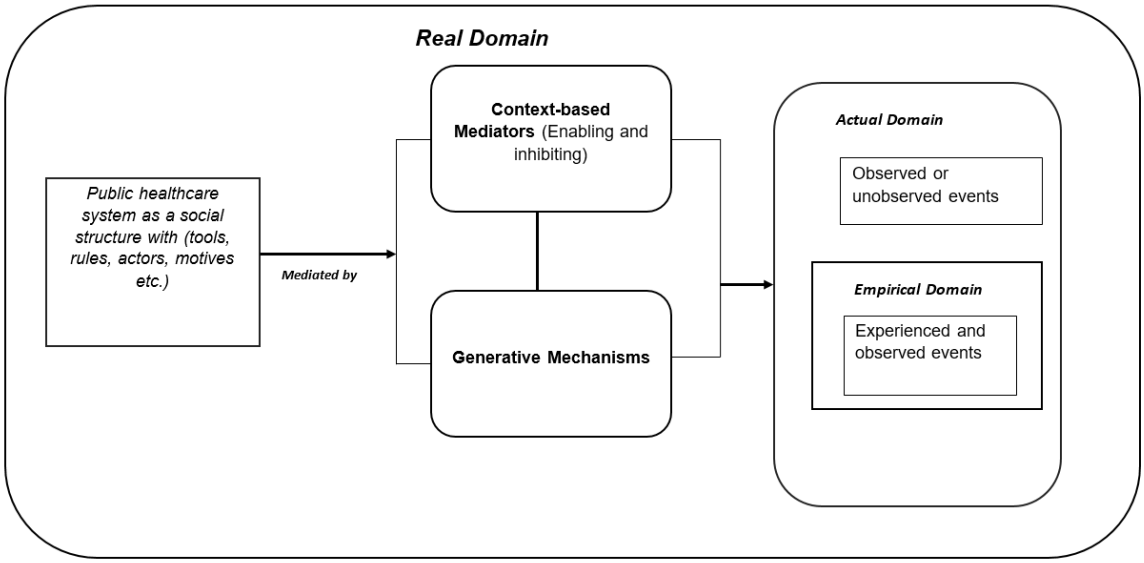

Figure 8-3: Representation of the stratified relation of events

8.3 Summary of Chapter 8

This chapter gave an analysis of the retroduction process methodology. The study adopted the NPT as analytical framework to identify, characterise, and explain the generative mechanisms for HIS implementation within in a healthcare context. The researcher adopted the four constructs of NPT as the key causal mechanisms with powers that, if enacted, would produce the outcomes from a critical realist perspective observed in the actual and experienced in the empirical domains. The study employed these constructs as generative mechanisms to explain the outcomes experienced in the empirical domain. The first mechanism (coherence) explains the role of HIS implementation activities that define and organise the intervention, ensure it is understood and rendered meaningful, and measure how much effort is invested by different stakeholders, especially those at the lower levels of the healthcare system, which would be the healthcare facilities. Cognitive participation is the second mechanism and explains the role of stakeholder engagement and commitment in defining and organising HIS implementation activities. The third mechanism is collective action, which in this instance explains the role of the HIS implementation work activities and to what extent these activities impact the existing daily work activities of healthcare practitioners. It also explains the role of division of labour that may influence the mechanism of collective participation. The fourth mechanism is reflexive monitoring, which explains the important role of ongoing monitoring and evaluation of the HIS to examine the benefits and values in relation to achieving individual and community- based goals and objectives in the healthcare system.

The chapter revealed that the outcomes of these mechanisms, however, are contingent on other context-based mediators such as the availability of resources, the widespread socio-economic challenges the country faces, health policies/strategies, etc. From the analysis, the study observed that events directly or indirectly experienced may be dependent on the complexity of the multiple generative mechanisms that are triggered by a combination of several context-based mediators. An understanding of the interplay between observed events, structures, conditions and causal mechanisms may explain why and how HIS implementation could improve healthcare service delivery in public healthcare facilities in resource-constrained environments.

9 CHAPTER 9 – CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

This chapter concludes the thesis by summarising the research process, and reflecting on how the research problem, objectives and questions were addressed. The chapter also presents the limitations of the study and makes recommendations, together with an evaluation of the research to support the conclusions. Each point concludes with an account of how the findings and recommendations contribute to both the scientific body of knowledge and the community of practice. The majority of the literature reviewed for this study on healthcare information systems focuses on whether the systems can or cannot work by examining the factors/challenges that enable or inhibit the successful implementation of information systems in various contexts. There is limited literature on research that focuses on how technological solutions are supposed to work in various settings especially in the healthcare sector.

In Chapter 1 of the study, it was stated that the aim of the research firstly was to understand the landscape of healthcare service delivery in resource-constrained environments in South Africa and the contextual factors the enable or inhibit it. An understanding of these contextual factors/mediators was key in establishing HIS implementation considerations in resource-constrained public healthcare settings. Secondly, the aim was to determine the causal mechanisms of these contextual factors that explain why the existing HIS implementation is not facilitating public healthcare service delivery. Of significance to the study was how HIS implementation in the public healthcare sector can be improved to facilitate healthcare service delivery.

Chapter 2 positions the study within the scientific body of knowledge and therefore surveys literature involving the implementation of information systems in healthcare settings as well as various applications of technology interventions in the healthcare sector. The chapter also gives various definitions of the term ‘implementation’ in the information systems field. The study adopted Nilsen’s (2015) definition of implementation, which underpinned the entire study. In Chapter 3 the tone of the research is set by presenting the research approach the study took. In this chapter, the study’s philosophical beliefs are detailed, and involve a description of critical realism as the underpinning philosophy. Chapter 4 then presents the research design in its entirety, including the research strategic approach, a description of the study’s case and unit of analysis, the study’s sample, data-collection methods and analysis techniques. The chapter also highlights the ethical clearance sought

before carrying out the investigations. Chapter 4 concludes by highlighting how the study managed its data and its importance.

Following the critical realist methodology, the study employed Bygstad and Munkvold's (2011) six-step framework. Each of the six steps is demonstrated from Chapter 5 to Chapter 8, where discussions of the application and interpretation of the steps are presented. Chapter 5 presents the first analysis of the multi-layered analysis process the study undertook. The chapter gives a thematic analysis of documents (including policy and strategy documents) that pertain to the delivery of healthcare services in South Africa. The chapter describes the documents by highlighting the context, text and consequences or implications the documents have on the delivery of healthcare services in the country. The themes that emerged from these analyses included purpose and motive, strategic initiatives, benefit or value, monitoring and evaluation, and resource infrastructure. The study argues that these themes reflect three different perspectives of health policy/strategy in the healthcare system. Each document was analysed from three perspectives: (i) context (purpose or motive) in which the document is prepared, (ii) meaning of the text or interpretations of the content, and (iii) the consequences that the other two perspectives may have in the broader context of public healthcare service delivery and the implementation and use of technology interventions in the healthcare sector.

Chapter 6 of the study presents the second layer of analysis that included the analysis of interview transcripts. The chapter analyses the empirical data using four investigative issues starting with the status of healthcare service delivery and HIS implementation and use from the perspective of healthcare practitioners and other stakeholders in the healthcare system. The chapter also analyses the purpose of implementation and use of healthcare information systems at the hospital and finally the role of healthcare information systems in the healthcare service delivery process. Based on these analyses, the chapter presents themes that emerged from each issue of investigation. The study presents these themes as outcomes in the healthcare service delivery process that is viewed as work activity system. These outcomes are generated as a result of several context-based mediators that are discussed in Chapter 7. Chapter 7 provides a discussion of the findings from the analysis. It begins with a discussion of the ActAD framework employed as a theoretical framework that explains the emerging contextual mediators and the effects they have in the healthcare service delivery process. The chapter concludes with a discussion of the implications of healthcare policies/strategies.

Chapter 8 focuses on the final step of the critical realist methodology – retroduction process. Where events are explained by identifying and hypothesising mechanisms and their causal powers that produce the observed or experienced events. Normalization Process Theory is used in this chapter as an explanatory framework to identify, characterise and explain these generative mechanisms.

The rest of this chapter reflects on the research problem and how the problem was addressed.

9.2 Reflections on the Research Problem

The main focus of the research problem in the study was on the implications effected by the undesired outcomes of HIS implementation activities in public healthcare facilities. The implications in some cases have been that much of healthcare information in public healthcare facilities is either not captured, or captured inaccurately. This is reflected in poor data quality and bottlenecks in workflow which impact turnaround times in the healthcare service delivery process. Consequently, the retrieval of healthcare information for the purpose of decision making at different levels of the healthcare system faced several challenges. These have obviously negatively impacted the delivery process of healthcare services, which is the opposite of the expected desired outcomes that the Department of Health hoped for with the implementation of healthcare information systems.

The study argues that the root causes of the challenges within the healthcare system are not purely logistical, but could also be associated with the implementation of technology interventions. Subsequently, the study sought to investigate causal explanations to the question, 'Why the existing HISs implementation strategies are not adequately facilitating healthcare service delivery'? In doing this, the study would establish how the implementation of HISs could facilitate healthcare service delivery to improve health outcomes in under-served communities. In the following sub-section, the researcher summarises the findings, addressing each research question.

9.2.1 Summary of the research findings

This sub-section reflects on the research sub-questions the study posed in the introductory Section 1.5. In this sub-section, the study also reflects on how the findings in each sub-question contribute to answering the main research questions that guided the investigations of this study. This study was guided by two broad main questions: **RQ1 ~***Why is the existing HIS implementation not adequately facilitating public healthcare service delivery?* **RQ2 ~***How can HIS implementation adequately facilitate public healthcare service delivery in resource-constrained environments?* The two research questions were framed in such a

way that the ‘WHY’ does in some way answer the ‘HOW’ of the questions. The ‘why’ question describes how a typical successful implementation of HIS in a healthcare facility will adequately facilitate service delivery processes by highlighting the reasons why the existing implementation is not producing desirable outcomes.

The first sub-question of the research was: *What are the factors that affect HIS implementation in the public healthcare sector?* The objective of this sub-question was first to identify the factors and then determine how these factors enabled or inhibited the implementation of HIS in public healthcare facilities, the focus being on facilities in a resource-constrained environment. In order to achieve these two objectives, the study first explored the existing status of healthcare service delivery in the country. The background to the research problem in section 1.2 and the literature review in section 2.2 describe the history and status of the healthcare landscape in South Africa, highlighting the progress that has been made in relation to improving access to healthcare services to the majority of the population that the public healthcare sector serves. Some of the progress highlighted includes the increase in healthcare facilities in rural areas; and the development of healthcare reforms, such as the National Health Act 61 of 2003 that was developed to redress the disparities in the healthcare system created by the previous apartheid administration.

Other progress made in the public healthcare sector since 1994 include advancement in technology infrastructure, improved access to healthcare services to the majority of the population and the publication of various health policies that have targeted reduction in the socio-economic inequities in various capacities in the healthcare system. However, despite the tremendous efforts that the Department of Health, and by extension the government, have put in place to reform the public healthcare sector to improve access to quality healthcare service delivery for the people who need it most, there are several challenges that still plague the sector. Evidence of this was portrayed in the background to the research problem and in the literature review as well. Responses from participants also revealed several of these challenges, for example, inadequate availability of medical resources, among others, as highlighted in Section 6.4.1.

In exploring these factors, the study also highlighted the complex nature of the healthcare service delivery process. The study classified the process into two categories, clinical and administrative processes. What emerged from this were the complex collaborative efforts required for a smooth interaction of the work activities within these processes carried out by various healthcare practitioners. The outcome of the interplay of the interactions among

the work activities, healthcare practitioners and tools, either produces an inadequate or adequate healthcare service delivery.

After exploring the first objective, the focus was on the status of implementation of technology interventions and their subsequent use in public healthcare facilities. The study highlighted the presence of HIS in public hospitals dating back to 1996/97, with the implementation of the DHIS to facilitate routine data management. Over the years there have been improvements to this system, with the introduction of the DHIMS. The status of HIS implementation and use was also explored from the participants' perspective, where the study sought the participants' perceptions of firstly the manual paper-based system and what they thought of the computer-based systems used to carry out work activities in the healthcare process. Some perceptions of the delivery of healthcare services using the manual paper-based system included *time-consuming, cost ineffective, poor management of health records, poor quality of data* and *duplication of processes leading to duplication of data.* Subsequently, the majority of the participants perceived that the computer-based system would mitigate some of the challenges of the manual paper-based system. Table **6**-**4** highlights the emerging themes on the status of HIS implementation and use based on the empirical evidence.

Subsequent to establishing the status of implementation and use, the researcher wanted to determine the purpose of implementation, as well as what role technology interventions play in the delivery process of healthcare services in public healthcare facilities. The study revealed that the rationale for HIS implementation in public healthcare facilities included the following: to improve management of health records at the lower level of the healthcare system; to manage cost of the delivery of healthcare services by doing more with less; to improve the quality of data at hospital level so that the retrieval of health information for decision making is based on adequate and relevant data; and to facilitate transparency and accountability in the healthcare service delivery process. The rationale for HIS use further included to enable collaboration among various actors in the delivery of services, and to increase turnaround times for the delivery of care to patients. For example, some participants mentioned that the use of the laboratory information system at the hospital significantly reduced the feedback time for results, which in turn reduced waiting times for patients.

Besides establishing participants' perceptions of the manual paper-based system, their level of awareness of the existing HIS, their perceptions and experience of using the existing HIS were also determined. The study concludes that participants' perceptions of existing HIS have the potential to influence future implementation of technological solutions,

and as such, should be one of the key factors that policy makers and implementers should consider. For example, in this study, participants who carried out administrative tasks thought manual paper-based systems were tedious and time consuming, while computer-based processes were more efficient. Therefore, they were happy to be involved in the implementation of HIS. Some of the participants in the clinical process were reluctant to foster the idea of integrating HIS with their work activities as they perceived HIS did not add any value to their work activities.

To understand these outcomes, the study drew on the key constructs of the ActAD framework as a theoretical lens within the critical realist paradigm to explain the findings in Chapter 6. A summary of the enabling and inhibiting factors that influence public healthcare service delivery is presented in Table 7-2. The factors are viewed as outcomes (independent variables in the work activity system) whose occurrence is as a result of mediating context-based factors such as maldistribution of healthcare resource, leadership and management. These context-based mediators transforms the activities within the healthcare service delivery process that is a dependent variable. This relation is depicted in Figure **7-2**.

The study divides the factors (mediators) into two categories: enabling and inhibiting mediators. Enabling factors in the healthcare service delivery process include availability of health policies, availability of adequate ICT infrastructure, and increased healthcare facilities, especially in under-served contexts which have increased access to healthcare services to the majority of the population. Inhibiting factors include shortage of resources (both material and workforce), low morale and dissatisfaction of healthcare practitioners, lack of accountability and transparency in the healthcare system, and poor skills and knowledge among healthcare practitioners. The impeding factors/mediators have adverse effects on the delivery process of quality healthcare services, more especially in under-served communities who rely mostly on public healthcare services. For example, inhibiting factors include increased turnaround times in healthcare processes, leading to long queues in public hospitals. Enabling factors such as the availability of ICT infrastructure have seen an increase in the implementation of healthcare information systems that play different roles as the findings in Section 6.4.4 indicate. However, the implementation of these systems is marred by challenges, as highlighted in the research problem in section 1.2 of the study.

One of the key factors that may influence HIS implementation is the interaction between the two categories of actors in the healthcare service delivery process: clinical actors and administrative actors. As shown in the findings, there are differences in the manner in which these two actors perceive the role of HIS in the delivery of healthcare services, with the administrative actors demonstrating greater awareness of existing HIS than the clinical

actors. It is evident then that the degree of achievement in differentiation, communal and individual specification and to some extent contextual integration is not present at the hospital. This may have negative implications for the implementation of technology interventions in the delivery process of healthcare services. The study goes beyond merely discussing the factors and examines the mediating conditions that enable these factors to manifest in the public healthcare service delivery process. Section 7.3.2.1 presents the mediators illustrated in Figure **7**-**3**. Mediating conditions such as *a lack of understanding of healthcare practitioner needs*; poor planning and lack of support, and manner of implementation have an inhibiting influence on HIS implementation.

Using the ActAD model as a guide to identify and explain the context-based mediating factors emerging from the study, the healthcare service delivery process is viewed as a work activity system. Mlitwa (2011) and Korpela et al. (2004) posit that the model reminds us of the importance of mediating conditions that shape the form of work activities. These mediators transform work activities into desired or undesired outcomes. The mediators are in turn also mediated by other mechanisms with causal powers that produce outcomes of the work activity system. HIS implementation is one of many activities within the broader work activity system. The study employed the ActAD framework as a theoretical analytical tool for the object-oriented system (healthcare service delivery process) in a process referred to as *abduction*. The abduction process for critical realists elevates the level of theoretical engagement beyond broad descriptions of the empirical entities, at the same time acknowledging that theory of choice is fallible.

To understand and explain the outcomes of the abduction process, the study employed the critical realist methodology of retroduction. This process posits that events should be explained through the identification and hypothesising of causal powers and mechanisms that can produce them. It is through the retroduction process that the study identifies, characterises and explains generative mechanisms that may explain the outcomes of HIS implementation in public hospitals such as the empirical case. To achieve this, the study poses the retroductive question; *"What is it about the structures which might produce the effects at issue?"* The study addresses this question by identifying, from empirical evidence, different aspects of the healthcare service delivery as a social structure, its physical structures and the contextual factors which are causally relevant and brings them into theoretical perspective as discussed in Section 7.2. From the critical realist perspective, the retroduction process is in the *real domain* because generative mechanisms are not observable directly. For this, the study employs NPT as an explanatory framework to investigate the generative mechanisms of HIS implementation in public hospitals.

The findings from Chapter 8 reveal that hypothesised generative mechanisms that may possess causal explanations of the outcomes of HIS in healthcare settings, include *coherence (the ability of participants involved in the implementation of HIS to make sense of the systems). Cognitive participation* is also a mechanism in this study as it helps explain why an inhibiting outcome such as the lack of stakeholder engagement is a challenge in the current HIS implementation. Another causal mechanism is *collective action*; this mechanism may explain the outcomes as a limited understanding of healthcare practitioners' needs in a particular context, which is an inhibiting factor; outcomes such as compatibility, and inadequate skills can all be linked to this generative mechanism. A predominant generative mechanism of the four NPT constructs is *reflexive monitoring;* findings revealed that this mechanism produces many of the outcomes of the current HIS implementation. There was no evidence that the relevant implementers carried out communal or individual appraisal of the current systems to modify or reconstruct the implementation of HIS. For example, at the hospital, there was evidence of systems that were either not in use or in partial use, because practitioners did not see their value any longer.

It is vital that these identified factors with potential causal effects on the implementation activities of technology interventions and to a large extent the delivery process of healthcare services, be considered matters of urgency in the transformation agenda of national government. The study hypothesises that should these factors be ignored, they may have negative implications for the transformation agenda of achieving universal health coverage in the country. It is therefore the opinion of the researcher that at all levels of management in the healthcare system (national, provincial, district or community-based) the inhibiting mediators must be addressed in order to leverage the enabling mediators. The researcher suggests that this should involve the decision makers going beyond identifying context-based factors/mediators, but also uncovering their causal mechanisms in order to put measures in place to address them. The process or the ability to identify the context-based mediators as well as identifying their causal mechanisms, the researcher believes, will give the relevant authorities the power to leverage the opportunities that come with adequately addressing the inhibiting mediators. The researcher believes this may prove to be beneficial in sustaining the implementation and subsequent optimal use of technology interventions in the public healthcare sector, thus achieving the broader strategic goal of improving healthcare service delivery in the country.

The second sub-question the study addressed was *How does the existing HIS implementation enable/inhibit healthcare service delivery?* The objectives of this sub-question were to establish and examine the status quo in HIS implementation and use in

public hospitals within resource-constrained environments. Another objective was to determine the use of HIS in public hospitals within resource-constrained environments. To establish how the existing HIS implementation enabled or inhibited the delivery of healthcare services, the study first sought to determine the purpose of implementation and use. This according to the ActAD model, influenced how HISs are utilised to enable or inhibit healthcare service delivery. A summary of the findings is presented in Table 6-4 and Table 6-5. The section also presents findings on the challenges experienced by participants in their daily work activities as they make use of HIS. What are revealed are challenges such as functionality of the systems and degree of use to influence healthcare service delivery. System functionality aspects such as reliable systems – *the continuous availability and uninterrupted* - to improve confidence in the pursuit of users' operational objectives. Also, findings indicate that constrained infrastructure capacity, inadequate coordination of network systems and constrained technical support are inhibitors in the implementation of HIS for public service delivery. Given the significance of the functionality aspect of the HIS, healthcare facilities are expected not only to put appropriate systems in place but also to ensure their undisrupted presence. Continuous updates therefore are important in ensuring relevance, so that systems can always react to the current operational needs of the organisation. Essentially, these factors point to the fact that the existing HIS implementation inhibits healthcare service delivery in public hospitals. Section 7.3.2 presents the contextual factors/mediators that enable or inhibit HIS implementation and use for public healthcare service delivery.

The third sub-question the study addressed is the question of *the existing HIS implementation strategies in the public healthcare sector.* The objective of this question was to identify policies or guidelines that inform the HIS implementation process in public healthcare facilities. At same time, the study sought the implications of these policies in the delivery of healthcare services and HIS implementation in public healthcare facilities. Part of this question is discussed in the literature review in Section 2.2.2 in Chapter 2 where the study explores health reforms in the sector that pertain to healthcare service delivery and the implementation of e-health technology intervention in the healthcare domain. Chapter 5 presents a thematic analysis of selected policy documents in the public healthcare domain. The analysis is done from three perspectives: context, text and the consequences the latter perspectives have on the broader healthcare system. The analysed policy documents included the National Health Act, 61 of 2003, DHMIS policy, eHealth strategy, mHealth strategy, National Health Insurance (NHI), and the most recent strategy, the *National Digital Health Strategy 2019–2024.*

From the analysis of the policy documents, the study establishes that the implemented policies and strategies, if not enacted prior to the Department of Health's performing a vigorous evidenced-based analysis, should be evaluated to determine the benefits or values of these policies/strategies; who the beneficiaries of these benefits/values are; the negative implications of the policies/strategies; and their cost-effectiveness in the healthcare system. The study argues that the implementation of HIS in public healthcare settings, especially in resource-constrained environments, requires continuous monitoring and evaluation, and reflection and adaptations where required, for the success and sustainability of the implementation outcomes of these systems. This would give the Department of Health the ability to establish policies and strategies that address the realities of healthcare at the lower levels of the healthcare system in the country. As demonstrated in this study, unpredicted realities in public healthcare facilities in resource-constrained environments may emerge from complex interactions between context-based mediators after initial HIS implementation (as experienced with the DHIS). Many of these context-based mediators may hinder the accomplishment of the objectives set out in the policies/strategies. The study further argues that policy makers in charge of introducing new interventions in the healthcare sector should take an approach that accounts for the realities of healthcare facilities in resource-constrained environments. This includes the realities of the differences in the context-based mediators and not only of what has been successful elsewhere in the development of policies/strategies.

In light of the findings on the three sub-questions, the study proposes considerations for HIS implementation in public healthcare facilities in resource-constrained environments. These considerations address the second research question on how HIS implementation can facilitate healthcare service delivery in public healthcare facilities.

9.3 Proposed Considerations for HIS Implementation for Public Healthcare Service Delivery

Based on the observed relationship between the contextual factors and causal mechanisms that produce the observable outcomes in the implementation of HIS in this study, the following prescription is provided as a pathway to best practices in respect of HIS implementation for public healthcare service delivery in resource-constrained environments. **Figure 9-1** depicts the proposed conceptual framework for HIS implementation considerations. The conceptual framework highlights the important role interrelations among underlying structures, generative mechanisms, contextual factors and HIS implementation activities have on an intervention such as HIS to enable facilitation of public healthcare services in resource-constrained environments.

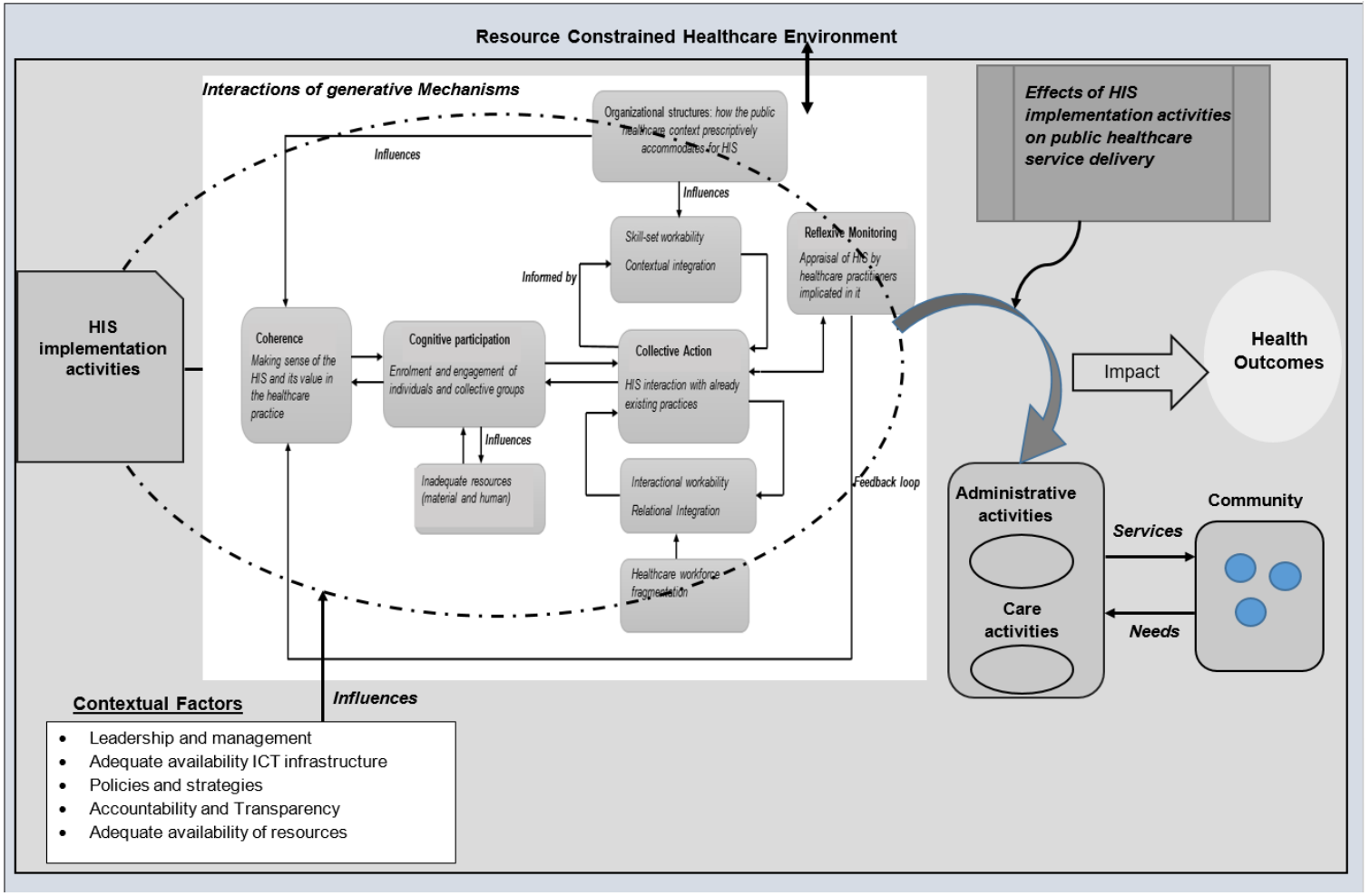

Figure 9-1: Research Conceptual Framework: HIS implementation consideration

In Figure **9-1** the context-based mediators' influence on HIS implementation activities which are in turn triggered by the generative causal powers. From a broader perspective, all these interactions take place in a resource-constrained environment that already has its own effects. The healthcare service delivery processes (clinical and administrative) are also influenced by the HIS implementation actions and may produce outcomes that are desirable or undesirable to the community. For the success and sustainability of HIS implementation and subsequent adequate use in healthcare settings, the study concludes the following factors/mediators are essential and should be addressed in equal measures. The factors include resources (material or human workforce), healthcare settings (context), adequate show of management control and leadership, and adequate implementation of health policies and strategies. With these factors in place, one would expect HIS in public healthcare facilities to have an impact on the delivery of healthcare services. As reflected across the study, all these factors are interrelated and somewhat interdependent; consequently, the combination of all factors in the analysis of HIS implementation highlights the interrelationships between them which gives an indication that they need to be viewed holistically. In developing the conceptual framework, the study takes the stance that successful HIS implementation in public healthcare facilities in resource-constrained environments should embrace a change management principles approach.

9.4 Research Contribution

This study attempts to address the gap of explanations on the interplay between healthcare systems as social structures, contextual mediating factors, and generating mechanisms, and how the effects of this interplay influence public healthcare service delivery in resource-constrained environments. The study's *'why'* and *'how'* contributions add to the body of knowledge in terms of why the current HIS implementation does not adequately facilitate public healthcare service delivery, more so in resource-constrained environments. The 'how' part of the study proposes considerations of HIS implementation for public healthcare service delivery. The considerations the study proposes include not only the contextual factors that enable or inhibit the implementation of HIS, but also the 'generative mechanisms' that trigger those contextual factors. An important aspect of this study is the philosophical contribution the study makes to research in the IS field. This study argues that this contribution will benefit the IS field by providing insights on applying the critical realist paradigm in the identification and characterisation of generative mechanisms with causal powers to influence HIS implementation activities in the public healthcare setting in

resource-constrained environments. The mechanisms are useful in understanding and explaining how HIS implementation outcomes emerge. Additionally, the study evidences the appropriateness of CR for developing a substantive contribution to the IS discipline, specifically, the application of the critical realist methodology to help identify, characterise and explain the relationship between generative mechanisms in HIS implementation and social structures. Thus, this study demonstrates the usefulness of a critical realist ontology for developing insight into HIS implementation in public healthcare settings.

The main practical contribution of this study is with regard to the planning, design and development of future strategies or policies to sustain initiatives in technology interventions in the public healthcare sector. Figure 9-1 provides a conceptual framework of HIS implementation considerations. Stemming from this conceptual framework, the study takes the stance that the implementation of HIS in public healthcare settings should consider features such as the context, resources, management, control and leadership in a holistic way and not independently. The research also contributes to the body of knowledge in relation to the implementation of technology interventions in healthcare facilities in resource-constrained settings. The study highlights the fundamental role of customisation of technology interventions to fit the context and purpose of use as well as the consideration of casual mechanisms of implementation activities of technology interventions in any context. Another contribution of the study is the consideration of context-based mediators with the causal mechanisms that produce their events as prerequisites in the implementation process. The mediators and mechanisms have implications for the sustainability and successful implementation of technology interventions in any organisational context, and as such, technology implementers and policy and decision makers should be acutely aware of the roles of these elements in the implementation process.

The methodological contribution of this study is mainly in the application of critical realist methodology to identify causal mechanisms in the implementation of HIS that may trigger outcomes that are observed or unobserved, and experienced in the healthcare service delivery system. The application of a combination of the ActAD framework and the NPT as explanatory theoretical lens in the identification and characterisation of context-based mediators and generative mechanisms that may provide causal explanations in the implementation of technology interventions in healthcare settings is a key contribution of this study. The application of a theoretical lens to enhance the IS field of understanding organisational and context-based mediators/factors that may influence the successful and sustainable implementation and normalisation of healthcare technologies in varied healthcare settings is a further contribution.

9.5 Limitations of this Study

A key limitation of this study is the use of a single-case study. Literature has criticised the limitations of case study strategies, which include lack of ability to generalise the findings, perceived inadequate rigour in case study research, and so forth. The study acknowledges these critiques, the intentions are not to generalise the findings in this study but to use the outcome as a starting point in the implementation of technology interventions in healthcare settings for the purpose of facilitating the delivery of healthcare services. Another aspect that may be considered as a limitation is the fact that the implementation of technology interventions in the context of this study is explored retrospectively. As such the implications of some of the generative mechanisms may not be determined but hypothesized.

9.6 Recommendation of the Study

The findings of this study only scratch the surface of HIS implementation in the public healthcare sector in resource-constrained environments, and lay the foundation for more substantive empirical work to be done in other contexts. The study proposes that future work on HIS implementation in healthcare service delivery should focus on developing frameworks for assessing the sustainability of HIS in the public healthcare space and also on assessing the process of operationalising health policy/strategy at facility level to evaluate the impact, benefits and value of these policies and strategies on the healthcare system. Table **9-1** provides a summary of the study's findings, based on the issues of investigation and the recommendations proposed.

Table 9-1: A summary of findings based on the issues of investigation and recommendations

Objectives of the study: The study's objectives firstly were to understand the landscape of public healthcare service delivery in resource-constrained environments, and thereafter establish reasons for HIS failure to facilitate healthcare service delivery adequately.		
Issues of Investigation	Findings	Recommendations
Status of Healthcare Service Delivery in Public Hospitals in Resource- Constrained Environments	• Public healthcare service delivery in South Africa has seen tremendous improvement since 1994. The national government has put efforts into initiatives to bring healthcare services to the majority of the population who live underserved-contexts. • Shortage of skilled healthcare workforce in under-served communities is still a reality. This could be attributed to the brain drain phenomenon that has hit the healthcare sector where most practitioners prefer to work in more urbanised than rural areas. • Maldistribution of resource is also a major challenge in the public healthcare sector which constrains healthcare service delivery to the people who need it most. • Low morale and dissatisfaction of healthcare practitioners in resource-constrained environments.	• The study recommends that there should be monitoring and evaluation mechanisms in place to assess the impact of health initiatives that have been undertaken to improve healthcare service delivery, especially in resource- constrained environments. • There should also be measures in place that assess and control distribution of resources to healthcare facilities in under-served contexts. • In cases where technology is used, considerable healthcare data is generated. The study recommends proper interpretation and use of data for decision making. At the same time, it is also recommended that issues around data integrity, confidentiality and availability should be addressed to improve the flow of healthcare information for better use in cases such as resource distribution. • Hospital management should perform routine appraisals of employee satisfaction and morale that may influence the manner in which employees perform their healthcare service activities.
Status of HIS Implementation and Use in Public Healthcare Institutions within Resource-Constrained Environments	• Most healthcare facilities in some capacity do have HIS implemented for healthcare service delivery. • These systems are used directly by healthcare practitioners to aid clinical and administrative activities (e.g., Delta 9™, EGK, PACS, Rx Solution). • There seems to be a lack of a systematic implementation process of HIS in public healthcare facilities.	• The study recommends that the benefits and values of the existing or any new initiatives are well communicated to healthcare practitioners to promote not only use but optimal use so that the sector can leverage the benefits and opportunities technology brings to the health sector. • The study also recommends the introduction of a basic health information technology programme into the academic syllabus of healthcare practitioners.

	• There is limited optimal use of existing HIS at the hospital even though there were claims of training being offered.	• The development and implementation of HIS at healthcare facilities should meet the needs of healthcare practitioners.
Role of HIS in Public HSD Process	• Facilitates *quick turnaround times* in the delivery of healthcare services. For example, a system such as Delta 9 supplies demographic and other statistical data such as medical payment to the patient information database, which accelerates the process when the patient returns to hospital. • Data duplication reduction which leads to efficiency in the delivery process. A system that predominantly plays this role at the hospital is the EGK system that manages laboratory orders. • Routine data/information management, decision making and surveillance of disease outbreaks. • Timely collaborations among various healthcare practitioners in different units at the hospital.	• The study recommends that the national department of health in conjunction with provincial and hospital management should have impact assessment evaluation on whether technology interventions carry out these roles. • To what extent do hospitals actually realise the benefits or value of HIS in the delivery of healthcare services.
Purpose (aims & objectives) of HIS Implementation & Use in Public HC Institutions	• Management of patient data and information • Cost management • Improve quality of data captured • Transparency and accountability in the healthcare process	• The study recommends that health policies/strategies need to facilitate the adoption, implementation and use of healthcare information technologies. • • The study also recommends that urgency be put on the maturity of collaborative efforts between policies/strategies and practice (at healthcare facility level) to match the purpose for technology implementation.

The study also makes recommendations from the lessons learnt offered by some of the respondents:

- ✓ Training on the use of technological initiatives should be integrated into the academic programmes of healthcare practitioners.
- ✓ The culture of various hospital unit/department government structures working in silos should be addressed for adequate patient-centred integrated healthcare service delivery.
- ✓ In most public hospitals, the ICT department is often perceived to offer support functions only instead of it being the core strategic unit with capabilities that enable the healthcare systems' objectives of improving healthcare services to those in need.

The study recommends that the South African Department of Health should invest in additional initiatives to encourage stakeholder participation in the process of HIS implementation and policy/strategy making. Based on the responses of the participants in this study, it became clear that they should be involved in HIS implementation from its inception. Another recommendation the study makes is the importance of taking into consideration the complexities of not only the HIS, but those complexities caused by the various stakeholders in the healthcare system who play different roles. Yet another consideration is that of the dynamic contextual changes that often have unpredictable realities in a healthcare setting. There is a great need for an understanding of the extent to which existing HIS in public healthcare facilities is 'embedded' and 'normalised' in healthcare practitioners' work activities. This should form part of HIS implementation continuous assessment. It is imperative that healthcare policies and strategies be examined and evaluated objectively to determine the impact they have on under-served communities. The study argues that if the enactment of policies and strategies does not ensure that healthcare services are accessible to those communities in under-served contexts, the issues of inequity and gaps in e-health initiatives between urban and rural under-served communities will proliferate.

The researcher, based on the findings of the study's analyses (including documents and interviews) observes that there seems to be a disconnect (gap) between the formulation of priorities in the documents' problem statements, and power roles, appraisal of evidence, healthcare work attitudes, work pace, transparency of goals, evaluation and continuation strategies, and public accountability. Creating awareness through studies such as this one

may result in greater compatibility among researchers, policy makers and healthcare practitioners.

9.7 Summary of Chapter 9

Healthcare technology initiatives have over the years shown potential, but often their implementation in varied healthcare settings has failed to facilitate the delivery of adequate healthcare services. The South African public healthcare system, even with modern HIS, still suffers from a lack of integration of its healthcare services. The critical realist methodology employed in this study illustrated how CR focuses on *'what works*, *how it works*, *in which conditions it works* and *for whom'* using context, mechanism and the configuration of outcomes. This study investigated HIS implementation for public healthcare service delivery, and in doing so, the research identified key mechanisms of why particular outcomes in the implementation of HIS and its use in the delivery of healthcare services were observed. This highlights the complex interaction of the tool and the context in which it is implemented. The study's findings suggest that factors with inhibiting causal powers in the implementation of HIS require greater focus during the pre-implementation phase. The argument therefore is that the public healthcare sector, in focusing on improved healthcare service delivery, should embrace aspects such as engagement and activation of all stakeholders, have adequate ICT infrastructure, and engage in regular appraisal of all outcomes in the delivery of healthcare.

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APPENDICES

This section consists of additional chain of evidence generated during the different stages of this study.

Appendix A: Ethics clearance letter from the Faculty of Informatics and Design

Cape Peninsula
University of Technology

P.O. Box 652 • Cape Town 8000 South Africa •Tel: +27 21 469 1012 • Fax +27 21 469 1002
80 Roeland Street, Vredehoek, Cape Town 8001

Office of the Research Ethics Committee	Faculty of Informatics and Design

Approval was granted by the Faculty Research Ethics Committee, on 17 May 2017 to Ms Mourine Achieng, student number 212300547, for research activities related to the PhD in Informatics degree at the Faculty of Informatics and Design, Cape Peninsula University of Technology.

Title of dissertation/thesis:	The efficacy of health information systems implementation frameworks for public healthcare service delivery in South Africa

Comments

Research activities are restricted to those detailed in the research proposal and a letter of consent from Department of Health is required in order to proceed.

Signed: Faculty Research Ethics Committee	**Date** 17/5/2017

RESEARCH ETHICS COMMITTEE
INFORMATICS AND DESIGN
ETHICS APPROVAL GRANTED
17 MAY 2017
Cape Peninsula
University of Technology

Appendix B: Ethical clearance from CPUT

Ethics approval certificate from the Faculty of Health and Wellness Sciences Research Ethics Committee (HW-REC).

Cape Peninsula
University of Technology

HEALTH AND WELLNESS SCIENCES RESEARCH ETHICS COMMITTEE (HW-REC)
Registration Number NHREC: REC- 230408-014

P.O. Box 1906 • Bellville 7535 South Africa
Symphony Road Bellville 7535
Tel: +27 21 959 6917
Email: sethn@cput.ac.za

5 December 2017
REC Approval Reference No:
CPUT/HW-REC 2017/H27

Dear Ms Mourine S Achieng

Re: APPLICATION TO THE HW-REC FOR ETHICS CLEARANCE

Approval was granted by the Health and Wellness Sciences-REC on 19 October 2017 to Ms Achieng, for ethical clearance. This approval is for research activities related to student research in the Department of Information Technology at this Institution.

TITLE: Healthcare Information Systems implementation framework for public service delivery in resource – constrained environments: A Critical Realist perspective.

Supervisor: Catherine Hutchings

Comment:

Approval will not extend beyond 6 December 2018. An extension should be applied for 6 weeks before this expiry date should data collection and use/analysis of data, information and/or samples for this study continue beyond this date.

The investigator(s) should understand the ethical conditions under which they are authorized to carry out this study and they should be compliant to these conditions. It is required that the investigator(s) complete an **annual progress report** that should be submitted to the HWS-REC in December of that particular year, for the HWS-REC to be kept informed of the progress and of any problems you may have encountered.

Kind Regards

Mr. Navindhra Naidoo
Chairperson – Research Ethics Committee
Faculty of Health and Wellness Sciences

Appendix C: Ethical clearance letter from the provincial Department of Health

Eastern Cape Department of Health

Enquiries:	Madoda Xokwe	Tel No:	040 608 0710
Date:	12 December 2017	Fax No:	043 642 1409
e-mail address:	madoda.xokwe@echealth.gov.za		

Dear Ms. M. Achieng

Re: Healthcare Information Systems Implementation Framework(S) For Public Healthcare Service Delivery In Resource-Constrained Environments: A Critical Realist Perspective (EC_201712_011)

The Department of Health would like to inform you that your application for conducting a research on the abovementioned topic has been approved based on the following conditions:

1. During your study, you will follow the submitted protocol with ethical approval and can only deviate from it after having a written approval from the Department of Health in writing.
2. You are advised to ensure, observe and respect the rights and culture of your research participants and maintain confidentiality of their identities and shall remove or not collect any information which can be used to link the participants.
3. The Department of Health expects you to provide a progress on your study every 3 months (from date you received this letter) in writing.
4. At the end of your study, you will be expected to send a full written report with your findings and implementable recommendations to the Epidemiological Research & Surveillance Management. You may be invited to the department to come and present your research findings with your implementable recommendations.
5. Your results on the Eastern Cape will not be presented anywhere unless you have shared them with the Department of Health as indicated above.

Your compliance in this regard will be highly appreciated.

SECRETARIAT: EASTERN CAPE HEALTH RESEARCH COMMITTEE

Appendix D: Ethics clearance letter from the Hospital

Province of the
EASTERN CAPE
HEALTH

Research Ethics Committee • Level 3 • Nelson Mandela Academic Hospital • Sissons Street -Fortgale •
Private Bag X 5152 • MTHATHA • Eastern Cape • 5100 • REPUBLIC OF SOUTH AFRICA •
Tel.: +27 (0)47 502 4546 • Fax: +27 (0)47 502 4968

07 May, 2018

Ms Mourine S Achieng
Cape Peninsula University of Technology
Bellville 7535 South Africa

Research Ethics Approval

Project Title:

Healthcare Information Systems Implementation Framework for Public Service Delivery in resource-constrained Environments.

The above-mentioned study has been approved by the Research Ethics Committee.

Yours sincerely

Prof N.T Tonjeni
Chairperson: Research Ethics Committee
Nelson Mandela Central Hospital

Appendix E: Consent forms for individual participants

Cape Peninsula
University of Technology

CONSENT FORM FOR INDIVIDUAL INTERVIEW PARTICIPARTION

Name: Mourine Achieng
Email: sachiengm@gmail.com
Telephone: 0214603091

Title of the study: Healthcare Information Systems implementation for public healthcare service delivery in resource-constrained environments: *A Critical Realist perspective*

Purpose of the Study: To explore the role of Health Information Systems (HIS) implementation process in facilitating healthcare service delivery in public healthcare facilities under resource constrained environments. With the focus on the context of a divergent national service delivery reality that impact the right to healthcare services.

Consent to take part in this research

1. I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
2. I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.
3. I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
4. I understand that I will not benefit directly from participating in this research.
5. I consent to my interview being audio-recorded.
6. I understand that all information I provide for this study will be treated confidentially.

7. I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.
8. I understand that disguised extracts from my interview may be quoted in dissertation, conference presentation, published papers etc.
9. I understand that signed consent forms and original audio recordings will be retained by the researcher according to CPUT's research data storage policy.
10. I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage as specified above (*by giving my contact details below*).
11. I understand that I am free to contact any of the people involved in the research to seek further clarification and information.
12. I voluntarily consent to participate in this research study.

Participant (Optional)

Print Name …… **Date:** ……

Signature: …… **Phone No** ……

Email: ……

Appendix F: Sample of interview questions

Examples of interview questions

Interview Questions for healthcare practitioners (Doctors, Nurses, administrators)

1. Can you describe your daily work activities in the hospital/clinic?
2. In your daily work activities of healthcare provision, do you make use of any HISs *(defined and examples given)*?
    a) Can you give examples of these systems?
    b) How do you use these systems?
3. In your view, what is the significance of HIS in facilitating health care services?
4. What role does HIS play in your daily work activities of healthcare service provision?
5. What has been your experience working with HISs to facilitate healthcare delivery?
6. Has your perception of various HISs changed over time?
    a) In what way?
7. How would you describe your involvement in the implementation process of the HISs?
    a) If no involvement is mentioned, would you like to be part of the implementation process? Why?
8. Generally, how is the HISs perceived or received amongst other healthcare practitioners and why?
9. Can you describe how the implementation of HISs has influenced/affected the way you work with other healthcare professionals?
10. How do you manage challenges related to the use of HIS in your work activities?
11. What was your exposure to HIS prior to using HIS at the hospital/clinic?
12. Was there training given during the implementation process of HISs?
    a) If yes, what was the mode of training? Was useful?
    b) If no, do you think training should have been given? (elaborate)
13. In closing, can you describe how the implementation of HISs has affected/influenced how you carry out your work activities of healthcare provision?

QUESTIONS for Hospital Managers, ICT managers, Provincial Dept. of Health representative.

1 What was the purpose for which HIS was implemented in the public healthcare sector? (HM; R)

2 What informed the implementation process of HIS for healthcare service delivery? (HM:R)

3 What kind of strategy was employed for HIS implementation process? (HM; R)
   a. Can you describe this strategy (s)?
   b. Were there any policies and guidelines?

4 How did you intend for HIS to meet the objectives of service delivery in public healthcare institution? (HM;R)

5 How does the hospital/clinic inform the use (by healthcare practitioners) of HIS, i.e. prescribes, compels or guide? (R; HM)

6 Can you describe how healthcare practitioners deliver care services to patients using HIS? (HM; R)
   a. What mode of training is provided to the healthcare practitioners during HIS implementation process?

7 How has the implementation of HIS affected the healthcare service delivery process? (HM)

8 Have you experienced any challenges with HIS implementation process? (HR; R; Technical personnel)
   a. What are some of these challenges?
   b. Can you describe how these challenges affect HIS implementation process?
   c. How do you manage these challenges?

9 With the rolling out of NHI in public healthcare facilities, do the existing HISs environment/platforms allow for scalability and integration i.e. data analytics tools? (HM, Technical person)
   a. Can you describe how this has been accommodated for?

10 What would you say are some of the benefits of the HIS implementation process? (HM)
   a. Do you think the public healthcare sector is leveraging on these benefits? (elaborate)

11 What factors would you say promote successful HIS implementation in public healthcare facilities in resource constrained environments? (HM)

12 In closing, what direction do you foresee the HIS implementation process taking in public healthcare sector? (HM)

Appendix G: Sample of interview transcripts

Interview questions and responses.

Date: 3rd July 2018
Interviewee: PRJ-M
Interviewer: Mourine Achieng
Healthcare Facility: NMAH
Venue: Office

Thank you for taking your time to participate in this study. The study aims to investigate the role of HIS implementation in facilitating healthcare service delivery in public healthcare facilities in SA.

Interviewer: To start, can you describe your role at the hospital?
PRJ-M: Basically, I have been working at the NMAH as a project manager for more 3 years now on a contract basis and my role at the hospital is monitoring and evaluating the system which was put in place at the hospital. Actually the main reason for which I was employed was to implement this system, it is an electronic system… it is an IT system. Okay, let me be very broad and say that over the years the DoH nationally actually took note that the expenditure for the laboratory services were/are increasing and uncontrollable and they had to find a system, a way of controlling that expenditure you may say a cost containment measure if you wish. But we always say that the measure was not put there to compromise patients' care management, whatever happens it was/is not about that.

But it was noticed that umm whilst the doctors are making requests in the NHLS, for blood investigations there were "things" let me put them as things for now…. that were happening. For example, doctor A goes to patient 1 and makes requests for blood tests and perhaps maybe does not indicted on the patients' file that as doctor A, on such a day for this patient, I have requested these blood tests (laboratory tests). On the same day later on doctor B comes to the same patient orders the same blood tests for the particular patient. So there was a lot of these cases of duplications of blood tests on the same day. These were some of the things that were picked up as one of the many contributing factors to the escalating laboratory high expenditures.

They (DoH) had to sit down nationally, and come up with a system that is going to control this, because there has to be something people… I am not gonna say people do not care… but without a system (IT) somethings will not work especially in a big hospital like this (NMAH)… depends in some other areas a system like this is not needed. And that is why when they (DoH) started implementing this systems (LHIS) they (DoH) started with tertiary hospitals nationally because they serve a lot of people. I am sure they (DoH) had seen that the expenditure was high mostly in tertiary hospitals. So basically this is what I do.

Interviewer: In your daily work activities of healthcare provision, do you make use of any HISs (defined and examples given)?

PRJ-M: The answer yes I do, on a daily basis.

Interviewer: Can you give examples of these systems?

PRJ-M: This Laboratory Health Information System is what I use. To be specific the one that I am using is called the electronic gate keeping system (in short we call it EGK).

Interviewer: How do you use these systems?

PRJ-M: How the system (EGK) works right? Ok so basically when the system was starting, we had to enrol every doctor who is employed by the DoH and practicing at the NMAH into a database but that is the NHLS database. The NHLS is a service provider for the DoH for laboratory services of course. So this is how the procedure works, each doctor practicing at the hospital had to be in the database because… so that…whenever the/a doctor makes a request, the system can identify that this is doctor A. The systems identifies the doctor as an intern, a medical doctor, registrar, physician, specialist or a consultant etc everything is in the system. So there can be 3 doctor A in the same hospital, so what happens is that in the NHLS request form for laboratory tests there is information about each and every doctor that they have to put in so when they do not put this information the system will not recognise them. So what happens is they will still be recorded, their information will be captured into the NHLS database and the lab tests they want. But when it comes to the doctor part, they (data captures) capture that as 0DR (zero doctor), the system cancels (we use the term cancel and not reject) all of those lab tests.

Interviewer: What was the purpose for which EGK system was implemented in the public healthcare sector?

PRJ-M: So as I mentioned earlier, when they (data capturers) capture the doctors as 0DR, the system cancels all of those lab tests. Because the doctors have to be identified for various reasons (i) accountability in every respect (ii) clarification for example, if the test results are abnormal and there is need for clarification from the doctor, who are they (lab assistants) going to call? So we were doing that (capturing doctors into a database) mainly for those two reason especially accountability because we have to account and other reasons as well.

One of the things I would do at the end of the month but I will be very honest I was/ am unable to do them to the degree that I wanted to because of the size of the hospital…I am working alone I don't have an assistant not that I am complaining but I have been unable to do some of the things because sometimes I have to do paper work, anyways what I would do at the end of the month when I find time is get a statement at from the NHLS which gives me or indicate…it's a report which shows me how we have or how the doctors have utilised the NHLS for the past month. So what I would do…. This is the reason why we need to or there is a need for the doctor to be identified on the form. It was/is helping me to be able to say in this department doctor so and so has exceeded their lab test request. For example, this happened in reality but I am not going to mention the unit or the doctor, you find that in certain month doctor A's expenditure is R5000 whilst doctor B's is R13000… you can justify that to a point, and say maybe doctor A was on leave hence low usage or

but doctor B expenditure is beyond the limit therefore considered an out layer so this is the reason for the system which then allows me to go the head of that particular unit and say look at this, let's find out why this particular doctor is an out layer. Others are here whilst this doctor has exceeded their lab request expenditure so we are able then to account for the various expenditures.

Interviewer: What kind of strategy was employed for HIS implementation process?

PRJ-M: Let me briefly tell you the process umm… we (the hospital) have got different departments or units that do different patient activities for example we have surgery, internal medicine, paediatric, x-ray medical wards etc. So these units make different lab requests, what is a priority for internal medicine will not be for surgery okay. The processes was as the project manager for the LIS, I had to go to each consultant and HoDs of all the units/departments, and you see I had to make things easier for them. I developed a (for lack of a better word) a framework of tests that are normally (we call them routine tests) that are normally requested by doctors in those departments/units. The framework include most of the tests but not all, so we went there and said here is the framework… so I would write the name of the test and I would say tell me how would you or how are you treating it? (if I may put it that way). For example how would you like the procedure of this test to be done? How often should the test be done; Daily, once a week and so on I was just giving them a guide. And number two, who do you want to make the request for this test, are there anyone within the unit that will be excluded from requesting lab test because some of this test are very expensive? So that was the structure in the process, I gave it to them so they made those decision across the various units say for this unit/department this is how I want this tests to be requested (for example repeat intervals etc).

One of the things was that out of all these people I have mentioned interns, medical doctors and consultants, the consultants were exempted from the whole process so meaning they would not have tests that are cancelled by the EGK system. So even if the tests sent by the consultants were irrelevant …what is this word that we are using appropriate. So whatever the consultants requested through the system went through because the assumption or logic is/was that they (consultants) knew what they were doing, they have lots of year of experience.

Well like we discussed earlier, I had to develop the guideline or policy if you want to put this that way. I had to take all the possible scenarios of the test that are commonly requested from various units and departments and write them down and consulting the HoDs of various units/departments to make decisions by themselves based on that. The guideline was the HoDs… they made their guideline for me it was a framework and they had to let me know what they wanted in that process.

Interviewer: How did you intend for HIS to meet its objectives?

PRJ-M: One of the things is that we had was a document circular that was sent out called minimum clinical data set (MCD). So for the doctors to meet all the requirements for the process of requesting lab tests they have to fill in the request form adequately, all the information required must be filled in. Like I was saying earlier if the doctors' name is not in the request form then the EGK system cancels that request. Ideally the doctors have to comply with the requirements for that particular process. If there is compliance and the

forms are filled correctly the system would be able to identify duplications should the same lab tests be requested for a patient in the same day. We have what we call the EGK 'rules' are already in the NHLS system, when the clerk is capturing the systems reads everything and is able to identify everything according to the rule. Like I was saying earlier the processes of consulting HoDs after they had given me their needs (this is what I want for my unit) so I had to take that information to the NHLS because NHLS maintain the whole system and I do not have access to that. NHLS IT I mean they are the once who now call it ummmmm….converted or configured the rules, what we say we want to happen into their own IT language according to the various departments ….the systems is very smart…. According to the categories of the doctors (intern, medical doctor, consultant etc.). This is how the system meets the objectives meeting the system meeting the objectives of service delivery. The system will read the information according to the departments for example what the rules are, what is the category of the doctor and then it will make a decision very quick. Yah.

Interviewer: What mode of training is provided to the healthcare practitioners during EGK implementation process?

PRJ-M: So what happened is the framework/guideline was given to the HoDs they reviewed it and brought it back to me and I had to develop that into one document. I'll show you…. So this is all the documentation of the process of using the system that was given to all the departments. They had to then tell me which kinds of tests can be done by whom etc. Then I put that into one big document.

Once I had that document, I sent it to the NHLS and there was a to and fro process where they were not understanding something and we had to explain/clarify what we mean. And also there were some requirements from us the NHLS were saying the system cannot do it. In such cases they would advise on how to go about it. So we were advising each other. When that was done and all parties were happy, again final document was produced, given to me and I took it back to the doctors.

After that before the system was implemented, everybody concerned (Head of the hospital and then the HoDs) was notified. Because the hospital has rotation of doctors, when new doctors come they are introduced to the system. Every year we have got inductions for the new doctors, they are told about the requirements of the system and how to adequately use the system to request for ab tests so that their requests are not cancelled.

Although there are times when we get cases where doctors request for Lab tests but they are not yet in the systems. But we try our best with follow up to make sure that doctor is captured into the system. What happens is that new doctors come into the hospital via the clinical director's office and they have to fill in the NHLS forms and that information is what we capture into the system for them to be recognised. Still we get those cases where my office miss new doctors of which the clinical managers' office is supposed to notify me when they get new doctors.

Most times because it's a big hospital and I also offer my services to other hospitals around I am stretched beyond my ability but I don't mind. So what I do is I normally target those big units/departments that put in many requests because chances are that they are the once that have a lot of expenditure and I would offer workshops in certain areas where one or

two things they are not doing correctly then I would educate and teach. Yah, we engage and interact the units/departments through this is and try and fix the problem.

Interviewer: How has the implementation of HIS affected the healthcare service delivery process?

PRJ-M: I must say the implementation of EGK system has improved the service delivery process for our patients. Because now all of a sudden there was someone who was not there before…, I am not just working with EGK, I also monitoring the whole service of the NHLS regarding the NMAH and thanks to EGK, at some stage when I was doing the monitoring like you know when you starting something and you see that it is really working, what I would do every hour …I am doing that randomly now it was like a routine that I would go the lab and check all these tests.

So this was the procedure, I would ask them (Lab technicians) to put aside for me all the lab forms that had tests requests that were cancelled by the EGK system. Then I would go into their systems, *they allowed me to use their systems because I do not have it in my office. Whenever I wanted to check something I would walk down to the labs*. And I would go that patients' *there is a laboratory number* and I would compare the forms and the requests in the system and so many times let say 3 out of 5 times I would find tests in the system that were not requested by the doctor and yet have been captured. And you ask yourself that this has been going on for a very long time. In some cases this could be linked to the interns who are given this lab test to do requests as part of their qualification of which the system does not allow them to do. Or you would find the data capturers capturing wrong sets of information. So this are the things I picked and what I do in such cases is report them to their supervisors/ superiors and this way to answer your question the service delivery is improved because people are not just capturing for the sake of it. People were not applying their mind whilst doing their duties. Because that was telling me that they do not care. There are a lot of errors that still occur some I am unable to pick up because it is a lot of work and like I said I am doing all this alone.

Interviewer: Why do you think the clerks that use these system make these errors?

PRJ-M: I think it is because they … *let me look for the correct word*… I think it is carelessness it is just carelessness I mean we all make mistakes but some of the mistakes/errors made … and I think … because I have asked myself that very same question, they are trained on how to use the system, I am not sure… they are supposed to be trained but I don't think so because I ask them for example they employed this guy that was a data capturer, the mistakes he was making and I ask the managers there, are you inducting(training them, introducing them to the system) these people? Do they know the environment they are working in? Because it is not the same with all due respect to be a clerk in a healthcare facility and to be a clerk in a retail shop. This is a healthcare facility and if you are capturing details of a patient lying somewhere in the hospital and from the form it needs to be done with more diligent, I mean we make mistakes we are all human but in most cases here its carelessness and 9 out of 10 it ignorance of the importance of the job they are tasked/employed to do. I have been working with and monitoring the system (EGK) and how it's used and can say with confidence that it is ignorance and carelessness. The data capturers (clerks) were trained to use the system, someone came from jo'burg sat with them for weeks taking so it is not like they do not know what they are required to do.

The system is very user friendly so for me the type of errors/ mistakes we get from data capturing is plain carelessness we get from them

Interviewer: Did you experience any challenges with the implementation process of this system?

PRJ-M: The response was positive when I was implementing the system so to answer you the answer is no.

Interviewer: With the rolling out of NHI in public healthcare facilities, do the existing HISs environment/platforms allow for scalability and integration i.e. data analytics tools?

PRJ-M: There is no healthcare facility in South Africa that is ready for NHI, especially when we are talking about the IT infrastructure. In my view the DoH is taking about NHI which is good, they are telling us everything apart from the how and who part of the NHI introduction. I am not anti NHI, but I am sitting in a position where I able to ask question like who is going to be doing what etc. So to answer your question whether the existing HIS environment allows for scalability and integration of NHI my answer is a confident no, especially where IT infrastructure is concerned. The first point of departure for the NHI implementation that they (DoH) are not doing, they are saying that there 23 people that have been sent across the country to roll out NHI. Now tell me the number of healthcare facilities across the country? There is no mention of provinces, just that there these 23 people. There is already a mismatch there how are these 23 people going to cover the entire country?

And the reason why I am saying no with regards to NHI is that, as long as we have not started using the ID as the unique identifier at public hospitals we are not going to go anywhere, we going to do certain things but we still going to struggle to service our people. Let me stress this, as long as we are not pushing the agenda of using the unique identifier at public healthcare facilities and for me that is the first point of departure for the rolling out of NHI. As long as we are not doing that, we are going to continue to see these data capture errors, duplications and medical errors etc. I am not saying that the use of the unique identifier will erase the problems immediately, but we will see a reduction and eventually erase such issues.

Interviewer: Is the EGK system and by extension NHLS scalable?

PRJ-M: I wish I could sit with you forever… now you are touching on my topics… listen if you were to ask me or if I were to give my views about the system to the MoH, The system has done much especially in cost reduction for the laboratory expenditure since I came in, there is no doubt about that, but it not ideal, if I were someone in the DoH who is someone that would recommend a system for future and for permanent use that could be used forever, then this would not be the system because it has a lot of gaps that I have identified. For example the need for a (warm body) meaning someone has to be there to constantly monitor and evaluate the system. And if all the public hospitals and clinics were to have such a system then it would cost the department a lot of money. On the other hand it is better than not having a system. There is a better system we can use but this is better than nothing.

I would want us to not speak about scalability of this system and rather look at using another system. One of the reasons why I am saying this is, each and every healthcare facility

needs to have this type of a system and would be costly to the DoH like I said the need for a warm body. I would recommend another system that allows the doctors to use the system directly without filling forms. Another gap for the EGK system is the lack of giving reasons for cancellation for the lab tests. There is a system that is a more interactive systems

Interviewer: What would you say are some of the benefits of the EGK system implementation?

PRJ-M: Besides the cost reduction benefits, I was able to also identify some of the many errors that marred the process of requesting for lab tests previously. Also, the doctors could also know what they were supposed to do in terms of the requests for Lab tests because if you remember that I had to go through that process initially where I went to all the unit/department HoDs and involved them in the decision making of how they wanted that process to be made.

Interviewer: Do you think the hospital is leveraging these benefits?

PRJ-M: Yes I think so, look at where the cost of expenditure of laboratory test are now compared to when I first came with this system 3-4 year ago. It has and is going down.

Interviewer: What factors would you say promote a satisfactory implementation of any IS in public hospitals such as this one?

PRJ-M: Leadership is one of the major factors. One of the things I found having worked here and *I am going to generalise* … is that where there is no leadership things are not going to happen. For example, a while back there was a memo from Bisho (DoH EC) stating that it was compulsory whilst capturing patients' details to use the ID as a unique identifier. This was communicated across the hospital. It was said that patients with no ID should be prioritised but overtime that was not seen through because it was not enforced from the top. Another factor is consultation of the relevant people in the implementation process, you need to know how to communicate with people involved and to me this goes back to leadership and I am talking from experience working here. Another factor is political will within the organization, this can sometimes stand in the way things are done. I think also availability of infrastructure also like if we are talking about IT should be there for the implementation to be a success. But to me overall its bout leadership and governance, who is leading? I am the type of person who would walk around and see how things are done for myself. People are just not doing things the way they are supposed to do… because there is no accountability, like the unique identifier rollout, when it started we were on fire but then we just went down and that is because no one followed up and if you did not follow the protocol there would be accountability.

Interviewer: Once again thank you very much for taking your time to participate.

Date 10th July 2018
Interviewee: DMA
Interviewer: Mourine Achieng
Venue: NMAH ([redacted]

Interviewer: Thank you for taking your time to participate in this study. To start, can you describe your daily work activities at the hospital/clinic and your previous involvement with an HIS?
DMA: I work as an orthopaedic surgeon at the orthopaedic section and have collaboration with the [redacted] that is used as an [redacted] of NMAH. We basically deal with issues that concern bones and we normally link with the hospital through patients who have to be admitted via NMAH the referred to [redacted]. As an orthopaedic I deal with bones, we get patients who have bone injuries and assess their condition, after getting a sense of the patients' condition, we plan for prosthetics. After all that the patient has to go through rehabilitation so that they can get used to the prosthetics. So yes we do offer healthcare services to patients.
Let me first of all give you my brief history having of experience of healthcare information systems having worked for 15 years in many public health systems in the Southern Africa regions which are classified as developing countries. I have worked with the Namibian system, the Tanzanian system and now I am here in South Africa (still finding my way through it). So we can talk about my overall view on the health systems and health information systems in these developing or resource constrained environments. I have got a lot of experience especially when dealing with health information systems I was major involved with the implementation of HIS in public hospitals in Namibia and I think that would help you with you study since you are looking at the implementation process. Here (NMAH) I see that they are using the WHO's district health information system. And when I was in Namibia, I would like to think that we prepared the health system to be the best in the Southern African region.
OK, the district health information system was developed in American for the developing countries. So the system in any country that it's used, needs to be modified to fit into the environment for that particular country. But unfortunately many of our developing countries just take it as it is. Which means that you get wrong information, you feed your system with wrong information. So at the time I was working with the Namibia health system, we used to bring some of the South African people from the department of health and would sit down with them and say that look we need 1, 2, 3 the prevalence disease in our area are these, we need this to be captured by this system so on and so on. But this system is an American system… so we changed it completely to fit our health system.
I know the DHIS very well, and have used it in the countries I have worked. We used it but with a lot of changes, not the same way we acquired it. Normally if you go the hospital and ask them about patients' data, for example from the out patients department. You ask them how many patients did they service today, they say no I cannot remember, or I cannot say. But you have the system you captured the patients' information there? Ahh this systems is not working, ok, that is the kind of response you would get at most public healthcare facilities. So we want this information but not only the information of the patient treatment, have we needed also the information of emergency cases like if there is outbreak of cholera in the district or catchment area of that hospital. Now if that information does not appear in the system that the ministry (DoH) head office can easily see it immediately the patient is

registered then you cannot address the issue of disease outbreak and finally it becomes a pandemic. That is why we need the DHIS system, the system helps to inform the managers who are supposed to take action immediately the problem is identified. Immediately the patient is diagnosed it is in the system and immediately the person using the surveillance system in the DoH head office see it and acknowledges that in district A we have identified a patient with such a disease and they then monitor how many of such cases are reported in that district. From there a team medical team is mobilised to go and address the impact. That is how the system is supposed to work, but in many cases you find that the system they (healthcare facilities) were/is not giving that information and they end up depending on the regional officer for such information that comes after 2 or three weeks which might be late to prevent an outbreak.

Interviewer: What has been your experience working with HISs to facilitate healthcare delivery?

DMA: In the future the manual work will seize to be there in the health system, we have started that in the prosthetics. You know what we do now? A patient comes, I stand them in the scanner, and then that information is sent to the miller, the milling machine mill the leg of this patient then the information is sent to the lamination room, lamination is done. With this, 2 hours of the patients' arrival the socket is ready. This was not possible in the manual system all this is done through a computer system and is more effective. This reduces the cost and patients time during the whole process because everything is digitalised.

Interviewer: Were you ever part of the implementation process of any information systems in a public hospital?

DMA: Yes, I was because I was under primary healthcare and you had to be part of the whole healthcare system.

Interviewer: Was there a guideline/strategy that informed the implementation process of the DHIS system? (Elaborate)

DMA: There was a guideline, at the time I was working there (Namibia) they called it "Otswarongo" document *(available online).* That document informs all the actions that need to be taken, who is supposed to take those actions, and an organogram of implementation of health information system is available in that document. So if something happens then regional office should be informed immediately, obviously through the surveillance system. In fact, it should start from the district hospital which informs the regional and from there the national level is informed. If there is need for back up from the national level then the regional level requests that. For example if there is a need for staff, the regional level informs the national level.

So that was the implementation strategy that we used, to make sure that issues of surveillance in nature must addressed immediately. There is no need to wait for permission from the ministry (MoH) in case there is an outbreak of a disease. In the planning of the implementation of these systems, there was the director of planning…not really by the name but in the sense that everybody even the minister of health if there is/was an issue of planning they refer to this person.

Interviewer: literature suggest that DHIS implementation in the public healthcare sector has been marred with many challenges. What are some of the challenges from your experience and knowledge of the DHIS?

DMA: Yes, I think the complexity of the DHIS software is a major challenge. Because it contains all the information we would like in health, however it fits the American context.

That is why I said when it comes (adopted) to particular country we need to modify it to fit the context. The DHIS requires that the lower regions of the health system in a country to feed information to the national level of the health system. And now the challenge is that it therefore needs IT equipment (infrastructure) because you cannot inform by word of mouth, you need computers. You need internet (connectivity) because the timely information needs the adequate connectively that is reliable internet. Here at NMAH we often have problems with the internet, just imagine the district and clinic around the region. If you wanted to implement the DHIS country wide you must have a heavy IT infrastructure and connectivity to support the system. That is one area the implementation of DHIS in South Africa is experiencing challenges. The second is human resource to manage (management of the DHIS system) the DHIS system, everybody (doctors, nurses, clinicians, laboratory technicians, pharmacists etc.) need to be informed, trained on the system and I don't see it done here (NMAH). Thirdly is the commitment of the regional managers needs to be committed to the implementation of the system, if they are not trained, the system will not work to its full potential. And the lack of accountability as well for the staff as well, most of the staff are not committed because there is no accountability. Those could be some of the issues with the DHIS in the South African health system.

The DHIS works but it needs to be modified according to the environment it's going to be used. It requires heavy investment of infrastructure (IT, network) and human resource.

Interviewer: What is your view on the preparations of the NHI and its impact on public healthcare service delivery?

DMA: *Laughs….* Even Europe has tried and failed with the implementation of the NHI. The country which I know NHI works well is Sweden. In Sweden NHI is compulsory and everybody is covered through the medical insurance system. I am looking at our (South Africa) population and culture and wonder can the monetary system afford NHI? Really, we talking of over 50 million people, they are failing with the education of the system which caters for a small portion of the population, now they want to introduce a NHI? My view is that this will not work, and if it does, it would involve a lot of corruption in it because we are not ready, you start something and yet you have not trained the population on how to use it.

If you put it (NHI) in private healthcare facilities then yes it may work because they have the infrastructure, like with the private medical aid available out there but even with those private medical aids there are conditions attached to them, you can only get certain medication etc. and that is not supposed to be. For me, I believe there is sufficient infrastructure to support NHI, the only problem is the implementation process, how have they prepared the healthcare facilities and the population?

Interviewer: In your view do you think the current DHIS system allows for scalability for new innovations such as the NHI?

DMA: The first thing that was done during the adoption of the DHIS, was that it was initially done in small scale. We started in one district and monitored it just to see if it could be used, then evaluation of the implementation was done within that district. From there it was rolled to the entire province and eventually the country.

Interviewer: When you were evaluating the system what were some of things you were looking for?

DMA: Ok, first of all we are looking at the reporting system, how do they report, is it flexible or you restrict based on the system and what it tells you to report, is there a where you can report a problem that is not in the system? That was sorted out by calling external parties

for example from other countries within the region and go asking them to go into the system and put additional information (basically testing the system) which allowed us to capture every circumstance of the health system. This was done in phases according to districts, regions and nationally.
It's important to note that by the time the system was being rolled out to the entire country the health system was ready infrastructure wise the country was ready.
Interviewer: What factors would you say promote successful HIS implementation in public healthcare facilities in resource constrained environments?
DMA: From my experience, proper planning and support is key. Understand the information that is needed by the health systems and how these systems need to be shared across the national health system. This would allow the success if the implementation of the HIS. Like a mentioned earlier as well commitment from leaders and teaching our people the importance of these systems for surveillance of disease.
Interviewer: In closing, what direction do you foresee the HIS implementation process taking in public healthcare sector?
DMA: You see my challenge is not the infrastructure that is there, although the government can improve it. What I see as a challenge is that there is an element of ageing implementers. The entire system has old people… They do not train the young people well so they can take over. But this is a challenge that the government and hospital managers can manage if they are keen and aware of what is happening.
I think the HIS systems can work very well in public healthcare facilities because they have the ability and the government have money, it is the political will that is required. The political will to look into where the weakness are in the delivery of healthcare services and what can be done to improve those weakness.
In healthcare facilities and at the DoH, management reports needs to be written to show clearly what the bottlenecks are in the health care service delivery process so that they can be addressed for future implementations of HIS.
And I see that as a particular problem in the pubic healthcare sector, one because you have an ageing population who are leading who need to transfer the knowledge the young people and currently we seem not to be doing that very well or at all, the second is the keeping these young people in the public health system and the third is the economic factor which I don't know how we are going to fix.
There are lot of questions to be answered about NHI and HIS implementation, Are we ready, do we need the system, and can we afford it these for me are some of the things we should addressed for the future of the public health system in South Africa. The mentality of the leaders and staff (health care practitioners) is key to carry out their mandate of healthcare provision using the tools at their disposal. Planning, that is where I have a big problem, those who are put in big positions…. *Like Prof Lumumba says …..in Africa those who are put to lead don't have the idea of what they are leading and those who are being led who have got ideas don't have the means to implement the ideas.* And that is why interventions like the NHI is being propagated from the top, down here at the healthcare facilities we do not know anything about it. Now it could come first from down but.
You know our health systems are supposed to be connected like the banks are but here in South Africa all the infrastructure remains with the bank. For example if you go to bank A you can withdraw using the ATM card from bank B because their systems are connected. Same with shopping online or in retail shops integration of information. We are missing a

lot in our health system. The HISs are not just for the health practitioners but how they can use it to service the patients better.

Interviewer: Thank you so much **DMA** for you time.

Date 8th July 2018
Interviewee: PRS-M
Interviewer: Mourine Achieng
Venue: Office ([redacted])

Interviewer: Thank you for taking your time to participate in this study. To start, can you describe your role at the hospital?
PRS-M: My role here at the hospital is a supervisor here at this unit (Patient registration) at the NMAH and we are the first point of contact when patients come to the hospital, they are sent to us. My job apart from dealing with patients' registration is to make sure that everybody (other staff members in the unit) is at their point of registration and all the other things they need/require to perform their duties are available to them and working accordingly. Things like their computers, printers etc. before we can start the registration process which involves capturing of biographical details of the patient such as (name, ID, Date of birth) including other things like if the patient is an in or out patient. So yah that is what we do here on a daily basis.

Interviewer: In your daily work activities of healthcare provision, do you make use of any IS/IT?

PRS-M: Yes.

Interviewer: What are some of these systems?

PRS-M: The system that we are using is called Delta9, and we are using it for the registration of patients, including the biographical details who come to this hospital. We register patients for recording keeping purposes and in cases where we have a relative who come to visit and is looking for the patient it is easier to identify that patient. But the system does not keep all the information it only keeps the biographical details of the patient like relatives' number, the clinic that the patient came from or is going to (for example if the patient was referred to the x-ray unit, the it would reflect in this system). We also keep records of the patients' whether they are in patients or out patients.

There is also the patients' record unit which together with us (registration) make use of delta9 system. In fact, the revenue department also make use of this system for billing. We collect the money (where applicable) they do the billing. As a patient you come to the hospital with your medical aid for those who have or a paying patient (those without medical aid). Then I am not going to be billed the same as those who can afford so all this the Delta9 system does from the billing point of view. So the revenue department will look at for example if a patient has lab tests, x-rays etc. they are billed. All this is managed in the Delta9 system. Case managers use the delta9 system for report purposes for example how

long a patient has been in the hospital and for what reason. They tend to use the systems for the purpose.

Interviewer: What has been your experience working with the Delta9 system?
PRS-M: We have been using the system (delta9) since the inception of the hospital in 2004 and I was there from the very beginning. My experience with the system has been good, it a system that is very easy to use. However, there are other modules of the system that we (the users of the system) wish we could have but we don't have since the system was bought by the hospital and there other development that hospital have not acquired. The Delta9 system is not controlled by the healthcare facility (NMAH) but by the provincial DoH offices. Sometimes we wish we could have something like sometimes we wish we could have some kind of paperless work processes but we don't have those modules.

For example we don't also have the interface that allows the patient to just come and put the finger and the system would pick up that patients previous information. This are modules that the new versions of Delta9 have, but here at the hospital we don't have so we still do a lot of the manual work processes. Anyways what we have is an easy to use system but we wish we could have more functionality of the system. Because we are still capturing and storing paper files, we have cases where patient files are lost and if we could do everything on a paperless system then we could avoid such cases. You see the other clinics around us are not using delta 9, one clinic just started last year, the province has a contract for delta9 but other clinics and hospitals are not using it, maybe it's because the managers of the facilities.
Interviewer: You mentioned that you were here when Delta9 was first introduced at the hospital, was there training given during the implementation process of it (elaborate)?

PRS-M: Yes, we were give training when the system was first introduced like for me I was there the initial stages and we were trained on how to use the system. Even now if a new staff come in they are trained on the system. Also the company that supplied (developed) Delta9 have made it their business to train users. They come even if it is only one person. But of course we are only using the registration part of the system, for other modules of the system the company send someone to show us how to use the system. In fact there is a lady from delta9 sitting here with us always showing assisting us on things we don't understand from the system.

Interviewer: In your view, what is the significance of HIS (such as Delta9) in facilitating health care services?

PRS-M: Remember we used to use manual books for the registration process of patients and record keeping of patients' information was very difficult because the books could be misplaced or the ink in the book fade overtime therefore making it a challenge to retrieve the record should they be needed for anything. But a system like delta9 we have backup that can be stored safely all you need is to look in the database for that particular record. For example at the moment the hospital is facing a lot of litigations *(where lawyers come and request files for patients who were referred or admitted at the hospital let say 5 years ago*). Now all we have to do is enter that patients details and search the system for the patients' file and retrieve it. Although other times we are not able to find the patients' file and we end up not being able to account for that particular patient which is a problem for the hospital.

Interviewer: In your view as someone who has experience with a system like Delta9, what would you say are some of the factors that could promote a conducive environment for the successful implementation of such a system in public healthcare facilities in resource constrained environments?

PRS-M: For me based on my experience here at this facility, if we could eradicate the continuous challenges of network issues that we have here then the system can be more effective. Sometime we may have network issue for an entire day and all the patient who were here that day will not be registered and that slows down the process. We also need supporting tools like printers, scanners etc that are always working then I think that would make our jobs easier. You may have you paper files but it would also be nice to have it digitally like they do other private health facilities around here. And also the purchase of other modules that are an improvement of Delta9 that we need here at the units should be purchased by the head office in Bisho. But the problem is that those who are the top there don't even understand the system. It is us who are using it here that understand and know the system even the leaders of the facility do not understand the system. You see, we don't have a, for example the HR and the supply chain system they do have provincial offices but for patients registration there is no provincial office, there is no one sitting there at the provincial office who looking at what is happening in the patients' registration unit except they hear it in meetings. They tend not to care about it, you see at the HR department they are using pastel and at the head office there is someone who monitors the system and can be able to see if there is something wrong going on. But on our side there is no one.

Overall the system is a good, I have never heard the delta9 crushed or anything in all the years I have been using it. What we need is for the decision makers who know system and what it is used for to perhaps say if maybe we can add this or remove this, that would make it effective in the service delivery.

Interviewer: How do you deal with challenges of the system?

PRS-M: We try and solve it by ourselves, even the CEO of the hospital does not know. Those of us here try and solve it and sometimes the lady from Delta9 Company assists us. Although there is supposed to be someone from the provincial department who monitors the system and to assist, there is no support. For example we are dealing with patient's money if money is paid and not captured how will the provincial department know? You see that's why there should be some there to monitor all this things happening because for us we are not serving the system but the patients. The problem for me is with the provincial department if we had an office there representing the patients' administration then they are the once who would be able to say we have requested this system because of a, b, and c. and how it should be implemented. There are no documents for the implementation of the system that I am sure. And there is no office that would be able to tell you how it was done. It may happen that it was the minister who decided on the system maybe they saw somewhere else and decided we need that system here you do know.

Even the clinics around us are not using delta9, they are using another system. We have people from the information systems management department and they come here and we have meetings and what they are saying it seems like we are moving to the direction of the clinics (where there are other systems) but at same time they are saying we are going to have a book that every patient who comes to the hospital must be recorded in that book

which they call a “tick record book”. Whilst we are using the systems whether its delta9 or another but we must still have the book. Which is double the process for us you see. There is not clear directive from the province on what the system should be used and how. You see that person from the information department does not understand the problems of Delta9, they are more interested in information (that the patient that comes here at the hospital, we must know whether they female or male or their age group) that is what they are interested on. We are interested on making sure all the patients that come through the hospital are registered. That is why I am saying we need a person/office at the provincial government office to drive the needs of the patient administration. Most time the people from information management drive the needs for us. Even us we can see that the Delta9 is conducive for the billing department but someone coming from the information management unit does not care about that they care about only information.

It would be better if we can have our own representatives in the provincial office who can be able to see that this two system should be merged. Instead of you buying many other systems within the same hospital. Or else moving from one system to another without cause. If we can have a structure in the province that covers the patient administration issues it can help us because sometimes even if we raise concerns in meeting about the system perhaps you say you want this module or something else concerning the patient administration, you are not take seriously because of you position (you are at a junior level so they do not take you seriously). Sometimes you can be called if there is a problem…can you please explain this or that nobody else knows only you, as junior as you are. Unlike other systems like pastel you find that the director knows what it is, when you go to logis BAS they understand the systems how it works, this section no one knows.

Interviewer: As a manager who oversees other staff in your department, how has the HISs been perceived or received amongst your colleagues and why?

PRS-M: I would say most of us here are used to the system. You see when we started the hospital was new and when were brought to the hospital from various places we were introduced to this system. It has made our work very easy as opposed to other regional hospitals where they are still using books to record patients’ details. You see the system allows us to easily locate patient files, we have been having cases where lawyers come and say the patient was here for example in 2004, it easy to find it on the system unlike using books that are stored in archive that can be easily destroyed. We can see patients’ records from other hospitals.

We have never had problems with the system itself even though we wish we could have other modules of it. Overall I think everyone here can tell you they like working with the system. What we need is decision makers in this section, people who would be able to say no okay, what if we add this, remove that because it does not assist us.

Interviewer: Thank you again for taking the time to participate.

Date: 26th June 2018
Interviewee: TP.ITS
Interviewer: Mourine Achieng
Healthcare Facility: NMAH
Venue: [redacted] department

Interviewer: Thank you for accommodating me in your schedule to participate in this study. The study aims to investigate the role of HIS implementation in facilitating healthcare service delivery in public healthcare facilities in SA.

Interviewer: To start, could you describe your role at the hospital.

TP.ITS: Ok. [redacted]

Interviewer: what does your role involve in terms of daily work activities?

TP.ITS: Well my daily activities would be supporting, maintaining, planning and ahhhh I would say planning and implementing projects (IT projects). Everything that is within the IT infrastructure ahh… IT range of things for example from your computers, servers to the network to telephones. Those are the things that I do on a daily basis at the hospital.

Interviewer: As the director of IT services, you are obviously in charge of the ICTs/ IS at the hospital, what are some of the information systems that the hospital make use of to facilitate healthcare service delivery?

TP.ITS: Yes, we do have quite a number of them. We have got Delta9 which is a patient registration system, we got RX solutions which is a pharmacy system, we got Jvex for the pac -picture archiving and communication system- systems as well ahh that's about it those are the major ones.

Interviewer: what about for your laboratory unit?

TP.ITS: Ahh yes, in the labs it is the NHLS (external to the hospital) that deals with that, they are a separate entity from us. So we do not know what they are running there they have got their own IT team that takes care of things there.

Interviewer: In your view, what was the purpose for which the systems you have mentioned previously were implemented at the hospital?

TP.ITS: Well… you know they are very important each and every one of the three systems that we listed are different from each other and it helps in that regard. For example Delta9 helps with patient registration when they are coming to the hospital, getting them registered and sending them to the right direction. Delta9 is most used by the admin team they are the once who register patients when they come and tell them which way to go and they take care of the patients to the wards by giving them their files so that they can go and see the doctors or the pharmacist after that if they need to be given any medicines. So, you got Delta9 for patient registration…let's just say for the admin part and then from that your delta9 would pass on the information to uhmmmm Rx system because after the patient has seen the doctor and has gone through the whole process they came in for, if there is any medication that is to be dispensed to them, they are going to go the pharmacy and that is

where they use the Rx solutions. So that is what Rx solution does, it is a medicine dispensing type of system. They can order from stores for bulk medicine and they can dispense to the patients in small quantity. So you have Delta9 giving through to Rx solutions. And then after that there is no any other system that the patient would go through. Which is relevant to what we are talking about now they will just go home. If not they are admitted and they need to be given x-rays or tests need to be done to them that is where we see Jvex coming it. The three systems pass on patient information from one step to another

Interviewer: In your role as [redacted] what has been your experience monitoring with the three systems?

TP.ITS: They are not difficult systems to work with, they are relatively easy to support and maintain. There is not much bugs in them, they are streamlined and efficient. Of course we would like to see a situation where they are interlinked so that we know that it is just one system that we are administering and we can take off and it does the work of all three systems that we spoke about. Because at the moment we just have information being passed from one system to another. Which can be problematic when it comes to quality of information. For instance information can be extracted incorrectly as it passes from one system to another. Otherwise working with the systems has been quite easy.

Interviewer: Following up on that, would you say that these systems are performing as they were intended to?

TP.ITS: I would say they do to some degree, like I mentioned earlier, the systems are streamlined and efficient in terms of how they support the healthcare service delivery. However what I can say also is that we have challenges here with things like slow network or when it is down in most cases doctors or nurses have to go back to paper work which of course can be stressful for them.

Interviewer: What role does the various information systems used at the facility play in healthcare service delivery?

TP.ITS: Ok. With the Jvex system we use it to support our x-ray activities. And Delta9 was deployed to fix the issues with patient registration. Same with the labs they have their own infrastructure to meet the need for the activities the NHLS would aid. Rx system is used for managing the dispensing of medicine to patients. As a hospital in most cases what we do is we acquire systems/IT infrastructure as we see the immediate need for them in aiding the service delivery process, for example with Jvex we acquired ourselves. I would say at the hospital those are some of the ways the systems fit into the delivery of patient care.

Interviewer: Let's take a step back, are you familiar with the acquisition process of these information system?

TP.ITS: You know it is quite difficult to say because with Jvex that is an external party program whom we gave a tender to support our x-ray issues. Ahhh delta9 I think was acquired by the hospital to fix the issues with patient registration. But I am not sure if it was brought by the hospital or provincial department or was it the national department. Because

you find that some of these systems/IT infrastructure come from the provincial department or national department and then some programmes we acquire ourselves as we see the immediate need for them for example with Jvex we acquired ourselves, Delta9 I am not quite sure whether it was from provincial or national department. Rx solutions that was provincial initiative initially but eventually pushed by the national department. So they come in from different levels for different reasons. If a lower level comes with an idea, and the higher level see it feasible to go through with then they are acquire it and trickle it down to the other hospitals, clinic or health centres.

Interviewer: How then does the implementation of these systems happen, whether coming from National, Provincial or within the hospital?

TP.ITS: At first they has to be training, not necessarily training but ahhh we would have to first assess the system that we want whether it is right for the environment that we are in. For example if we talking five different hospitals we have to first assess all five hospitals that they can indeed welcome this programme and they can work with it in an IT manner (available IT infrastructure) Then after the assessment of the site then we would go into the training of the individuals who would be supporting these systems and from training we go into implementation where we monitor the implementation process from beginning to the end. After the implementation process we then monitor and see that the systems works the way we wanted it to work, the hand it over to that specific hospital. Whether it is that technical people we handover to or it's whomever the end user is that would be working with the program and then we know that the process has been catered for and is done.

Interviewer: You mentioned training as one of the steps in the implementation of these systems, what mode of training is provided to the users of these systems/programmes?

TP.ITS: With the two different users would be give two separate training. For the technical users it would have to be something more of backend having to fix issues having to do with databases or maybe altering systems to cater for specific needs or specific hardware needs that hospital has at that particular time. And then for the end-user it would end-user training how to work with the programme A to Z maybe navigate through the programme if it has got different branches for different things you want to do. So that would be the difference between the two. One would be front end and the other be back end.

Interviewer: Does a system/program such as Jvex that you were involved in during its implementation meet its intended objectives?

TP.ITS: Definitely. Because the Jvex system not only takes the images and stores them, it does it in a chronological manner and then it is easy for the end user to find whatever images they want to use. It also helps in keeping the images digitally safely stored and ready for whenever it would be required. It is a robust system, we have never had the x-ray people complain about it, they just give praises about it. So it goes to show that it is a quality system and from us as the IT department we also have the support of the developers. The Rx solution was only recently handed to us, the department acquired and so we are responsible for the maintenance of the hardware, software. So it's proving to be an adventure but not a challenging one because with the hand over came a proper training for

the back end of things. And we do have support from the guys in Jorburg who have been working with Rx solutions for a very long time. So the acquisition of it by the department was quite good and the process of handing it over as well was catered for because training was done and we are moving on with administering ourselves. Delta9 we have onsite support and we are using it here at the hospital and also our orthopaedic hospital. So whenever we have an issue with it and the IT guys cannot solve it we know there is someone on site to help us with it. So the downtime is never more than an hour.

Interviewer: In your view how has the implementation of these systems especially those you were involved in, affected the delivery of healthcare services at the hospital?

TP.ITS: You know since I have been here, what I have noticed in terms of the use of these systems is that mostly the users are affected negatively when we have down times for example when we experience power outages and we have to wait for backup generators which normally take about 15 minutes so you see when the end user reacts to that especially having to go back to doing things the way they were doing before it was mostly paper based so you see the end user being or their attitude changes because they were used to a systems that was working efficiently and taking maybe five minutes to do a job that was they were doing before in 20 minutes and having going back to that due to the down time you get those negative attitudes. So you see that is a major impact that this systems have done to the end user and most the patient experience because that is the most important thing. And also the time that patients spend at the hospital is reduced because of these systems. So I would say a part from the time we have the down times (Network or power related) we have had a positive influence in terms of the delivery of healthcare services to our patients. You know just like the end users of the Delta9 system, the doctors that use Jvex and pharmacist using the RX solution they will tell that the program/systems have improved the way they work. You will not here them say that this programme cannot do this or that. Instead the systems make their provision of healthcare services better.

Interviewer: When the National or Provincial health department decide to deploy/implement these systems are you as the ICT department or involved?

TP.ITS: Yah they do involve us, they employ the same process I mentioned earlier, they will let us know what the idea is, they will come through is they need to assess the site, and then whilst making the assessment they will brief us on was it that they are coming to do. And if we are ready there is training then the deployment. So its first do an assessment and if everything is fine they train us, then we deploy whatever system or program that needs to be deployed together with the people or team from the national or provincial department that are responsible for the system. From there we would just be supporting it. Or for example if the service provider who came with the system has not handed it over to us but is going to help with the support then we laisse with them, either we log a call or send an email then we work together in fixing the issue.

Interviewer: Following up on that, would you say both departments (National and provincial) have a strategy that informs the implementation of this systems?

TP.ITS: Yes they do.

Interviewer: What are some of the examples of these strategies?

TP.ITS: The immediate once that come to mind are the ehealth strategy and the DHMIS policy that is used by the national department.

Interviewer: Does the hospital have anything in place that informs the end users of the various systems on how to use the systems apart from the initial training thy receive?

TP.ITS: Yes there is, the guidelines would be based on the previous discussions done with the service providers prior to the deployment of the programme. It would be features that we requested or an addition of them or maybe a subtraction of them depending on the overview of the prior discussions of the implementation process.

Interviewer: How has the implementation of these three systems changed the process of healthcare service delivery at the hospital?

TP.ITS: It has definitely changed how healthcare services are provided to patients who come to this hospital. We see that on the overall experience of the patients, so if it means that the patient gets here in the morning and leave in the morning then that means the overall process was a success. Because when a patient walks in, now from a 20 minutes process of registration or being told where to go, that is cut down to 5 minutes now. And when the patients are in the wards, even being seen by a doctor is now done systematically. The patient flow now changes from what it used to be to something that is going to cater for the new speed of patients coming to see the doctors. And then after that if you are going to get medicines dispensed to you we have got the RX solution which makes it easy to dispense and label the medicines. That decrease the patient stay and improves the overall experience of the patient. And then, from there the patient either goes home or admitted and we move on to the Jvex system where the images are collected and view in a faster manner than they would have previously. And with the use of this technologies many other things can be picked up in a short space of time. So overall the systems really do make a difference in the way healthcare services are delivered to the patient.

Interviewer: And then finally what would you say promotes a satisfactory implementation of an information system in a public healthcare setting like this hospital?

TP.ITS: Ok. Here are my steps that I think would be appropriate, 1. Proper planning – meaning first we would have to look into the investigations in what we putting into the hospital, what does that primary health facility need to have for this to succeed, do we need physical resources, internet connections, computer hardware/software of a certain calibre and from there what else do we need, do we need a certain level of education from the end user to be able to use the system or it something that can be done by anyone. Then from there would be the planning of the demographics – how far is it from the tower maybe for easy access to the network, how far is the facility from the nearest town, do we need daily transportation. There are so many things to put into considerations before you go into a facility and implement whatever it is that you want.

2. Skills development- for whoever is going to be using or supporting these programmes on a daily basis.

3. Proper maintenance- kind of like after sale support. Coming through and seeing what it is that people want, is there innovations that the users thought of that could be added as part of the system that would help that specific community because you know each and every place is different. So yah I would say those points

You know information systems are very important especially if you look at the stats and the numbers and by that we get to move forward so if it wasn't for those systems we could move forward if it wasn't for the information that these systems provide we would be innovative and look at other avenues of making primacy healthcare much more accessible to the people.

Interviewer: Just quickly picking up what you have mentioned with regards to new innovations, do you think the public healthcare facilities are ready for NHI?

TP.ITS: Look the NHI is an example when it comes with its new development and when it comes we wouldn't say no because we know it would improve healthcare in some way. We would then be able to scale what we already have. Obviously when the department present the box they don't bring an empty box to us they will say this is what we have and we would then choose what we have, want or wish we can have, so they can come with that. The programmes that we have seen them come with so far outside this hospital now in the districts and clinics in the HPRS (Health Patient Registration System) which not only takes care of the demographics in that area but expands to the whole of SA, so it makes it quite easy for a patient to move around within the country and have the medical information with them. The government can also easily monitor or put surveillance on the outbreak or spread of disease, they can even see the migration of people from one place to another. So there is a lot of spin off to what NHI is bringing and it is a step forward.

Interviewer: interesting. Thank you for your time **TP.ITS**.

Date: 5th July 2018
Interviewee: GYNO
Interviewer: Mourine Achieng
Healthcare Facility: NMAH
Venue: Ward
Interviewer: Thank you for agreeing to take part in this study, let me start of by asking you to describe your role at the hospital is?

GYNO: Well I am a gynaecologist in the hospital, I started working at the hospital at the beginning of the year.

Interviewer: In your role, can you describe you work activities?

GYNO: What I do is assess and manage patients who have either confirmed or suspected gynaecological malignancies. So from investing them to working them up for theatre if they are for theatre to facilitating their referral to umm oncology unit in East London for radiation if they need that to giving them chemotherapy if needed here in the healthcare facility.

Interviewer: In your daily work activities, do you make use of any technologies?

GYNO: Yes I do.

Interviewer: Can you give examples of the technology

GYNO: I use my cell phone mainly and also the PACS for viewing patients' mammograms

Interviewer: How do you make use of this technology (electronic) in your work activities?

GYNO: I use it to receive and check results from our NHLS lab. Actually more than that…initially when I started here I insisted that we type our theatre slates and we type our theatre notes in order to always have our soft copy back up because folders get lost all the time and you cannot find information when you need it. And also the system of writing these is so last century*…laughs…* sometimes you cannot make out the handwriting on the theatre notes, whereas if you have got a standard template to document your operations it makes more sense and it is reusable that way so the challenge with that … there are computers lying around everywhere but most of them do not work ahhmmm but there is one working in theatre but the challenge is printing because either the printer are unavailable or toners is unavailable so I have to print document at home. Yah so I try to make use of these electronic but with great challenges. But for the theatre I insist on it because it will help us in future because if we have standardised templates that you fill in typed then we can get rid of the handwriting factor. Certainly we use our cell phones to receive lab results because there is no network in the hospital, these computers are not linked to a network so we that is why we end up using our phones.

Interviewer: How does these challenges affect your work activities?

GYNO: It is very strenuous to be honest ahhhhh… you know all these consulting rooms should have to have desktops with network so that we don't even need to write folders that are going to get lost. Now you write on a folder and the hospital insists on keeping these folders afterwards. And they don't have…you should go the records it is chaotic, they don't have a file system whatsoever and you try on behalf of the patient as a doctor to help the patient to go and look for their records because you want to get on with their work and you get the rudest people there who do not want to do their job. Finding these folder in there is a mission. So that means if have seen the patient before, and this patient was just for reviewing or whatever, you have to start from scratch because you cannot remember what you did with a patient the last time they did a consultation. So it is duplication leading to inefficiencies leading to long queues, because now you have started the whole again from scratch so the patient comes for the same consultation they did previously meaning longer queues at the hospital. So the whole process of manual filing that should have taken you a step forward takes you two steps back and double the number of patient and you are not moving. So if we could have systems that are connected to network such that you just fill in patient information and you store them so that even for your referrals your colleague from other hospital just need to punch it the folder number and see what was done. But now even when you are referring a patient you write a referral letter and the summary you have to make it comprehensive as possible of the patient report but still that leads to you know you are curious about other information like what did the other doctor find about this and that and you cannot access that because the folder is gone.

For the radiology department I tell you, patients have their CT scans done and they've got typist down there who are constantly on their desktop watching movies of listening to music. There is a radiologist who is fighting that (typing CT scan results) because I think he is old fashioned, he is used to writing, which is fine but the typist are supposed to type these things and keep them electronically. So that we can do our work properly. But instead when go there firstly you have to go there to look for results, they will give you the original copy of the hand written results and then now the folder is lost and you have to get everything again, next time you go there you can get the CT report because you took it. Why don't they have electronic back, and why do they still… so for CT scans you have to believe what they say or you have to go to their computers to view the results because they do not have a software that enables us to view the radiological result wherever we are, whether it is in the clinic, theatre, surgery. The whole country is moving towards that. And if a patient has had a CT scan, an oncologist in East London cannot rely on what the patient says they have to read their own CT scans. Because we don't have that software for the Eastern Cape that a CT scan is done here and somebody in East London can view it, they have to take their word for it. Now what we try and say we will take this copy but can you try and print it on a disk so that a radiologist can view because we don print on x-ray film any more now you go there and the person who promised you earlier in no longer there and this other person says I am busy. Now that means that East London have to do their own CT scans which mean duplication which leads to inefficiencies. And how much does a CT scan cost thousands, duplications leading to inefficiencies. Now that means that the patient has to join the queue at Frere and I don't me ohh I you come today in the morning and leave at three o'clock the queue I mean I mean is in one month time you are going to have a CT scan yet it was done here. It simply does not make sense, or a patient who had a chest x-ray and now admitted to the ward for a minor procedure and you find that they need a major procedure, she had an x-ray filling done, again because we don't a software to view this thing on the computer, they give you the film and they do not have a filing system for those x-rays. So when she comes back again in two weeks' time for a major procedure she has to have another chest x-ray because the other one is lost, because there is no filing system and the anaesthetists they don't believe it was normal because somebody read it as normal and all of a sudden they what another one. And the patient has to go up and down.

So apparently there was a software here at hospital to view x-rays, apparently it worked for a few months many years ago and then it stopped and they thought that IT was on it and IT gave up and they gave up, everybody gave up.

Interviewer: So there is no prompt initiative by management to restore the faulty systems?

GYNO: No, they don't not at all. Also I mean it's so easy if you want ehh certain investigation done radiological investigation done if you had the software you hook the thing on the computer and instantly you would get to the person doing the booking that day. But because we don't have that software I have to request one of my doctors to go and look for the booking person which means taking that doctor away from a patient.

It is also not the IT that is a challenge, the work ethics is leaves much to be desired, because you know that you are making bookings that day and you disappear with the booking book so that no one can get an appointment for... It is frustrating and then you get this request form and you put it on the patients' folder so that when the patient comes back there they can go and have their procedure done and then the folder goes missing and they start

again. I hope you sense my frustration because I know that this place is in the rural area but all the facilities are there for it work but the sloth factor in the people is a problem. For us to get a print out of the results, because what the lab does, they do, well, they claim to print them out waste of paper. When these results get here there is no way to which a nurse can tell which patient those results belong to, also there is no place to file them, so they are lying in a pile somewhere. It is a redundant system where processes are continually repeated because of negligence is I can put it that way, yet if they could have these computers connected to the network we would avoid such. That is why I am saying the lack of utilization of these HIS leads to inefficiency leads to frustrations.

Interviewer: Where do think the problem with all these issues lie?

GYNO: I think the problem is at different levels, the fish rots from the head, if management is rotten then everything will follow, because there is no sense of accountability of anyone and people are complacent with the current situation the way it's always been, maybe it because they don't know better, but some of them know better but there is no vision to improve anything non whatever. You found it like this you'll continue like this. Whilst you are continuing like this the standards of healthcare service delivery drops even more and this institution was declared NHI ready! This place is not NHI ready, it shouldn't even be called a tertiary institution or a teaching hospital, not at the way coz all things could you know! it's not just the failure in utilizing the technology there a lot of things that need to be fixed before we can say this place is NHI ready there is no way. If somebody has the funds to pay for private care I would never bring my relative here.

Interviewer: Have you tried to have management to address these challenges?

GYNO: So many time it is giving me ulcers so many times. The problem is you as individual you try and address these challenges and it fall on deaf ears because they are people who do see any problem with what is happening and they have these attitude that this one come all the way from the Western part of the country and she feels like this place is too long she wants to change things whereas they don't see anything wrong. So you write memos, there are whatsApp groups where we communicate which is nice only if people would follow things up and do something about them but they don't.

Interviewer: In an environment such as the one you have described, what do you think can be done to improve the healthcare delivery process at the facility?

GYNO: I think people just have to realise that we could do better for our patient because the money is there. Don't ask me where the money goes after it has been allocated because it anybody's speculation. But the money is there, there is full support of the hospital in terms enabling it. They have got an IT department that is underutilised. When I got here for instance in wards that computer, I was told that no that computer is not working at all and I could believe that and I asked why they said we don't know we haven't used that computer in years we don't even know what the password is. And I asked what does the IT say about the response was that we never really use so we haven't bothered. I called IT and they responded saying that they just had to change the keyboard and the computer worked and it's still works. I think that if the IT department was given the capacity to go around the hospital and say we want to improve this and this, if they spearheaded this project instead of the doctors because the process of getting this to be done here a nightmare. There is no

constant person who overlooks the HIS at the hospital that is why you have a lot of these computers here either not working or not being used. I think that in as much doctors should be involve in all thing I don't think we can add more onto our already overflowing plates. Also this short answers like there is no network is not an answer, when you say there is no network but there was yesterday what happened to the network? Was is that somebody did not pay the network provider or somebody stole the network cable outside or inside? But all you get is those short answers that do not promised that things will be better.

Also I think a lot of people who work here, I mean we studied in tertiary institution where not necessarily formally but where all this technologies were available so we are quite comfortable. But maybe some people are not. And training in utilising this technologies would be important. I think that they should just get rid of paper. Major public tertiary institution in this country are going paperless but even the basic things we can't even do so we still a long way from a paperless institutions they need to pay attention to all these to make sure we have got the foundation and then we can proceed.

Interviewer: Would you as a doctor want to be part of the implementation of a new IS at the hospital?

GYNO: Yes, for sure I would want to be part of that.

Interviewer: What would be the benefit of your involvement?

GYNO: At least I would ensure that the clinical team is compliant in utilising the system being implemented because there is no point in filling up this place with all these technologies but people are not using them perhaps because they are not trained or they are just not willing to be compliant. And also for the maintenance it is still important to have a clinical voice because we will be the utilizers of these systems. We don't want to leave it up to the IT team. So I think those are some of the reasons why it would be beneficial for us as doctors to be part of the implementation process of new systems.

Interviewer: What do you envision for the public hospitals in terms of improving healthcare services?

GYNO: You know, when I see this place I see great potential in what already is here. Some of the things that are already here are very new that you don't see in other public hospitals. Only if we could change the mind set of people not just staff, change the mind set of patients, enable and empower our patients not to accept sub-standard healthcare services. I think if we could enable the patients first, and then go back to square one with our staff, yes people have gone to school to study what they do, but we need school of disciple for the clinical staff, the management, we need to send them to school of commitment, school of dedication, school of accountability. With this in place this institution could be bigger. We have not even touched on this like research work, there is a lot of pathology being done in this part of the country that are not being documented, whereas if we had software right at our consulting tables where we could be able to capture the data, it could be so easy, we could be a centre of excellence in clinical care, in research and we could be bigger than other public hospital in the country. But at the moment we are worse than most district hospitals because as I said fish rot from the head, but I still feel like there is hope, but I don't know if enough energy to stick around and one day enjoy that. Right now my heart is full of negativity because you feel so disempowered when nothing works, you'll that I will try

and fix one thing a day at a time, then I think I am moving forward and then things break behind you because there is no sense of accountability, there is no sense of responsibility, no discipline and that frustrates.

I think the combination of knowing that you salary whether you do little or more is the same. And whether you miss behave or not you got a union that will back you up and you can never get tired that mentality is the one that is breaking us. The other work ethic issue that is disgusting is the fact that this remuneration work outside public services, there are no rules here, people who are supposed to be stationed at work like I am now are busy running there private practices. Some of them are on call, they don't come, you call they tell you they are not coming, and again no accountability. You report such issues to the bosses and it goes nowhere. I just don't understand why we have to be punitive to be responsible and the punishment doesn't exist so we continue that way, why do we think like that? Why do we think that lack of punishment means I can do whatever it is I want. Why can we just be disciplined as a person who sworn to serve people? And we don't feel guilty for collecting salary for not even working.

After our history you would think that we would ensure that we look after one another, but it's everyone for themselves. And this people (patients) are poor you can do whatever, they don't have a voice. You have to know somebody in a powerful place or someone with some level of power to get decent healthcare services that should be standard. My nanny, when she comes to the clinic in the morning she comes back home at 4 o'clock but that is only after, tells me, after she bribes someone to get her clinic card stamped because at least that means you are going to move up the queue. Otherwise you are told to come back tomorrow and it's the same thing. I think we are moving towards such raw corruption in our public hospitals.

Interviewer: Thank you so much your time.

Date: 3rd July 2018
Interviewee: AMS
Interviewer: Mourine Achieng
Healthcare Facility: NMAH
Venue: Surgical Ward

Interviewer: Thank you for agreeing to take part in this study, let me begin by asking you to what your role at the hospital is?

AMS: I am the area manager at the surgical ward at the NMAH, I was employed by the department of health as a professional nurse in 1988 so you can calculate ….*laughs*

Interviewer: In your role as the area nurse manager in the surgical ward can you describe your daily work activities at the hospital.

AMS: Here at the hospital I am in the surgical ward, we deal with the surgical patients, we admit surgical patients. Others (patients) arrive already operated on, others (patients) are prepared here at the hospital for being operated. So post operatively they (patients) are being nursed so as to prevent complications especially to those operated, there are also

the cancer patients, we have the oncological patients that are admitted in our unit (surgical) so we got ehh under surgical unit we've got ehh general surgery, cardiothoracic, neurology, eye that is ophthalmology, ENTs that is ear nose and throat as well the urology. Those as the specialities we have in this unit.

Interviewer: So, you mentioned the various processes in your unit can you elaborate on work activities you are directly involved in?

AMS: When I come to work, I make sure that I visit all my units so as to make sure the smooth running of the wards is being done, patients are cared for, nurses are equivalent to the patient so that there is no shortage, the comfort of the patient is priority. Also make sure that observations are done, treatment are given as well as the assessments. Make sure that the doctors have seen the patients so as to assess them.

Interviewer: During this process do you make use of any technologies, is any of the processes automated?

AMS: No, what we have here are not functional, it is not working, so we are not using any. Most of the time it is paper work.

Interviewer: And how do you store the paper work? I can imagine there is a lot of paper work that goes with your work activities?

AMS: As you can see me (points to a files on the desk), having that file it is part of it. I file them in the cupboards so as to be able to peruse through them later on. Like now I was looking for the off duties file for 2015, I have just got them from my files, so we just store them in file inside the cabinets.

Interviewer: How do you find that process of manually looking for files?

AMS: It is a long process, rather than (compared) to using the system where we could just search by nurse id or patient reference number.

Interviewer: Are there any systems (technologies) at the hospital in other units that are used for the same purpose of managing the filing process?

AMS: Hmmmm… there are …

Interviewer: How does your unit make use of these systems (technologies?)

AMS: Some of the documents, there is a ward clerk next door, so for each ward at least for each ward has a ward clerk who is able to store some information. Like typing is being done by the ward clerk and even the typing of off duties is done by the ward clerks, statistics. Even the admission of patients is done by the ward clerk.

Interviewer: How is that information shared with you?

AMS: After the information is captured and processed, they (ward clerks) bring it to me so that I take to management. We usually store the files for a five years, they are kept at the department of registry.

Interviewer: In paper format?

AMS: Yes.

Interviewer: Given that you mentioned that you currently have limited use of systems (technology) in your work activity, would having a system be something you would like to have?

AMS: Yes yes… that would be better, and we would have less time do the paper work, because it takes time to write these paperwork it would allow us to focus our time on the patients and less on the paper work and some get lost.

For example if we had a technology for monitoring our post-surgery work activities on the patients that would be better, because after surgery a patient's condition may change, they have internal bleeding or a complication, we need monitors for each patients so that it can make our work activities much user friendlier for our patients, doctors can be alerted immediately if a patients' condition changes.

Interviewer: Back to the filing process, what happens in cases where files take longer to find or go missing?

AMS: Cases are opened to investigate if files are missing.

Interviewer: How does this hinder the healthcare service delivery process?

AMS: The hospital spends too much money fighting such cases. The patient in most cases have to go through a lot in terms of repeating things they had through because we won't have anything to know what their condition was previously. For us as well we do double work, which shouldn't be the case. If we had a system that once we store this things they stay there, not this papers they can easily be lost.

Interviewer: You've been in this profession for almost 30years, what has been your experience with the public healthcare service delivery over the years?

AMS: It has been fine and I have developed myself, I started training as a general nurse, then midwifery, then I did administration community degree then I did critical care and also education. So at last I am enjoying it because I have developed myself in my profession.

What I also do is train the upcoming nurses so that I can share my knowledge so that I can see that they are following what I taught them in the provision of patient care. I do not want to retire and leave with my experience.

Interviewer: In your provision of healthcare over the years, are there any challenges you have experienced?

AMS: Yes.

Interviewer: What are some of these challenges?

AMS: There are many challenges such like shortage of staff, we have the staff but not enough for the patients that we serve. And sometimes another challenge is the availability of equipment, as I told you I am a critical care trained nurse, in these wards for example, you find that even if you want to do something (work activities) you find that there are no

equipment to allow me to do my work properly…you are unable to. So those are the immediate challenges we face in terms of care service delivery.

What I can also say during this era of training colleges or training institutions, they focus more on theory rather than practical. And we experience this when the new recruits (medical personnel)… they are not like my generation, because during our time we focused on the practical aspect of the clinical care. So that is a major problem that we encounter with our new medical care. To add on to that despite the 1 year they are given of computer service, there is still is no improvement. So that is a huge problem we encounter in the clinical area.

Interviewer: How do you manage these challenges?

AMS: For the shortage of staff we just have to manage, it is demanding but we manage. For instance recruitment is done by GHR and it takes time for the recruitment to be implemented that staff is being provided. So at least now it is better than when we opened the hospital so many years ago. We make do with what we have.

Interviewer: How would you like to see the hospital/ DoH improve the healthcare service delivery process?

AMS: ahhh I can say even for example the staff in the unit their morale can improve if they can be remunerated better. If they are working ahhh as demanding as the working conditions can be better if they are remunerated better, that can improve performance in the care provision. We have staff development for those staff with at least 2 years of experience who are encourage by the hospital to apply for the developments, the hospital at least allows for 10% of the staff to apply. However, we cannot as a hospital release everybody because as I mentioned we are short staffed. I think this is something that can better our service delivery to our patients as we can see the benefits of such as the staff acquire new skills, their morale are boosted as they are recognised as being senior. And that translates to their work of caring for the patients.

Interviewer: In closing, what would you say can be done to improve healthcare service delivery process?

AMS: I would suggest that the training especially for clinical care personnel should go back to the more practical aspects of clinical care if not 50/50 because now I can say it is 20% clinical 80% theory and that obviously translate to the work activities… you see they cannot work properly because they know nothing. So we experience nurses have to coach even if it is a person is already a professional nurse. That takes me away from my own work. And the unfortunate part is that is we don't do the coaching we are putting our patients at risk.

The working conditions of our staff needs to also be improved for them to be able to perform their duties properly. For example, you saw the security when you came in, there is no proper security at the hospital anybody can come and go as they please. You can imagine at night how it is. So the working conditions must improve in our public hospitals.

Thank you so much for your valuable time.

Appendix H: Summary of data-analysis process

The content of this table shows a summary of the coding process of the interview transcripts.

Interview Questions (Doctors, nurses, ward clerks, administrators)	Summary of Key Responses	Keywords/ codes
1. Can you describe your daily work activities in the hospital/clinic	**GYNO**: "Well I am a gynaecologist in the hospital, what I do is assess and manage patients who have either confirmed or suspected gynaecological malignancies. So from investing them to working them up for theatre if they are for theatre to facilitating their referral to umm oncology unit in East London for radiation if they need that to giving them chemotherapy if needed here in the healthcare facility." **DMA:** I work as an orthopaedic surgeon at the orthopaedic section and have collaboration with the [redacted] that is used as an orthopaedic unit of NMAH. We basically deal with issues that concern bones and we normally link with the hospital through patients who have to be admitted via NMAH the referred to [redacted] unit. **AMS**: I am the area manager at the surgical ward at the NMAH, we deal with the surgical patients, and we admit surgical patients. Others (patients) arrive already operated on, others (patients) are prepared here at the hospital for	Role and responsibility Work activities

	being operated. So post operatively they (patients) are being nursed so as to prevent complications especially to those operated on…	
2. In your daily work activities of healthcare provision, do you make use of any HISs *(defined and examples given)*? a) How do you use these systems?	**GYNO**: Yes I do, I use my cell phone mainly and also the PACS for viewing patients' mammograms. I use it to receive and check results from our NHLS lab. Actually more than that…initially when I started here I insisted that we type our theatre slates and we type our theatre notes in order to always have our soft copy back up because folders get lost all the time and you cannot find information when you need it. …there are computers lying around everywhere but most of them do not work, but there is one working in theatre but the challenge is printing because either the printer are unavailable or toners is unavailable so I have to print document at home. Yah, so I try to make use of these electronic but with great challenges. But for the theatre I insist on it because it will help us in future because if we have standardised templates that you fill in typed then we can get rid of the handwriting factor. **DRG** "…yes sometimes we use these system order patients' blood test and receive the results on our mobile phones… " .	Awareness and actual use of technology Purpose for use Efficiency improvement Perceived usefulness Non-functional ICT infrastructure

	PRJ-M: This (LHIS) is what I use. To be specific the one that I am using is called the electronic gate keeping system (in short we call it EGK). **DMA:** In the future the manual work will seize to be there in the health system, we have started that in the prosthetics. You know what we do now? A patient comes, I stand them in the scanner, and then that information is sent to the miller, the milling machine mill the leg of this patient then the information is sent to the lamination room, lamination is done. With this, 2 hours of the patients' arrival the socket is ready. **AMS:** No, what we have here are not functional, it is not working, so we are not using any. Most of the time it is paper work. **RN-N** "… there are computers in our nursing stations, but they are never used because [either] they are not working or it's not connected to the hospital network". **Doc-CL** "…we receive notifications from the labs with patients test results on our cell phones…that is the only time I use technology…"	

3. In your view, what is the significance of HIS in facilitating health care services?	**GYNO**: You know all these consulting rooms should have to have desktops with network so that we don't even need to write folders that are going to get lost. Now you write on a folder and the hospital insists on keeping these folders afterwards. Finding these folder in there is a mission. So that means if have seen the patient before, and this patient was just for reviewing or whatever, you have to start from scratch because you cannot remember what you did with a patient the last time they did a consultation. So it is duplication leading to inefficiencies leading to long queues, because now you have started the whole again from scratch so the patient comes for the same consultation they did previously meaning longer queues at the hospital. **DMA:** This was not possible in the manual system all this is done through a computer system and is more effective. This reduces the cost and patients time during the whole process because everything is digitalised. **AMS** "…you find that sometimes we don't even have things like gloves to allow me to do my work properly, you are unable to…"	Frustrations Unavailable resources Inadequate availability of infrastructure ICT
4. What role does HIS play in your daily work activities of healthcare service provision?	**PRS-M**: The system that we are using is called Delta9, and we are using it for the registration of patients, including the biographical details who come to this hospital. We register	Purpose and role

	patients for recording keeping purposes and in cases where we have a relative who come to visit and is looking for the patient it is easier to identify that patient. **PRS-M**: The revenue department also make use of this system for billing, we collect the money (where applicable). **CM**: Case managers use the delta9 system for report purposes for example how long a patient has been in the hospital and for what reason **PRJ-M**: When they (data capturers) capture the doctors as 0DR, the system cancels all of those lab tests. Because the doctors have to be identified for various reasons (i) accountability in every respect (ii) clarification for example, if the test results are abnormal and there is need for clarification from the doctor, who are they (lab assistants) going to call? So we were doing that (capturing doctors into a database) mainly for those two reason especially accountability because we have to account and other reasons as well.	Improvement of working condition Expectations
5. What has been your experience working with HISs to facilitate healthcare delivery?	**PRS-M**: …My experience with the system has been good, it a system that is very easy to use. In many ways it has change the way public hospitals used to do patient registration… However, there are other modules of the system that we (the users of the system) wish we could have but we don't have	Improve working conditions, Perceived ease of use Scalability of the system

	since the system was bought by the hospital and there other development that hospital have not acquired. **PRS-M**: we were give training when the system was first introduced like for me I was there the initial stages and we were trained on how to use the system. Even now if a new staff come in they are trained on the system. Also the company that supplied (developed) Delta9 have made it their business to train users.	Training programmes Support
6. Has your perception of various HISs changed over time? a. In what way?	**PRS-M**: Remember we used to use manual books for the registration process of patients and record keeping of patients' information was very difficult because the books could be misplaced or the ink in the book fade overtime therefore making it a challenge to retrieve the record should they be needed for anything. But a system like delta9 we have backup that can be stored safely all you need is to look in the database for that particular record. **Tech.P**: It would be nice if we are trained on the new systems so that on doesn't have to spend a lot of time trying to figure out how to fix or solve a problem that could have be avoided if I had the training. You find that it would	Performance improvement Working condition Improvement Reduction in waste of time, duplication

	have been a simple thing if you have the training of how the system rather than do trial and error. **GYNO**…here I insisted that we type our theatre slates and we type our theatre notes in order to always have our soft copy back up because folders get lost all the time and you cannot find information when you need it.	
7. How would you describe your involvement in the implementation process of the HISs? a. If no involvement is mentioned, would you like to be part of the implementation process? Why?	**GYNO**: At least I would ensure that the clinical team is compliant in utilising the system being implemented because there is no point in filling up this place with all these technologies but people are not using them perhaps because they are not trained or they are just not willing to be compliant. And also for the maintenance it is still important to have a clinical voice because we will be the utilizers of these systems. We don't want to leave it up to the IT team. So I think those are some of the reasons why it would be beneficial for us as doctors to be part of the implementation process of new systems. **Tech.P:** Ideally, it is supposed to be like that but it has not been happening like that in most cases **DMA** "…need to be informed, trained on the system and I don't see it done here"	Participation, Representation Involvement

8. Generally, how is the HISs perceived or received amongst other healthcare practitioners and why?	**PRS-M**: I would say most of us here are used to the system …I have not heard people in this unit complain about the system …it is easy to use." **DMA** "…this system it is very quick and easy to use…" **N-NH** "…some of us were never trained on how to use this computers…so we find difficult to use them…" **GYNO**: "…although there is be an improvement, we still see patients waiting along the corridors …"	Ease to use Perceived benefit/value
9. How do you manage challenges related to the use of HIS in your work activities?	**PRS-M**: We try and solve it by ourselves, even the [redacted] of the hospital does not know. Those of us here try and solve it and sometimes [redacted] from Delta9 Company assists us. Although there is supposed to be someone from the provincial department who monitors the system and to assist, there is no support. **Tech.P**: Most time I have to do my own research and try and solve these issues which can take time and patience. There are times when you do even have someone to refer to like in other departments they don't even know the external people to refer you to.	Leadership/management Support structures

Interview questions with Managers at the Facility /ICT directors (hospital and provincial)		
Interview Questions	Summary of Key Responses (R)	Keywords/codes
1 What was the purpose for which HIS was implemented in the public healthcare sector? (HM; R)	**NM-EC**: Our objective as the dept. of health is to give efficient services to the citizens…most the systems currently don't do much, but collect to information about the patient **TP-ITS**: you know they are very important each and every one of the three systems that we listed are different from each other and it helps in that regard. For example Delta9 helps with patient registration, Purpose for Rx-solutions systems was to ease the dispensing and management of medication **PRJ-M**: let me be very broad and say that over the years the DoH nationally actually took note that the expenditure for the laboratory services were/are increasing and uncontrollable and they had to find a system, a way of controlling that expenditure you may say a cost containment measure if you wish	Purpose of technology Improve healthcare service delivery Achieving standard quality of data across
2 What informed the implementation process of HIS for healthcare service delivery? (HM:R)	**TP.ITS**: You know it is quite difficult to say because with Jvex that is an external party program whom we [hospital] gave a tender to support our x-ray activities. Because you find that some of these systems/IT infrastructure come from the provincial department or national department and then some	To address a need Mandated by the National or Provincial government

		programmes we acquire ourselves as we see the immediate need for them **PRJ-M**: "…expenditure for the laboratory services were increasing and uncontrollable and they had to find a system, a way of controlling that expenditure you may say a cost containment measure…"	
3	What kind of strategy was employed for HIS implementation process? (HM; R) a) Can you describe this strategy (s)? b) Were there any policies and guidelines?	**TP.ITS**: At first they[implementers] has to be training, not necessarily training but…we would have to first assess the system that we want whether it is right for the environment that we are in. For example if we talking five different hospitals we have to first assess all five hospitals that they can indeed welcome this programme and they can work with it in an IT manner (available IT infrastructure) Then after the assessment of the site then we would go into the training of the individuals who would be supporting these systems and from training we go into implementation where we monitor the implementation process from beginning to the end. After the implementation process we then monitor and see that the systems works the way we wanted it to work, the hand it over to that specific hospital. Whether it is that technical people we handover to or it's whomever the end user is that would be working with the program and then we know that the process has been catered for and is done.	Achieving standard or uniformity
4	How did you intend for HIS to meet the objectives of service delivery in public healthcare institution? (HM;R)	**TP.ITS**: A system such a Jvex for example does not only takes the images and stores them, it does it in a chronological manner and then it is easy for the end user to	Efficiency

	find whatever images they want to use. It also helps in keeping the images digitally safely stored and ready for whenever it would be required	Improve working conditions
5 How does the hospital/clinic inform the use (by healthcare practitioners) of HIS, i.e. prescribes, compels or guide? (R; HM)	**TP.ITS**: With the two different users would be give two separate training. For the technical users it would have to be something more of backend having to fix issues having to do with databases or maybe altering systems to cater for specific needs or specific hardware needs that hospital has at that particular time. And then for the end-user it would end-user training how to work with the programme A to Z maybe navigate through the programme if it has got different branches for different things you want to do. **NM-EC:** The mode of training is mostly a combination of many methods, sometimes the users are sent pamphlet with a sort of guide on how to use the system or sometimes you get workshops. I think we uses different channels or sources of training. In fact, there is a workshop happening next week on HPRS for two days. The training is usually done before the implementation and then maintained throughout because like I said people move in and out of the facilities and we need to maintain the training.	Training Support Capacity Skills and development
6 Have you experienced any challenges with HIS implementation process? (HR; R; Technical personnel) a) What are some of these challenges?	**NM-EC:** Obviously the biggest challenge because we are dealing with systems is the connectivity issues. Another challenge we have is the training of the users of the system, it is not happening as often as it is supposed and sometimes we also have the issue of change management	Connectivity Network infrastructure

		(people not accepting the systems or technologies that are adopted) so it is often difficult to move from manual to the new system. So change is a big thing/issue. Management is also another issue that can be seen as a challenge because you would expect certain thing to be done but they are not being done or are done in bits and pieces like for example in the past six months there has been no training given for the HPRS except for the upcoming workshop. Yet this this something that needs to be done on a monthly basis. **DRA**: I think the complexity of the DHIS software is a major challenge. Because it contains all the information we would like in health, however it fits the American context. That is why I said when it comes (adopted) to particular country we need to modify it to fit the context. You need internet (connectivity) because the timely information needs the adequate connectively that is reliable internet.	
7	How has the implementation of HIS affected the healthcare service delivery process? (HM)	**TP.ITS**: It has definitely changed how healthcare services are provided to patients who come to this hospital. We see that on the overall experience of the patients, so if it means that the patient gets here in the morning and leave in the morning then that means the overall process was a success. So a systems that works efficiently and takes maybe five minutes to do a job that was they were previously doing before in 20 minutes. So you see that is a major impact that this systems have done to the end user and most the patient experience because that is the most important thing. And also the time that patients spend at the hospital is reduced because of these systems	Benefit and values Systems functions expectations

		TP.ITS :The HPRS (Health Patient Registration System) which not only takes care of the demographics in that area but expands to the whole of SA, so it makes it quite easy for a patient to move around within the country and have the medical information with them. The government can also easily monitor or put surveillance on the outbreak or spread of disease, they can even see the migration of people from one place to another. **NM-EC**: The systems have aided the department to monitor and capture that all kinds of relevant information. These systems are there to make our healthcare service provider work much more efficient, for example how many people did we give treatment for HIV/AIDs or how many people consulted the doctors for TB treatments) **PRJ-M:** Besides the cost reduction benefits, I was able to also identify some of the many errors that marred the process of requesting for lab tests previously. Also, the doctors could also know what they were supposed to do in terms of the requests for Lab tests because if you remember that I had to go through that process initially where I went to all the unit/department HoDs and involved them in the decision making of how they wanted that process to be made.	
8	With the rolling out of NHI in public healthcare facilities, do the existing HISs environment/platforms allow for scalability and integration i.e. data analytics tools? (HM, Technical person)	**NM-EC**: In terms of scalability to accommodate for the NHI … oh no, the public hospitals even the clinic in the EC do not have the necessary infrastructure in place. And when I say we do not have infrastructure you need to know what type of system are currently running in the health facilities and what types of systems would be needed in future and	Expectations Availability of infrastructure

	from there you need to calculate how much for instance the serve, if you are outing the fibre, how big is the fibre going to be in order accommodate. Be able to say for instance I have 20 people in the clinic today, and tomorrow there are 40 I shouldn't say that there traffic because the number of patients have increased, in to be able to still use the system efficiently. **DRA:** Ok, first of all we are looking at the reporting system, how do they report, is it flexible or you restrict based on the system and what it tells you to report, is there a where you can report a problem that is not in the system	
9 What factors would you say promote successful HIS implementation in public healthcare facilities in resource constrained environments? (HM)	**TP.ITS:** Ok. Here are my steps that I think would be appropriate, 1. Proper planning – meaning first we would have to look into the investigations in what we putting into the hospital, what does that primary health facility need to have for this to succeed, do we need physical resources, internet connections, computer hardware/software of a certain calibre and from there what else do we need, do we need a certain level of education from the end user to be able to use the system or it something that can be done by anyone. Then from there would be the planning of the demographics – how far is it from the tower maybe for easy access to the network, how far is the facility from the nearest town, do we need daily transportation. There are so many things to put into considerations before you go into a facility and implement whatever it is that you want. 2. Skills development- for whoever is going to be using or supporting these programmes on a daily basis. 3. Proper maintenance- kind of like after sale support. Coming	Capabilities (skills, resources) Monitoring and evaluation

	through and seeing what it is that people want, is there innovations that the users thought of that could be added as part of the system that would help that specific community because you know each and every place is different. So yah I would say those points. **NM-EC**: I think from what I have seen lacking currently is the engagement of stakeholders in the implementation process. Because once you lose the stakeholders at the beginning chances are you would have lost them throughout. Once you have them involved they are more opened to what they want and how they want it and then you tailor it to fit their work activities. Another factor that would promote a successful implementation of HIS is the understanding of the environment where the systems are going to be implemented. For example clinics, community centres and hospitals (district, academic, tertiary) are all different environments. These facilities have different roles that they play in the community in terms of delivering health care services so one need to have an understanding of that environment. So you need to tailor all that into the implementation process. **PRJ-M**: Leadership is one of the major factors. One of the things I found having worked here and I am going to generalise … is that where there is no leadership things are not going to happen. For example, a while back there was a memo from [redacted]) stating that it was compulsory whilst capturing patients' details to use the ID as a unique identifier. This was communicated across the hospital. It was said that patients with no ID should be prioritised but	

	overtime that was not seen through because it was not enforced from the top. Another factor is consultation of the relevant people in the implementation process, you need to know how to communicate with people involved and to me this goes back to leadership and I am talking from experience working here. Another factor is political will within the organization, this can sometimes stand in the way things are done. I think also availability of infrastructure also like if we are talking about IT should be there for the implementation to be a success. But to me overall its bout leadership and governance, who is leading? I am the type of person who would walk around and see how things are done for myself. People are just not doing things the way they are supposed to do… because there is no accountability, like the unique identifier rollout, when it started we were on fire but then we just went down and that is because no one followed up and if you did not follow the protocol there would be accountability.	
10 What direction do you foresee the HIS implementation process taking in public healthcare sector? (HM)	**TP.ITS:** You know information systems are very important especially if you look at the stats and the numbers and by that we get to move forward so if it wasn't for those systems we could move forward if it wasn't for the information that these systems provide we would be innovative and look at other avenues of making primacy healthcare much more accessible to the people. **NM-EC:** The nice thing about the IS implementation process is that they are dynamic in nature in that you can always go back to the previous step with the lessons that you have learnt, the process should be flexible enough to	Functionality Usability Compatibility

	allow for the lessons learnt to be addressed. The implementation process helps you the implementers to be focused and also it makes sure that the relevant and necessary stakeholder that are supposed to be involved are included in the implementation process from the very beginning which improves acceptance and use at a later stage. The systems will always have a role to play. For example with the IoT (internet of things) is something that could perhaps play a major role in healthcare service delivery.	Readiness

Appendix I: Sample of overarching themes and evidence of findings based on the investigative issues

The contents of this table presents the study's overarching themes and evidence of findings based on the investigative issues under investigation.

Context/ Issue of investigation	Themes	Text extracts (A summary of key responses)
Status of healthcare service delivery in South Africa	1. Advancement in ICT infrastructure and technology use 2. Improved access to healthcare 3. Shortage of resources (Human and material) 4. Slow turnaround in healthcare workflow 5. Low morale and dissatisfaction amongst healthcare practitioners 6. Inadequate infrastructural(physical)support and malfunctioning of medical equipment	"…I was employed by the department of health in 1988… from my experience we have generally come a long way since then, in some areas we have improved since technology was brought in…" (AMS) "…we have seen a lot of improvements in this hospital ever since we changed the way laboratory test are done…which has helped the patients and doctors as well…previously a patient would wait for a very long time for lab test result, but now it is faster" (PRJ-M) "…although there is be an improvement, we still see patients waiting along the corridors …" (GYNO). "But at the moment we are worse than most district hospitals because as I said fish rot from the head, but I still feel like there is hope, but I don't know if enough energy to stick around and one day enjoy that. Right now my heart is full of negativity because you feel so disempowered when nothing works, you'll that I will try and fix one thing a day at a time, then I think I am moving forward and then things break behind you because there

		is no sense of accountability, there is no sense of responsibility, no discipline and that frustrates." (GYNO) "The hospital spends too much money fighting such cases." (AMS) "…if we could eradicate the continuous challenges of network issues that we have here then the system can be more effective. Sometime we may have network issue for an entire day and all the patient who were here that day will not be registered and that slows down the process." (PRS-M) "…you find that sometimes we don't even have things like gloves to allow me to do my work properly, you are unable to…" (AMS). "…the process of consulting with a patient is now quicker" (DMA).
Status of HIS implementation and use in public healthcare facilities	**HIS implementation themes** 1. Availability ICT infrastructure 2. Lack of systematic implementation process 3. Duplication of healthcare data 4. Lack of customization of HIS 5. Poor coordination of existing HIS (leading to fragmentation) 6. Training and Support 7. Lack of scalability capabilities	"…I have not heard people in this unit complain about the system …it is easy to use" (PRS-M). "…this system it is very quick and easy to use…" (DMA) "…some of us were never trained on how to use this computers…so we find difficult to use them…" (N-NH) "…we don't also have the interface that allows the patient to just come and put the finger and the system would pick up that patients previous information" (PRS-M) "…system in any country that it's used, needs to be modified to fit into the environment for that particular country" (DMA)

	HIS use themes 1. High level of awareness 2. Carry out Healthcare work activities (clinical & administrative) 3. Decision making process 4. Cost Management	"...lack of network connectivity makes it difficult to continuously use some of the systems here…" (GYNO) "Ideally, it is supposed to be like that but it has not been happening like that in most cases…" (Tech.P) "… there are computers in our nursing stations, but they are never used because [either] they are not working or it's not connected to the hospital network" (RN-N). "…interventions is always being propagated from the top, down here at the healthcare facilities we do not know anything about it" (DMA) "…you will find that the young doctors, our interns are the ones who are interested in technology…" (Doc-CL). Carry out administrative work activities indicated that a system such as Delta9 system, they used was useful to their work activities of capturing, storing, and retrieving patient data (PRS-M and C-M) "…we receive notifications from the labs with patients test results on our cell phones…that is the only time I use technology…" (Doc-CL). "…yes sometimes we use these system order patients' blood test and receive the results on our mobile phones… " (DRG). "…some of this process needs to be automated so that we can have record of patient information at hand…spend less time looking for information …" (GYNO).

Purpose of HIS implementation and Use in public healthcare facilities	**Themes for Purpose for Implementation** 1. Management of Patients' information 2. Cost management 3. Improve quality of data captured 4. Transparency and Accountability in the healthcare process **Themes for Purpose for Use** 1. Quick turn-around time in certain healthcare activities 2. Reduce bottlenecks in the healthcare process as a result of the over burden in the health system 3. Improve workflow processes 4. Ease access to information to aid decision making in the healthcare process	"…expenditure for the laboratory services were increasing and uncontrollable and they had to find a system, a way of controlling that expenditure you may say a cost containment measure…" (PRJ-M). "Case managers use the delta9 system for report purposes for example how long a patient has been in the hospital and for what reason." (PRS-M) "…there was a lot of these cases of [data] duplications…" (PRJ-M). "…it takes time to write these paperwork … also, this papers can easily be lost…" (AMS). "Ahhh delta9 I think was acquired by the hospital to fix the issues with patient registration." (TP.ITS)

The role of HIS in the healthcare service delivery process	1. Enhance efficiency and effectiveness in the healthcare delivery process a. Quick turnaround times, eradicate data duplications, improve timely collaborations 2. Enhance of health data/information management 3. Enable informed decision making process	"…for the registration process of patients and record keeping of patients' information was very difficult because the books could be misplaced or the ink in the book fade overtime… But a system like delta9 we have backup that can be stored safely all you need is to look in the database for that particular record." (PRS-M) "With the Jvex system we use it to support our x-ray activities. And Delta9 was deployed to fix the issues with patient registration. Same with the labs they have their own infrastructure to meet the need for the activities the NHLS would aid. Rx system is used for managing the dispensing of medicine to patients. As a hospital in most cases what we do is we acquire systems/IT infrastructure as we see the immediate need for them in aiding the service delivery process…" (TP.ITS) "So you write memos, there are whatsApp groups where we communicate which is nice only if people would follow things up and do something about them but they don't." (GYNO)

Appendix J: Sample of ATLAS.ti transcripts, codes and word clouds generated for document analysis

Project: Literature Review

Report created by sachi on 06 March 2020

Code Report

All (35) codes

Purpose of document

Comment: by sachi

Does the documents give an indication of the purpose of its development

13 Quotations:

1:5 It is of particular significance that this policy includes the ownershi..... (6:2085 [6:2436]) - D 1: District Health Management Information System Policy_2011

It is of particular signifcance that this policy includes the ownership and management of the DHMIS. For the DHMIS to continue to provide the essential information it generates, and for its limitations to be overcome, it is imperative that health managers at national, provincial, district and facility levels assume full ownership of this system.

1:6 Government's vision for 2010-2014 is to achieve a "long and healthy li..... (7:286 [7:910]) - D 1: District Health Management Information System Policy_2011

Government's vision for 2010-2014 is to achieve a "long and healthy life for all South Africans".

Linked to this, the Negotiated Service Delivery Agreement (NSDA), signed in October 2010, requires the health sector to achieve four key outputs: increasing life expectancy; decreasing maternal and child mortality rates; combating HIV and AIDS and Tuberculosis; and strengthening health systems effectiveness. A well-functioning DHMIS, generating good quality data with incontrovertible integrity has a vital contribution to make, together with other data sources, in monitoring progress towards the health sector's NSDA.

1:7 It defnes in detail the requirements and expectations from users of t..... (9:900 [9:1097]) - D 1: District Health Management Information System Policy_2011

It defnes in detail the requirements and expectations from users of the DHMIS at all levels of the health system, namely, national, provincial, district, sub-district, and health establishments.

1:9 The focus of this policy is on enhancing the management of health serv..... (10:2208 [10:2447]) - D 1: District Health Management Information System Policy_2011

The focus of this policy is on enhancing the management of health service based information, with the vision that South Africa will over time develop a comprehensive and integrated National HMIS, of which the DHMIS will be a key component

1:12 The policy outlined here provides an offcial regulatory framework for..... (13:86 [13:687]) - D 1: District Health Management Information System Policy_2011

The policy outlined here provides an offcial regulatory framework for the DHMIS in terms of the National Health Act of 2003, which empowers the Minister to establish the legal framework for health information systems. It presents in detail what the NDOH expects from users of the DHMIS at all levels of the health system, i.e, national, provincial, district, sub-district, and health establishments. The benefts of such a policy include harmonisation of information across the country, as well as formalisation of the resources required for effective implementation of a well functioning DHMIS.

2:1 The eHealth Strategy for South Africa is a roadmap for achieving a we..... (1:212 [1:362]) - D 2: eHealth programme reference implementation in primary health care facilities

The eHealth Strategy for South Africa is a roadmap for achieving a well-functioning, patient-centred electronic national health information system.

2:4 The aim of this reference implementation was to develop and refine t..... (1:972 [1:1168]) - D 2: eHealth programme reference implementation in primary health care facilities

The aim of this reference implementation was to develop and refine the eHealth architecture building blocks and assess the challenges in implementing the interoperability norms and standards.

3:6 The mHealth strategy provide us with an opportunity to guide us from..... (7:1254 [7:1772]) - D 3: mHealth Strategy South Africa 2015-2019

The mHealth strategy provide us with an opportunity to guide us from the current status to an environment where mobile solution providers conform to a set of normative standards that will ensure data collection is unified that benefits monitoring public health programme implementation and operational functioning of the health services. The strategy adopts a set of principles which include getting the basics right, taking an incremental approach, building on what already exists and looking for early wins.

3:10 The overall aim of this strategy is to provide a single, harmonised a…… (9:464 [9:980]) - D 3: mHealth Strategy South Africa 2015-2019

The overall aim of this strategy is to provide a single, harmonised and comprehensive mHealth strategy and implementation plan that: a. supports the priorities of the health sector, b. addresses and meets the needs of the following groups: • Individuals so that they are empowered to maintain and promote their own health as well as that of their families and communities, • Providers of health care services, and • Managers and policy makers.

c. paves the way for future public sector mHealth requirements,

5:1 To provide a framework for a structured uniform health system within t…… (2:168 [2:463]) - D 5: National Health Act

To provide a framework for a structured uniform health system within the Republic, taking into account the obligations imposed by the Constitution and other laws on the national, provincial and local governments with regard to health services; and to provide for matters connected therewith.

7:4 The eHealth Strategy for the public health sector provides the roadma…… (5:1849 [5:2026]) - D 7: South-Africa-eHealth-Strategy-2012-2017

The eHealth Strategy for the public health sector provides the roadmap for achieving a well functoning natonal health informaton system with the patent located at the centre.

8:16 strategy will contribute towards the South African National Developmen…… (12:2518 [12:3039]) - D 8: national digital strategy for south africa 2019-2024 b (1)

strategy will contribute towards the South African National Development Plan Vision 2030 of "Information and Communications Technology (ICT) that underpins the development of a dynamic and connected information society and a vibrant knowledge economy that is more inclusive and prosperous". The release of the new strategy is timely, following the establishment of the Presidential Commission on the Fourth Industrial Revolution by President Cyril Ramaphosa [1], announced during the February 2019 State of the Nation

Word Frequency for purpose of policy/strategy documents.

○ Stakeholder involvement in the

Comment: by sachi

Are there any indication of stakeholder involvement at all levels in the healthcare system

5 Quotations:

3:23 Stakeholder Engagement (16:3105 [16:3126]) - D 3: mHealth Strategy South Africa 2015-2019

Stakeholder Engagement

3:28 Coordinate an ongoing participatory forum with all mHealth partners a…… (16:4608 [16:4851]) - D 3: mHealth Strategy South Africa 2015-2019

Coordinate an ongoing participatory forum with all mHealth partners and stakeholders to produce consensus on key focal areas for mHealth research.

The mHealth project repository will act as the central point to report on mHealth research.

7:32 Stakeholder Engagement eHealth needs efectve collaboraton in order to…… (27:1413 [27:1694]) - D 7: South-Africa-eHealth-Strategy-2012-2017

Stakeholder Engagement eHealth needs efectve collaboraton in order to succeed. This can only be achieved by engaging with all stakeholder groups afected by eHealth, including mHealth and Telemedicine. This helps to mobilise support, identfy opportunites, highlight priorites, man

○ Strategies for technology intervention implementation

Comment: by sachi

What are the aims, objectives and strategies put in place in all the reviewed documents

1 Quotations:

2:3 In order to navigate the policy, legislative and regulatory terrain e…… (1:737 [1:971]) - D 2: eHealth programme reference implementation in primary health care facilities

In order to navigate the policy, legislative and regulatory terrain efficiently, the National Department of Health (NDoH) implemented the integrated PHC eHealth Programme in the 10 National Health Insurance (NHI) pilot districts.

○ Strategy of the implementation of the documents

7 Quotations:

2:7 This integrated implementation of the eHealth Strategy undertaken by…… (2:1123 [2:1322]) - D 2: eHealth programme reference implementation in primary health care facilities

This integrated implementation of the eHealth Strategy undertaken by the NDoH in the NHI pilot districts has the potential to revolutionise how information is collected and patients are managed.

3:22 The Department's fve year (2014/15 to 2018/19) strategic goals are to…… (12:888 [12:1876]) - D 3: mHealth Strategy South Africa 2015-2019

The Department's fve year (2014/15 to 2018/19) strategic goals are to: • Prevent disease and reduce its burden, and promote health; • Make progress towards universal health coverage through the development of the National Health Insurance scheme, and improve readiness of health facilities for its implementation; • Re-engineer primary healthcare by increasing ward based outreach teams, contracting general practitioners and district specialist teams, and expanding school health services; • Improve health facility planning by implementing norms and standards; • Improve financial management by improving capacity, contract management, revenue collection and supply chain management reforms; • Develop an effcient health management information system for improved decision making; • Improve the quality of care by setting and monitoring national norms and standards, improving user feedback systems, increasing safety in health care, and improving clinical governance;

3:25 This strategic implementation plan for mHealth is aligned to the nati…… (12:1969 [12:2626]) - D 3: mHealth Strategy South Africa 2015-2019

This strategic implementation plan for mHealth is aligned to the national eHealth Strategy for South Africa 2012-2016 which is driven by several initiatives, including: • The proposed National Electronic Health Record system; • The proposed National Health Insurance; and • The roll-out of a national electronic medical record system for monitoring anti-retroviral treatment for HIV/AIDS.

In the short to medium term, this mHealth strategy seeks to address the NDoH's short and medium term priorities. These priorities are outlined in the Department of Health's Strategic Plan for 2014/15–2018/19 and the Annual Performance Plan 2014/15 – 2016/17.

7:11 Take an incremental approach – build on what exists already in both th…… (8:1296 [8:2284]) - D 7: South-Africa-eHealth-Strategy-2012-2017

Take an incremental approach – build on what exists already in both the public and private sectors and fll the gaps where necessary.

• Look for early wins in implementatons and benefts to build the confdence of health professionals, patents and the public in eHealth.

• Advocate the benefts of care enabled by eHealth and ensure that these benefts are realised.

• Constantly evaluate eHealth initatves and measure improvements in health outcomes in order to build an evidence base that demonstrates the net benefts over tme of eHealth and guides planning and decision-making.

• Establish natonal co-ordinaton on all initatves in order to improve the efectveness of eHealth at all levels.

o Enable integraton between systems wherever appropriate.

o Enforce common standards, norms and systems across the country.4 o Establish common data standards and terminology across informaton systems.

8:20 The process for developing the strategy involved engagement, consultat…… (13:2498 [13:2943]) - D 8: national digital strategy for south africa 2019-2024 b (1)

The process for developing the strategy involved engagement, consultation and technical development processes. Figure 1 provides a synopsis of the development processes. As depicted in Figure 1, the strategy development process began with the review of the previous strategy implementation, which led to the identifcation of successes, lessons learnt, challenges, gaps, opportunities and risks. The review provided a foundation for the strate

8:27 The new strategy will be translated into a detailed implementation pla…… (25:3018 [25:3301]) - D 8: national digital strategy for south africa 2019-2024 b (1)

The new strategy will be translated into a detailed implementation plan to deliver the strategic interventions, integrated with the South African government Medium Term Expenditure Framework (MTE) and annual operational plans. This will be structured to deliver on specifc milestone

9:5 our key interventions need /" \t1;;;:Ffibk::.. <itwww~- \ IM?~t ~~rs…… (5:850 [5:1125]) - D 9: nationalhealthinsurance

our key interventions need /" \t1;;;:Ffibk::.. <itwww~- \ IM?~t ~~rs the whole ~lmuitaneously: i) a ii) the total overhaul of the entire healthcare system iii) the raclic;;cll management iv) the provision of a comprehensive·pacl<a'!lre engineered Primary Health Care.