Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa

by

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Thesis submitted in fulfilment of the requirements for the degree

Master of Technology (MTech) in Information Technology

In the Faculty of Informatics and Design,

at the **Cape Peninsula University of Technology (CPUT)**

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Cape Town Campus

August 2013

DECLARATION

I, Nokubalela Ntombiyethu Mchunu, declare that "Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa" represent 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.

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ABSTRACT

Healthcare services are vital to all human beings, as our daily lives depend on them. In South Africa approximately eighty per cent of the population uses the public healthcare services. In the current healthcare systems data corruption exists which threatens data quality in the systems. The aim of this study was to understand the existing information handling processes and factors that affect the accuracy and integrity of healthcare data. A qualitative research methodology, under the interpretive paradigm was used for this investigation. Activity theory is used to formulate an analytical framework, the "healthcare information system data quality activity theory framework". This was very helpful for understanding the healthcare information handling process as an activity system that consists of actors with individual goals. Though the goals are varied, they are joined together by the common objective. The logic of the framework is that a realisation of goals in the activity system depends on a number of factors. At the beginning, there must be a synchronous inter-linkage between the goals of the actors, the mediating factors such as adequate tools, user skills, enabling policies, and the systematic procedures that are diligently enforced. It is assumed that any situation which prevents this inter-linkage will have a negative impact on the realisation of the sought objective. The framework therefore, was very helpful in informing questions, the data collection and ultimately, the analysis processes.

The public healthcare sector is the main source of data; other sources were literature, the Internet and books. The analysis of data was done using content analysis to find what themes emerge and the relationship (s) between them in what is being analysed. The findings reveal a lack of adherence to information handling procedures and processes which lead to corrupt data in the systems. In addition, most users have limited skills, which is a hindrance to them in performing their duties as expected by the healthcare sector. In fact, the healthcare sector is also challenged by systems which are constantly slow or down, due to limited network capacity and human errors. The presence of these challenges suggests non-adherence to data handling procedures, which explains the existing corrupt data in the healthcare systems.

Therefore the recommendation is that the public healthcare administration must enhance their training programs. The training must be re-designed to cater for the needs of all users, regardless of their background. It needs to improve user skills and boast their confidence in using electronic systems. Obviously, any changes and improvements need to be sustainable, and the sector is unlikely to succeed without enforcement of new procedures. Therefore, adherence to data handling procedures must be strictly enforced, with policies thoroughly communicated to the users. That way, the sector will not only have systems and related policies, but also ensure their full exploitation for improved service delivery in the public healthcare sector in South Africa.

ACKNOWLEDGEMENTS

I wish to thank:

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GLOSSARY

Terms/Acronyms/Abbreviations	Description
ANT	Actor network theory
AT	Activity Theory
DoH	Department of Health
EHR	Electronic Health Record
HIS	Hospital Information System
IS	Information systems
ISO	International Organisation for Standardisation
MDG	Millennium Development Goals
MDM	Master Data Domain
MMS	Materials Management System
PACS	Picture Archiving and Communication System
PHCIS	Primary Healthcare Information System
PIS	Pharmacy Information System
RIS	Radiology Information System
ST	Structuration Theory

CHAPTER ONE – INTRODUCTION

1.1   Importance of Healthcare Sector

As an important part of all human existence, healthcare is concerned with the health of people and includes a wide range of services and products aimed at treating illnesses, preventing them and even improving the general health conditions of individuals and even the entire population (WHO, 2009a).

From antiquity to modern times, many people have always depended on one form of public healthcare or another, to treat and control ailments that resulted from various epidemics, pandemics, endemics and/or natural injuries. Early accounts of public healthcare for example, include the use of natural herbs and massages by traditional healers and divine tellers (Birbas, 2004) in Ancient Greece to heal and advise their patients (*ibid*). The Indian traditional healers also used aromatherapy and traditional herbs to treat physical, mental and emotional problems (Indiasite, 2009). These healers also believed in a relationship between spiritual purity and health, where the methods such as Yoga were used to heal the soul and improve the wellbeing of a person from within (*ibid*).

In South Africa izangoma and izinyanga (traditional healers and divine tellers) used indigenous herbs and natural products for the treatment of ailments, for immunization and to predict and advise people on matters of health and fortune (Pretorius, 2004). An effective and universally accessible healthcare system[1] is fundamental to the well-being of every society, without it people cannot survive, as it is needed daily in their lives. Healthcare includes the provision of services such as awareness campaigns, which create awareness about diseases, information on how to live a healthy life, tend to improve safety in households and on roads, as well as others, such as risk and disaster management (WHO, 2009a)

Healthcare services have not changed in significance in modern societies. Instead, the methods, techniques and systems have advanced and became more formalized. The modern healthcare systems have advanced in terms of the structure and the methods of training, diagnosis as well as the prognosis, to suit and cater for the changing lifestyles of people/populations. Structurally, the ancient healthcare systems were more informal, independent and not administered by government ministries or controlled by legislation as is the case today. They were also not organized into formal hospitals and clinics that are characteristic of the modern system. In ancient Greece for example, whilst novice healers did most of their mentored practice in Lesvos Island until they could go back and practice in their communities, the training was largely conducted within societal settings, through observation and by word of mouth (Birbas, 2004). Similarly in the Nguni tribes of Southern Africa, healers worked from their homes, with either describing the ailment to the healer or the healer using spiritual powers to complete the diagnosis. Patients with complicated illnesses were also moved to stay with the traditional healers so that they could be monitored while undergoing treatment (Pretorius, 2001). The trainees also resided in their mentors' homes[2] to learn through observation and practice (ibid). Whilst

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[1]It is a group of healthcare institutions with resources that aim to provide effective, responsive and fair healthcare services (WHO, 2005)

[2] In extreme cases, healers also visited patients in their homes (Pretorius, 2004)

these methods may have worked in ancient communities, the world population[3], health challenges and needs have since multiplied, both quantitatively and in the levels of sophistication over the centuries.

The emergence and growth of chronic diseases such as cancer, asthma, diabetes, malaria, tuberculosis, as well as the HIV/Aids, ebola[4] and the recent H1N1 pandemics are examples of the challenges confronting the modern healthcare systems (WHO, c.2009). By their very nature and threat to human survival, these not only demand advanced initiatives, but also global cooperation in healthcare services. To this effect, the healthcare system has undergone innovative advancements over the years, from the ancient informal and semi-structured, to the modern intra- and inter-national healthcare structures, systems and processes.

1.2   Earlier Healthcare Information Handling Innovations

Innovations in the ancient information handling tools can be traced back to the early uses of different sounds and shapes to represent certain information (Pretorius, 2001). For example, in the administrative, healthcare and commercial industries they used the clay tablet that was called the cuneiform. The cuneiform was used to write information using a wedge-shaped pen, which were stored in caves (*ibid*).

From the data quality perspective, an information system in the form of a master data domain (MDM) should promote the completeness, consistency (Power, 2009) validity and integrity of data (Moore, 2007). Whilst data consistency instance refers to whether or not data that is stored in different locations contain exactly the same values, validity refers to the extent to which the values of data can be generated and kept within an acceptable range (Maydanchik, 2007). The new cuneiform innovation was an enormous change in comparison to sharing information by word of mouth in that reliable information could now be recorded on these tablets. Whilst this was an improvement however, there were security limitations with this innovation. Despite the sensitivity of patient data and the optimum accuracy required, information tablets in caves were open and vulnerable to unauthorized access. In other words, it could easily be removed or stolen by unauthorized persons, and or be destroyed by natural disasters (beyond the point of recovery) as it was not protected (Cuneiform Digital Palaeography, 2004). With such vulnerability to security risks, the confidentiality and integrity compromises (Gollmann, 2005), which the modern healthcare sector cannot afford, remained a major limitation in this ancient system.

In addition to security limitations however, the clay tablet also had efficiency limitations. An efficient information system (IS) according to Palmius (2007) further needs to deliver tangible and visible benefits in terms of reliability of storage, ease and speedy retrieval, as well as the accurate handling and effective sharing of information. The availability of information was not immediate in that the practitioner had to go to the caves and retrieve what they needed from the tablets (Cuneiform Digital Palaeography, 2004).

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[3]The Current World Population figures show the world population to have increased from 6,790,062,216 billion in 2009 (Rosenberg, 2009) to 7.06 billion in mid-2012 (Haub, 2012), having passed the 7 billion mark in 2011 (*ibid*).
[4]Ebola is a fatal disease that kills its victims within two weeks due to massive blood loss. It is found in human beings and animals such as monkeys, gorillas and chimpanzees. It is caused by infection with Ebola virus which spreads to humans by direct contact with the infected animal or with infected persons (DoHHS, 2009).

Further, amendment of information was not possible since the dry clay prints could not be revised (Gill, 2010). Adding new information or record amendment therefore, required the creation of a new clay record. Because of the bulk of clay and the large number of records that practitioners had to work with, it was a physically daunting and time consuming effort to retrieve and use information. Practitioners had to wait a long time for others to finish using the tablet and return it to the cave before they themselves could access its contents, which limited the efficiency of the healthcare service delivery under this ancient system. Obviously, with the growth of the population and the multiplication of diseases, this ancient method became inadequate in meeting information handling needs of the changing healthcare system of the modern world

1.3   Current Healthcare Information Handling Processes

Given the multiplied demand for healthcare services today, it would have been impossible to identify patients, to know their medical history, to efficiently record and retrieve treatment information under the ancient insecure and inefficient information system. Innovation from the clay tablet, into the modern paper based information system therefore, was most timely. The arrival of the paper based system introduced the usage of patients' paper-based files, where information can be categorized into demographical and medical history sections within one portable file (Medline Plus, 2010). Although the information handling processes in the healthcare sector have improved compared to the ancient system, there are limitations that still threaten data security and the efficiency of healthcare information systems.

1.4   Research Problem

There are a number of security limitations that threatens the integrity of data in the South African public healthcare information systems. Cybercriminals are reported to be stealing patient data in South African public hospitals and clinics. Stolen data is then used to fill "false patient claims to insurers and government agencies that provide health services" (RSA, May 2010: 2). The major threat to the quality of services is that unauthorized users are able to make unauthorised alterations such as deletion, modification, or corruption of patient data. The problem is that since the causes of the vulnerability are unknown, corrective measures cannot be realised, which ensures a continuation of the threat to the safety of patient data.

Further, data errors on patient records have been an on-going problem in both the paper-based and the electronic healthcare information systems (Mullins, 2009). There are many cases in public hospitals and clinics where patients find themselves with more than one healthcare record or with their personal details spelled incorrectly. The duplication of data can disrupt processes as work cannot be done properly with inaccurate data (Power, 2009). Data corruption weakens the operations, and has a potential to cripple an already overstretched public healthcare system. Whilst the implications of the threat are clear, the causes are not understood. As a result, solutions remain unsought and unfound. Unless the causes of data corruption can be understood and the problem addressed, the quality and efficiency of the healthcare services remain threatened.

1.5 Aim of Research

1.5.1   Research Objective

Given the research problem, the goal of the study is to understand the factors that affect data quality (in terms of accuracy and integrity) within the paper and electronic based information systems in the public healthcare sector in South Africa. The objective is to understand the status of information handling systems and processes in the public healthcare sector with regard to data quality and the causes of data corruption. The idea is to contribute towards the enhancement of the quality of public healthcare service delivery in South Africa.

1.6 Research Questions

What are factors affecting the adequacy of healthcare information (electronic and paper-based) systems in terms of how the handling, storage and exchange of patient records affect the quality of data in the South African public healthcare sector (public hospitals and clinics)?

1.6.1   Sub-questions

1. What is the relevance and appropriateness of the paper-based and electronic information system to the handling, storage and exchange of patient data?

2. What are the factors that influence the quality of data over the paper based information handling processes?

3. What are the factors that influence the quality of data over the existing electronic information system/s?

4. How does the public healthcare information system currently support the effectiveness of data quality?

The methodology in chapter three further elaborates how the objective of this study will be fulfilled, also where and how the research questions will be addressed. Operational definitions (Table 1: Operationalisation of variables) are presented in the following page.

Table 1: Operationalisation of variables

Dependant Variables		Independent Variables			
Variable		**Variable:** Paper-based system		**Variable:** Electronic system	
	Description	**Data Handling Processes**	**Data Handling Tools**	**Data Handling Processes**	**Data Handling Tools**
Accuracy	Refers to data correctness, completeness and validity (Olson, 2002).	Data - Collection - Alteration - Retrieval - Sharing - Storage	- Strategies & procedures - Writing equipment - File or folders - Cards - Filing cabinets	Data - Collection - Alteration - Retrieval - Sharing - Storage	- Strategies & procedures - Electronic information system - Computers - Access rights - Networks - Servers
Confidentiality	Refers to the maintenance of data secrecy. Protecting systems against intrusion and unauthorized access to data (Corporate Executive Board, 2010).	Data - Collection - Retrieval - Sharing - Storage	- Strategies & procedures - File or folders - Cards - Filing cabinets	Data - Collection - Retrieval - Sharing - Storage	- Strategies & procedures - Electronic information system - Computers - Access rights - Networks - Servers
Efficiency	Refers to the quality of system competency to enable access, storage and sharing of data (Barua et al, 2010)	Data - Collection - Retrieval - Sharing	- Strategies & procedures - File or folders - Cards - Filing cabinets	Data - Collection - Retrieval - Sharing	- Strategies & procedures - Electronic information system - Computers - Access rights - Networks
Integrity	Refers to consistent validity of data. Ensuring the system is protected against unauthorized access, amendment or removal of data (Data Center Definitions, 2005).	Data - Alteration - Retrieval - Sharing - Storage	- Strategies & procedures - File or folders - Cards - Filing cabinets	Data - Alteration - Retrieval - Sharing - Storage	- Strategies & procedures - Computers - Access rights

1.7 Conceptualisation

- **System Adequacy**

  Is the ability of a system to supply the comprehensive business requirements of the customer at all times, taking into account scheduled and unscheduled timeout of system components (Kundur et al., 2004). System adequacy, alongside security, is one of the functional aspects of reliability.

- **Data Accuracy**

  It refers to the authenticity and correctness of information recorded (Olson, 2002).

- **Data Confidentiality**

  This refers to the protection of data from being accessed by unauthorized users (Health Professional Council of South Africa, 2007), and also ensuring that patient data is correct and secured.

- **Data Collection: gathering and recording**

  This refers to the primary acquisitioning and writing or recording of information from its primary source for permanent keeping so that it can be re-used by the organization (Pearson, 2003).

- **Data Integrity**

  It is a term used in information security to refer to any security measures that are taken against unauthorized accessed to, and amendment of confidential information. It refers to the state of ensuring the original accuracy and authenticity of data that is stored or exchanged whenever it is accessed and used (Gollman, 2005).

- **Data Storage**

  It is a process of safeguarding information on paper or a computer system, so that it cannot be destroyed or stolen, and can be used in the future (Word IQ, 2010). The data is locked away from being access by unauthorized users, by the use of physical keys in the medical records or by using username and passwords with restricted access, for electronic records. (Moosavi & Simon, 2008).

- **Data Retrieval**

    It refers to accessing information that was recorded and stored safely at a specific location to be used at a later stage (Mansson et al, 2004). This is done for the benefit of the organization and its clients, in order to improve the quality of services.

- **Data Sharing**

    It is a process of using systematic methods, as well as reliable tools to exchange information between authorized users, so that it is always in an authentic format before and after use (Sonnewald, 2006). Systematic methods refer to consistent procedures that are exclusively accessible and easy to follow. Reliable tools on the other hand refer to the paper and electronic information handling equipment such as stationery, papers and computer systems that are efficient, safe and easy to use.

1.8 Conclusion to Chapter One

This chapter clarifies the importance of healthcare in people's lives from the richest to the poorest in the community. It also looks at the history and importance of information or data in the healthcare sector and the information handling processes. From the earlier healthcare systems to those that are current, the importance of patient data has been increasing the main reasons being to protect patients and for institutions to have well balanced data repositories. As the healthcare systems have improved to the meet the needs of current lifestyles, they also face challenges such as security threats, poor data integrity and data corruption to mention a few. This study aims to find the root cause of these problems and propose solutions. By identifying the causes, the research questions can provide guidelines of what to look for and where to look for it. Further the conceptualisation in this chapter clearly defines the key terms used in this study. Chapter 2 that follows gives a detailed review of the literature that is concerned with the quality of data in the healthcare sector.

CHAPTER TWO – DATA QUALITY IN THE PUBLIC HEALTHCARE SECTOR

2.1 Introduction - Healthcare Data Quality

For data to be regarded as good quality it must be free of errors (Lee et al, 2006). Organizations use data to make decisions about business processes, and to improve the quality of their service (Pipino et al, 2002) therefore data quality is vital in all the organizations whether private or public. In data quality there are twelve data dimensions which help organizations to establish their data quality needs (McGilvray, 2008), namely accuracy, data integrity, duplication, presentation quality, data decay, transact-ability, data coverage, timeliness and availability, data specifications, ease of use and maintainability, consistency and synchronization, lastly perception, relevance and trust. Whilst all these dimensions are important, this study mainly focuses on the following data quality dimensions: data accuracy, data duplication, and data integrity in the public healthcare sector, along with the aspects that support them. Based on the environment setup of the healthcare sector, the data used is regarded as highly sensitive and confidential. The chosen dimensions above support the confidentiality of data in this sector. Data accuracy, duplication and integrity, depend on six themes (usage of tools, user skills/competencies, functionality, user access control, data integrity, and data sharing) developed for this study. These themes are discussed thoroughly in chapter 6.

Healthcare information systems must produce data that is accurate and valid, which can be used by healthcare planners and decision makers (HealthSystems2020, 2012). For example the patient information that is captured in the system, will later be used by decision makers to generate reports, based on the information they need at that time. Reports drawn from the system are mostly used to make decision such as the allocation of funds, resources etc. From the point of entry (data collection), it is therefore crucial that the data capturers and clerks capture accurate data. Most importantly, because incorrect data would negatively impacts the quality of information and decisions taken based on that data. On the other hand, data duplication refers to having multiple entries of the same set of data in your database (Boochever, 2004). Dimensions chosen for this study are based on the type of data that the healthcare sector deals with. The primary goal of the healthcare sector is to provide quality patient care services (Fisher, 2010), and in order to achieve this goal, data quality must be a major consideration. Procedures and processes within the sector can be used to improve data quality. Lack of data accuracy, (errors on data) may lead to the incorrect identification of patients. This situation can risk patients' lives and threaten the quality of service provided to the patients (Van Mens-Verhulst & Radkte, 2006). The healthcare sector has to have a structure that ensures that the patients get good healthcare services.

The structure according to Avison and Shah (1997) represents a hierarchical composition and decomposition of a system, processes and procedures. As a defining feature of the structure, a

system represents a combination of people, procedures (Long, 1984), devices and methods that are interrelated and are working together towards achieving a common goal (Szymanski et al, 1991). From this perspective, the structure represents the arrangement of different parts into a coherently organized body of material or immaterial things that make up a purposeful system (Oxford, 2002). The South African healthcare system is divided into two sectors: public and private sectors, with a population of 49 million people. Above eighty per cent (40 million people) of the population rely on the public healthcare sector (Sidley, 2012). The public healthcare services range from the basic services which are offered by the state free of charge, to highly specialised services offered in both public and private sectors (SAI, 2012).

As opposed to the informal and semi-structured ancient healthcare sector, the modern healthcare services are now organized into formal entities with defined objectives, policies, procedures, roles, actors, activities and outcomes. The entities are organized into regulative and operational hierarchies at international, national and local levels. Whilst the World Health Organisation (WHO) under which 192 countries are registered (Rosenberg, 2009) and the United Nations institutions represent a regulative structure at international level, the national and provincial governmental departments of health regulate local healthcare services (Briney, 2009).

2.2 The Regulatory Healthcare Structure

The international and national policies set out objectives and desired outcomes, as well as the roles, guidelines and procedures on how to improve the quality of healthcare. To this effect, the objectives of the WHO are to foster cooperation and support towards the highest possible level of health among all people in the world (WHO, 2009b). In the same light, the United Nations also sets to reduce the rate of mortality and HIV/AIDS among the global population as the fourth and sixth priorities in its Millennium Development Goals (UNMDG, 2005). At a national level, the South African (SA) Government also declares healthcare services in its National Constitution (1996), as not just a privilege but a basic human right. This undertaking was supported by the operational guidelines in the form of a national health plan in 2008, to provide better healthcare services (DoH, 2008).

2.3 The Operational Healthcare Structure

It is within the local operational entities such as hospitals, clinics, private doctors' rooms and local pharmacies (SAGI, 2009) however, that the international and national healthcare policies are implemented and medical procedures carried out (Oluwole, 2008). In terms of the operational hierarchies, the International Red Cross assists citizens of all countries that are in desperate situations, with a fair quality of healthcare services (International Red Cross, 2009). Nationally the

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healthcare system is also structured at regional and local levels. There are public[5] and private[6] hospitals, clinics and pharmacies, as well as private medical practices, which offer primary, secondary and tertiary levels of healthcare services directly to the public (SAGI, 2009).

2.3.1 Levels of the Healthcare Sector

The primary sector is the basic level of healthcare which caters for all types of health problems, including the diagnosis and prevention of diseases at an early stage, to people living in a specific geographic area (Mosby, 2009). At the next level, secondary healthcare offers more specialized healthcare services. Hence, its institutions are occupied by specialist professionals who are equipped with more specialized resources. Finally, the tertiary healthcare which is equal to specialized healthcare services, except that it focuses on the unusual diseases where patients must be isolated and monitored closely (*ibid*). All these three levels of healthcare service are available in both public and private sectors. However the demand differs in the public healthcare sector as these services are highly utilised, while the equipment and resources are scarce. This creates a huge gap in the quality of these services offered by the sectors, as private sector services caters for middle to high income earners mainly belonging to medical schemes (SAI, 2012). These services are offered by the highly qualified medical personnel (*ibid*).

In line with the national and international regulatory frameworks and policies, private and public hospitals facilitate the provision of a wide range of healthcare services, including temporal consultations and the admission of patients who need monitored treatment (McKee et al, 2006). The medical tertiary education institutions and academic hospitals carry out roles of developing and training medical practitioners such as doctors, nurses, pharmacists, and therapists[7], among others. At a slightly lower level, clinics and pharmacies provide more temporal consultations and the dispensing of medicines and drugs (*ibid*). Similarly, independent medical practitioners provide specialized medical consultations, treatment and healthcare advice to individual patients, on a private basis (Herman, 2005). In the complex healthcare structure, hospitals and clinics institutions are at the operational level where patients go for their consultations. For the public healthcare structure to yield meaningful outcomes however, a functional system becomes necessary. Since is a coherent sum composed of different but interrelated components that are joined together by a common purpose and sets of rules (Mursu et al, 2007) – all pushing towards a common end, the coherence of different components of the healthcare information systems environment is crucial in the success of the healthcare structure (Mlitwa, 2011). It goes without

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[5]Public healthcare sector is owned and funded by government, and mostly used by a numerous number of the population that cannot afford to pay for their medical expenses, due to the high rate of poverty and unemployment in the world (SAI, 2000)

[6]Private healthcare sector is owned by private healthcare groups and provides costly services to individuals who are able to pay for their hefty hospital bills (*ibid*)

[7]A variety of therapeutic occupations include physiotherapists, psychological therapists, chemotherapists, occupational therapists and psychiatrists, among others (Network Therapy.com, 2010).

saying thus, that a link, coherence and dialogue between the components of the public healthcare information systems, viz., the goals, actors, tools, rules, activities, procedures and outcomes become a vibrant part of the public healthcare structure across all its levels.

2.3.2   Role Players (Actors) in the Delivery of the Healthcare Services

Individual role players, such as the medical doctors and nurses, as well as the institutional management and the clerical personnel within these institutions, carry out various tasks to oversee direct delivery of healthcare services to the members of the public. Medical doctors carry out activities such as diagnosing patients, prescribing medication, recording patients' visits, and offering medical advice (*ibid*). Similarly, information systems operators are expected to handle patients' enquiries, maintain and order stock for the wards, and file patients' medical folders (Provincial Government Western Cape, 2010). The clerks are the first point of contact with patients when they visit healthcare institutions. They gather demographic details; establish initial information on health needs of the patient, which will in turn be passed on to the nurses and the doctors.

It has been argued and clearly demonstrated in preceding sections that healthcare is, and has been a significant part of human existence since antiquity. Just as money is said to "make the world go round" in the competitive world of commerce (Mlitwa & Kachala, 2008) however, information[8] is equally central to all aspects of healthcare and the success of its service delivery. For the traditional healers and doctors to be able to diagnose and treat patients they need reliable information. They need the identity of the patient (demographic data), the nature and the root cause of the illness (diagnostic data), as well as information on how a patient can be assisted (treatment/prognostic data) (Pretorius, 2001). Both in ancient and in the modern healthcare practices for example, practitioners have always needed to know the identity and all basic information about the patient, hence the need for the accurate collection, storage and the reproduction of these demographic details.

In closing, the ancient information handling processes were informal and not reliable. For example, information was exchanged through word of mouth, memorized, and shared by telling it to the next generations (Mencák, 2009). Reliance on word of mouth however, is circumstantial, with information transmission dependant on continued existence of the expert. The reality in ancient healthcare systems however, is that valuable knowledge has been lost as experts could not record it so that it could be used by generations to come. Further, without reliable tools, methods and procedures, there were no guarantees that the practitioners would fully remember their patients' names, diagnosis and medical history. This could have negative implications on the quality of diagnosis and prognosis, with fatal consequences for some of the patients (Museum of

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[8]As used in this study, information refers to the meaningful chunks of data (Leidner et al, 2007) about the patients' demographic details, medical history, the current diagnosis and all the prognostic measures.

America Heritage, 2002). With the population having multiplied together with the number and magnitude of diseases and pandemics in recent history, the damage done by poor information handling processes has the potential to be even greater than in the past. Hence, information handling tools and procedures have become a priority in the development of modern healthcare systems and procedures.

2.4 The Paper- based Healthcare Information System

The paper-based innovation caters for most of the clay tablets limitations. Firstly, modification becomes possible as information can easily be added on to the patient records (Mikkelsen & Aasly, 2001). For example clinicians are able to add more information when the patient revisits the healthcare institution and then keep them in one file. Secondly, sharing of information is also simplified (Van Dyk, 2002) as the files are light in weight and easy to carry compared to the clay tablets. Further, the files can be loaned to different departments within the hospital or to external institutions. Finally, because of the size and portability the paper files are locked securely in medical records storage rooms located within the healthcare institutions, to ensure that the patient records are kept safe (National Archives and Records Services, 2003). In the medical records storage rooms, patient files are secured and organized properly in an alphabetic or numerical order which allows easy retrieval and usage by the users (*ibid*). However, the paper based system also has its challenges and limitations.

2.4.1   Challenges and Limitations of the Paper-based Healthcare Information Systems

The main security challenge with the paper-based system is that the papers can easily be destroyed by water and or fire (Sanbar, 2007). The file can also be lost or stolen easily. Although records storage rooms are locked, there are not many access restrictions in some other areas. For example the locks in the medical records storage rooms have to be changed regularly to ensure security (*ibid*). The failure to make changes for security purposes may result in unauthorized people being able to access the patients' file, change, steal or destroy the patient data and bypass access controls (Beimel et al, 2007). The destruction of any parts of patient files causes a loss of data integrity, as the correctness, accessibility and validity (Barquin, 2007) is no longer guaranteed after files have been missing. Losing patient files also causes considerable problems for the organization. For example the case of Middelburg hospital in Mpumalanga, South Africa, it was reported that the missing patient data caused huge problems for the nurses and doctors (Nkombua, 2008). The inconveniencing of healthcare personnel affects and delays the delivery of good quality and reliable healthcare services (Wachter, 2009).

There are many other cases related to the Middelburg one, where patient files were lost after they were moved from, or loaned and not returned to, the medical records storage rooms. This loss of patient data then forces the creation of a new patient file to replace the lost one, which puts at risk the accuracy of information, as the new data will not necessarily be the same as those in the old

file (Cline & Luiz, 2013). The information that was compiled for years in the old patient file is a huge asset to the organization, losing it incurs a high cost of time and money to the institutions (Drennan, 2008) as the processes have to be repeated when creating a new folder and the loss also affects the quality of data and subsequently, the service delivery.

In most instances the files are not really lost but are just misplaced by the users, as some are later found in personnel offices (Mchunu & Mlitwa, 2010). By the time these files are found or returned, a replacement file has often already been created and therefore duplicates exist (*ibid*). Duplicated information is considered to be poor and unreliable (Cline & Luiz, 2013), and data with duplicates is a problem for many organizations and systems (Moore, 2007). There are other limitations and disadvantages of the paper based system: one is that the patient files are fixed at one point in the medical records room, so the data in the file cannot be easily shared by many users (JobQnA, 2008). Another limitation occurs if the clinicians' hand writing is not clear, and some users struggle to read it (*ibid*).

There are many arguments that support the idea that the computer-based system provides better service when compared with the paper-based system.

2.5 The Computer-based Healthcare Information System

In response to the limitations of the paper-based system, computerized innovations were designed in the information systems sector, and adopted by the healthcare sector to improve the quality of their processes (Mbananga et al, 2002). Examples of these innovations include the open Electronic Health Record (openEHR), the Pharmacy Information systems (PIS), the Radiology Information system (RIS) and the Hospital Information System (HIS). The openEHR is the application that structures, stores and manages patient data. It also allows the sharing of data amongst healthcare providers (Pishev, 2006). Secondly, the PIS is the computer based system that was designed to accommodate for the needs of the pharmacy personnel such as medication dispensing (Biohealthmatics, 2006). Thirdly, the RIS was designed to manage administrative and operational functions in the radiology department (MedicExchange, 2009), and finally, the HIS was designed to improve patient care, ensuring easy access to and management of patient information (Mbananga et al, 2002).

2.5.1   Advantages of the Computer-based Healthcare Information System

These applications allow easy sharing, availability and management of information over different networks. Among other systems that were implemented the hospital information systems (HIS) was introduced to the South African healthcare sector and is still being implemented in other institutions whilst others are still using the paper-based system (*ibid*). This information system was designed so that information can be accurate, effective, secured and shared amongst all the institutions and improve the quality of service delivery. Accuracy of information involves certain

steps that need to be followed such as acquisition (collection of raw data), input (typing the acquired data into the information system), proper storage, retrieval, sharing and management (Kelly, 2007).

The modern computerized system accommodates features which make it fit in properly with the current changing world of technology. While the system allows sharing of information across networks, the developers and system administrators cannot ignore the fact that patients' information carries sensitive data which must be highly protected at all times (Buse, Mays &Walt, 2012) and must remain confidential information. The implementation of the computerized information system introduced certain security control features to ensure that patients' information is protected. For example access to the information and systems by the users is controlled and rights are granted according to tasks that the users will perform; this access control feature is emphasized by the International Organisation for Standardisation (ISO), ISO 17799:2005. In the healthcare industry it is vital that information is accurate, efficient and secure. More especially in the public healthcare sector as it serves a large proportion of the population and deals with the most sensitive personal issues. There should be no room for errors as they can result in major inconveniences and costs to the organization. For example an incorrect name and allergy on a patient's file can result in patients being given incorrect medication, which in turn may lead to the death of patients (Mchunu & Mlitwa, 2010).

2.5.2 Challenges encountered by the Computer-based Healthcare Information System

Despite the advantages provided by the computer based system, modern healthcare information systems are still far from perfect, with a number of security, efficiency and accuracy limitations being experienced by users every day.

2.5.2.1 Security limitations

Security should ensure that patient data is protected. Unauthorized access to the system threatens the efficiency (Hau, 2003) and privacy of patient data. The problem in this case is that unauthorized users continue to gain access to patient records in most healthcare institutions (Mullins, 2009). For example in April 2010 thousands of patient files of Frere Hospital were found freely available on the internet (Stone, 2010). These files contained sensitive patient information such as names, telephone numbers and home addresses (*ibid*). Worse still, is that the problem is reported to be growing. According to the RSA (May, 2010) report for example, the percentage of exposure for healthcare data has increased by a drastic 4%, from 3% in 2008 to 7% in 2009. This high rate clearly shows how patient data is at risk.

These security limitations are threatening the integrity of the healthcare system, in a number of ways. The major threat is that unauthorized users may make unnecessary alterations such as deletion, modification, or corruption of patient data and information. In fact, cybercriminals are

reported to be stealing data and using it to fill "false patient claims to insurers and government agencies that provide health services" (RSA, May 2010: 2).

2.5.2.2 Information and data corruption

Dirty data is any data that has spelling errors, is incomplete, out-dated or has duplicates. It reduces the quality of data and causes a negative impact on the organization (Moore, 2007). Dirty data affects most organizations, and the healthcare sector is no exception (*ibid*). Data errors on patient records have been an on-going problem in both the paper-based and the electronic healthcare information systems (Mullins, 2009). For example some patients in public hospitals and clinics find themselves with more than one patient record or with their personal details spelled incorrectly (Just Associates, 2005).

The duplication of data may seem to be a small problem that is not worth much attention to some organizations, yet it has a great impact on the efficiency of the systems. It can disrupt processes as work cannot be done properly with inaccurate data (Power, 2009). Data corruption therefore, weakens the operations and threatens the existence of the organization (*ibid*), with a potential to cripple an already overburdened public healthcare system. As discussed above, the paper-based and computer-based healthcare information systems are not the only systems used in the healthcare sector. There are other systems used in the public healthcare sector, which are discussed in the section below.

2.6 Other Information Systems Used in the Public Healthcare Sector

There are other main systems that are used in the public healthcare sector. These systems are used in the finance, pharmacies, radiology, supply chain and assets departments.

2.6.1   Billing System

This is designed for the public healthcare sector to bill patients according to their income (Klein, 2013). Since the public healthcare sector serves a large population that is unemployed, this system is able to cater for the free healthcare service for those that cannot afford their medical bills. The billing system is used in the fees departments for debtor account inquiries, debt follow up, it's also integrated into the patient administration system (Clinicom) (*ibid*). This integration improves the processing of debt collection for the fees clerks, as the patient demographic data is accessed easily. This system is helping the DOH Western Cape to know how much money is outstanding and also recover these debts form the patients (Klein, 2013).

2.6.2   JAC Pharmacy System

This is a system used to manage and maintain pharmacy stocks and services, since 1999 the DoH Western Cape moved away from a paper-based pharmacy system and started implementing this electronic system (JAC, 2012). Currently it has been implemented in 22 healthcare institutions in the Western Cape Province. This system is partly integrated to the patient administration system (Clinicom). The integration is helping all these healthcare sites to be able to centrally share data; patients now have faster access to their medicines as they can go to any nearest hospital for their medication (*ibid*). This also helps reduce long queue of patients waiting for their medication. The pharmacists have an easier access to drug information, which also improve the clinical management of patients in all sites (JAC, 2012). It is not only in the pharmacies where the healthcare has introduced the electronic systems. The radiology department also has an electronic system called Picture Archiving and Communication System which is discussed in detail below.

2.6.3   Picture Archiving and Communication System (PACS)

It is a system used to capture and store patient's medical images such as CT scan, ultrasounds, x-rays etc. (Guma, 2013). Previously in the public healthcare sector the x-rays were printed and presented in a paper-based (film) form, however this became a challenge as information on paper cannot be shared by multiple users and the costs of maintaining this system were high. These limitations raised a need to move into this electronic system; therefore the public healthcare sector implemented this system which is used by clinicians and radiologists. PACS offers benefits of x-rays being centralised and can be shared by multiple users at the same time in different locations (Carestream, 2013). Waiting periods for x-rays has been improved as patients and clinicians are able to get results immediately which subsequently enhance the diagnosis and treatment process (Guma, 2013). PACS is predominantly used by radiologists and clinicians, PACS work hand in hand with the Radiology Information System which is discussed below.

2.6.4   Radiology Information System (RIS)

Radiology Information System is the system where all patient's radiology appointments and attendance and orders are captured and stored (Carestream, 2013). Patients arrive with request forms in the Radiology department and their requests are captured in the system. This makes it easier to trace the patients' radiology history, how long the radiology exam took, who performed the exam and why the exam was requested (Guma, 2013). RIS is also used by radiologists and clinicians, but also radiographers (*ibid*). Management can also be able to draw report from RIS and measure the efficiency of their radiology departments (Guma, 2013)

2.6.5 Materials Management System (MMS)

It is an asset management system used to manage supply chain processes, and standardise the procurement of goods in the public healthcare sector (Publico Communications, 2012). Currently it's been used by the academic hospitals (Groote Schuur, Red Cross and Tygerberg hospitals) in the Western Cape province, South Africa. All the internal and external requisition of stock from the stores is done in this system, which provides enough security and accountability for the stock supplied (Daniels, 2013). MMS helps with monitoring and issuing of stock to cost centres, the visibility, tracking, acquisition, maintenance and retirement of assets (*ibid*). The use of this system is helping the public healthcare sector to improve the turnaround time for requisitions, and reduce the shrinkage as assets are now accounted for (Daniels, 2013).

The other systems used in the public healthcare sector, for patient information management system (Clinicom and Primary Healthcare Information System) and the reports system (Cognos Report Viewer) are discussed in the later chapters of this study.

2.7 Conclusion to Chapter Two

The focus in this chapter is mainly on data quality, as it is the area of investigation of this study. The chapter starts by outlining data quality dimensions and identifies those that this study will focus on while investigating the public healthcare sector in the Western Cape, South Africa. Due to the type of data that the healthcare sector handles and the purpose of this study, the following dimensions were chosen: data accuracy, duplication, and integrity. Further, this chapter explains how the healthcare structures work together with the same goal of improving the lives of people from global, national and provincial structures. It also identifies the main stakeholders and how they carry out their daily tasks to try and achieve the healthcare goal, which is to provide quality services to the patients. This chapter looks at the healthcare systems used in the public healthcare sector both paper-based and computer information systems. Further this chapter elaborates on the advantages and disadvantages of these systems, with an aim to address the challenges that arise with the use of these systems. A research methodology is presented in the next chapter.

CHAPTER THREE - RESEARCH METHODOLOGY

3.1 Introduction – Information Systems

An information system (IS) is an applied field of practice and an academic discipline with roots in the computer sciences, management and social sciences such as psychology and sociology (Baskerville & Myers, 2002). As an applied field, it draws on the research methods of traditional computer science, and natural science to prioritise the practical development of systems, software and database development, as we well as the analysis of data and systems (Avison & Elliot, 2005). Hence, there is a reductionist tendency to see IS merely as a technical field that can be constrained only into technical (rather than socio technical) practices. A common mistake with this narrow approach is that it focuses on the technical development of artefacts only from the positivist research tradition, neglecting the social and interpretive aspects of IS (Vessey et al, 2002).

The multi-disciplinary approach on the other hand, builds on a specific type of IS research problem and objective of investigation to determine the approach and method of investigation (Avison & Elliot, 2005). For example, it would make sense for a purely practical IS artefact development project to draw on the positivist research associated with computer science and other natural sciences (Mlitwa & Van Belle, 2010). However an IS research problem with both technical and social aspects may require the use of a combination of natural science and social science methods (Mlitwa, 2011). Finally, there may also be instances where a certain IS research problem is purely explanatory, which in turn, would call for an interpretive or critical research approach (*ibid*). The section below further discusses the paradigms in research.

3.2   Research Philosophies and Paradigms

There are at least three levels of conducting research, which are the philosophical, social and technical levels (Williams, 1998). The philosophical level encompasses the axiological, ontological, and epistemological assumptions:

3.2.1   Axiology

It originated from a Greek word axia which means value, or worth (Heron, 1996). The studies in this philosophy focus on judgements about values (Given, 2008). Axiology looks at how different people determine the value of different things (*ibid*). It also examines the nature of value as well as different types of value such as ethics, moral, religion and aesthetic (Given, 2008). Values influence people's behaviour. Though this study was not values based, the element of ethics (which is a segment of axiology) is always relevant whenever one deals with human subjects. Whilst this philosophy falls outside the scope of this study, and therefore not adopted in its entirety, there were certain areas where the researcher asked some value-infused axiological

questions. As it emerges in the findings section, the answers of these questions were based on the participants' views, preferences and judgements on the context of healthcare information handling processes in public hospital and clinics. The section below discusses the philosophy of existence (ontology).

3.2.2 Ontology

It is the philosophy that focuses on the nature of reality or existence (Welty, 2003). The main goal of this philosophy in IS and computer science is to clarify meanings, to provide understanding of what is (existence), and ultimately to help eliminate confusion (*ibid*). The main types of ontology, for example the realist (realism) and nominalism revolve around the existence of the objective versus non-existence and the subjective accounts of reality (Searle, 1996). The realist account assumes the existence of the objective reality, independently of human mind or consciousness (Sider, 2009), which is aligned with the positivist epistemological paradigm of knowing about reality. At the opposing extreme, nominalist accounts dispute the existence of reality outside human consciousness. Arguments in this ontological perspective are that humans create structures of reality by naming, labelling or defining concepts (Welty, 2003). This is known as the social construction of reality, which holds that reality is subjectively created and exists within human consciousness - not independent of it (Glasersfeld, 1995). This view is aligned with the interpretivist epistemological paradigm of knowing about reality. Since the main objective of this study was to understand and explain the causes of the existing challenges, this philosophy of existence was therefore adopted as a background supplement to the intepretivist epistemology followed in this work. The philosophy of knowledge (epistemology) is discussed in detail in section 3.1.3.

3.2.3 Epistemology

The name of this philosophy originates from a Greek word epistêmê, meaning knowledge (Trochim, 2000). It is referred to as a theory of knowledge as it deals with what is known, the nature of knowledge and the construction of knowledge (Audi, 1998). There are two ways of acquiring the knowledge in this philosophy namely: empiricist and rationalist assumptions. Empiricism assumes the objective way of getting to know, which is through first-hand experience (Van Fraassen, 2002). This logic is commensurate with natural sciences, and is in line with the realist ontology of the objective reality associated with natural sciences and quantitative research methods (Mäki, 2008). Rationalism assumes the subjective (or rather, inter-subjective) way of acquiring knowledge. The belief is that knowledge is obtained through a detailed encounter with the subject or object of study, with full recognition and interpretation of the underlying context (*ibid*). It is made clear in this study that the public healthcare sector has multiple challenges that are linked to structural, systemic, managerial, technical and social contexts. By the very multifaceted nature of these challenges therefore, understanding and interpreting the context was

crucial, hence the relevance of the interpretivist philosophy in the study. Therefore this philosophy was used to investigate, interpret and explain contextual knowledge of the challenges in the public healthcare sector.

The main focus in research philosophies is on understanding the reality (ontology) and knowledge (epistemology) of nature. This is what researchers across disciplines and topics always investigate in their studies, based on the suitability of a philosophy and alignment with the nature and purpose of the study. To this effect, the nominalist ontology assumes the existence of the subjective reality inside and outside human consciousness. Epistemologically, rationalism assumes that knowledge is embedded in both the subject, the phenomenon and the context, hence knowledge is said to be inter-subjective, and can also be socially constructed (Van Fraassen, 2002). In line with these philosophical assumptions, this study focuses on healthcare information systems which are socially constructed, and largely determined by national policies and healthcare institutions which are suitable philosophical basis of this study.

At the social level of conducting research there are different types of paradigms that help guide researchers on how to do their investigations. A research paradigm is described as a framework within which theories are built (Henning, van Rensberg, & Smit, 2004). Paradigms also guide researchers to view and thoroughly analyse the areas of their research (Burke, 2007). These research paradigms are positivism, interpretivism, and critical theory. The three paradigms, as well as the choice of an appropriate and relevant approach for this study – are motivated for in the sections that follow.

3.2.4 The Positivist Paradigm

The positivist paradigm is based on the realist and empiricist philosophical presuppositions of reality and the way of knowing. It assumes there to be an objective reality that is independent of human consciousness (Babbie, 2007), based on the notion that knowledge can be discovered only through the supposedly 'objective', empirical and functional methods that separate the subject from the object and context (*ibid*). The positivist paradigm is mostly aligned with natural sciences and related quantitative methods such as experiments, surveys and statistical analysis (Voce, 2004). The positivist paradigm often makes deductions from theories in order to formulate and test hypotheses and to predict the patterns of human activities, ignoring the consequences of their cultural circumstances (Burke, 2007). Within this tradition, the researcher cannot be part of the study or what is being investigated (Healy & Perry, 2000), and according to this paradigm natural science is the only way to find meaning or the truth (Krauss, 2005).

The positivist paradigm is suitable for studies of natural objects that can easily be viewed separately from their context and subjective interpretations. It is suitable for studies with direct measurements in statistics or mathematics, or methods in hard sciences such as physics,

geology or chemistry (Jenkin, 2009). The limitation with this approach is that it does not cater for the understanding of context-based phenomena and inter-subject interpretations of the socially constructed aspects of knowledge associated with the humanities and socio-technical studies. Since this study is socio-technical in nature, in that it focuses on the socially-constructed healthcare information systems that are largely determined by national policy and healthcare institutions, the positivist paradigm was not suitable as a philosophical approach for this study. Alternative paradigms are explored in sections that follow.

3.2.5   The Critical Theory Paradigm

This paradigm is an output of theorists within the Frankfurt School of social theory (Geuss, 1981). In this paradigm, the researcher seeks to understand the conflicts caused by cultural, social, political and economic factors (Clarke, 2000). This paradigm challenges both the objective and subjective reality; however it supports the concept of subjective reality as it acknowledges that the existence of reality is influenced by cultural, economic, and social factors (Myers, 2009). Since the 1970's, it has been widely used across disciplines such as film and media, humanities and social sciences, to critique repressive power-relational phenomena (*ibid*).

The goal in this paradigm is to transform society and bring about change in situations by clearing away all the myths and coming out with reality (Burke, 2007). As a research method it uses a qualitative research methodology, which focuses on peoples' perspectives, educational work and action research (Babbie & Mouton, 2001). Whilst this paradigm focuses on bringing about change in society, it is limited to the goal of society transformation, a focus which, according to the cynics, tends to support political agendas (Clarke, 2000). The critical perspective is indeed important in challenging unjust power relations. Whilst a critical analysis of phenomena is also crucial in this study, the objective is to do more than just challenge the status quo. The main objective of this thesis is to understand the causes of data corruption to the current healthcare information systems. Using this paradigm alone therefore would be useful, but inadequate for this purpose. Whilst this thesis does borrow from this paradigm, a contextual and a more interpretive approach is sought.

3.2.6   The Interpretivist Paradigm

The interpretivist is an epistemological paradigm used to view phenomena within their contexts (Burke, 2007). It helps to understand people, how things are happening and what can happen in the future *(ibid)*. The interpretivist paradigm assumes that reality is constructed inter-subjectively (Angen, 2000), which means that it cannot be separated from its context.

This paradigm seeks to understand phenomena from the subjective interpretations of the investigations and of the researcher, mostly by observing society's behaviour in a specific environment (Voce, 2004). The interpretivist approach depends on observations, interviews, and

analysis of existing literature to get a meaningful reality (Myers, 2009) which makes it subjective and contextually based. A research methodology that can be used in this paradigm is the qualitative methodology as it focuses on analysing social behaviours, by the collection, analysis, and interpretation of text (Murtonen, 2005). Since this study involves observing peoples' behaviours towards the hospital information system, with the objective to understand the causes of data corruption to the current healthcare information systems, this approach is considered more appropriate than any other.

Research may be conducted for various purposes, which are either to explore (exploratory research), to describe (descriptive research) or to explain (explanatory) phenomena.

3.3 Research Purposes

3.3.1 Exploratory Research

There are three purposes of conducting exploratory research, namely: to satisfy curiosity, to test the feasibility of conducting a study, and to develop methods to be used in any future study (Babbie, 2010). The goal of exploratory research is to uncover basic information where there is limited insight about the subject; often when the subject of interest is new and where very little is known about it (Babbie, 2007).

Since the trends and concepts in the public healthcare sector are well established, the purpose of this research would be better served by descriptions (descriptive research) and explanations about existing trends in the sector.

3.3.2 Descriptive Research

In descriptive research the researcher seeks to describe the phenomena; this is done by recording observations (Babbie, 2010). Descriptive research focuses on the "What" question, and caters for other questions such as where, when and how. A clear definition of variables studied is also prioritized under this method (Creswell, 2009).

This study adopts the descriptive method since its main question is "what are the factors affecting the adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa?"

Since the understanding of the status quo in the sector forms a significant part of this research, it clearly fits the descriptive label.

However, in order to improve the insight associated with these descriptions, and ultimately to make informed recommendations, there is also a need for explanations, hence an explanatory method is also used.

3.3.3 Explanatory Research

An explanatory study seeks to explain relationships between variables (Creswell, 2009). It investigates subjects that already exist and works on clearly defining the subject for better understanding of relationships between variables (Babbie, 2010). Explanatory research answers the "Why" question, explaining things by establishing the casual relationships (*ibid*). A causal relationship exists between two variables where it is believed that a change in variable A can affect variable B (Welman et al, 2007).

The explanatory format is suitable for this study, since although the main question is a "What" question, the study also seeks explanations in order to understand "why" there is data corruption in the healthcare sector.

Whilst descriptions of the status of information handling processes in the public healthcare sector are a significant basis of this research, the main objective is to understand and explain the causes of the present situation, so as to inform recommendations. In addition to descriptive questions therefore, major emphases are placed on understanding the causes of data corruption, the reasons why it happens, and ultimately, on possible solutions.

3.4 Research Methodology

Research methodology is a scientific system used to guide research studies; the focus here is on the procedures used to obtain research findings (Babbie & Mouton, 2001). The research procedures/methodologies are supported by methods and techniques, the research methods are the scientific techniques used to collect and evaluate data (*ibid*). There are three types of research methodologies namely: qualitative, quantitative and mixed methods (Williams, 2007). However, the quantitative and qualitative are the most frequently used methodologies (*ibid*). The quantitative methodology focuses on natural sciences studies and the use of measurements in numbers and statistics, while in the qualitative methodology the goal is to describe and understand phenomena within their context (Babbie & Mouton, 2001).

The section below discussed the quantitative and qualitative methodologies in detail.

3.4.1   Quantitative Research Methodology

The history of the quantitative research methodology can be traced back to the early 19th century, where it was strictly associated with hard-core natural science disciplines (Creswell, 2009). The focus on this methodology is on the objective reality as advocated by the positivist paradigm (Myers, 2009). It is mostly known for its use of statistical analysis; the researchers here make use of figures i.e. numbers, percentages, and experiments (*ibid*).

The substance of the quantitative research is on variables that are being studied and the results are not described but they are measured (Williams, 2007). This methodology is more appropriate when the researcher is working with quantitative data i.e. statistics and figures – which is not the case in this study. The aim of this study is to find descriptive and explanatory accounts of information handling processes in the public healthcare sector. This requires a descriptions and explanations of the phenomena under investigation, which can be best achieved through qualitative methodological techniques.

3.4.2   Qualitative Research Methodology

Since quantitative techniques are not designed to cater for in depth descriptions of qualitative data, they cannot adequately support context-based social and socio-technical studies (Hancock, 1998). In the light of these quantitative methodological limitations, qualitative research methods have been developed for social science disciplines such as sociology, psychology etcetera, to facilitate the understanding of phenomena within their social or cultural contexts (Myers, 2009).

Whilst quantitative methodologies are based on the principle of separating the subject from the object (objective reality) and of the researcher from the subject, qualitative methods focus on the context-based reality that is subject to contextual interpretations (*ibid*). The goal of a qualitative study is to understand and describe the phenomena being investigated (Hancock, 1998). Further,

the researcher is part of the investigation; which helps the researcher to get more insight into the phenomena being investigated (Williams, 2007).

3.5 Sampling Techniques

Sampling is the technique of selecting a small and workable representative number of a larger research population (Neuman, 2011), so as to enable generalisations about the phenomenon of investigation (Trochim, 2006a). Sampling has two types, namely the probability and non-probability methods. The sections below elaborate on both methods.

3.5.1 Probability Sampling

Probability sampling is based on a random selection of a representative sum of research subjects from a larger research population (Neuman, 2011). Implications under this technique are that the quantity and the exact location of all the elements of a research population are identifiable and reachable by the researcher (ibid). Probability sampling is regarded as a non-bias sampling method as the researcher has no influence in the sample selection process (*ibid*).The random selection process aims to ensure that the elements of a research population have equal chances of being selected into the sample (McIntosh, 2008). This sampling method is appropriate when dealing with numerical data such as ratios, statistics, etc. Hence, it is often aligned with quantitative research methodology (Babbie, 2010). Types of probability sampling are: systematic, stratified, simple random and cluster samples. Since the probability sampling is aligned with the quantitative methodology, this relationship makes it inappropriate to use it in this study, since this is a qualitative study. Therefore the sampling used here is not probability but non-probability.

3.5.2 Non-probability Sampling

In probability sampling the representatives of the randomly selected sample are reachable and known, whereas in non-probabilty sampling the exact location of all the elements of the population is not always known (Trochim, 2006a). Instead, the elements of a population are not necessarily finite, and often too widely dispersed for each to have the same chance of being equally chosen for a research sample. Thus, only non-probability sampling techniques are practical under the circumstances of this study. Non-probability sampling techniques include accidental or convenience, quota, self-selection, snowball, and purposive sampling:

3.5.2.1   Accidental / Haphazard or Convenience

This method is also referred to as the 'man on the street' method (Trochim, 2006a). Since all elements in the population are involved and are chosen based on the convenience, the interviewer just selects any representative of the sample in trying to get general views on a specific subject being studied (Neuman, 2011). This method is mainly used by researchers when

they are running out of time, and they want to get the population samples quickly (ibid). Since the plan of this study was to persuade all stakeholders to be part of the sample, it was not appropriate to use this method.

3.5.2.2   Quota Sampling

In quota sampling the researcher chooses categories of the population and identifies the number to be used (Babbie, 2010); this decision is influenced by the specific quota that the researcher puts in place (ibid). Samples must meet specific characteristics that are outlined based on the investigation being done in that study (Neuman, 2011). The disadvantage with this sampling method is that it is biased, as the researcher is able to choose whom s/he wants to use for interview. There were no ratios developed or used when selecting samples for this study, this fact therefore made quota sampling unsuitable.

3.5.2.3   Self-selection

The self-selection sampling is a method where the participants volunteer (if they want) to participate in the sample (Babbie & Mouton, 2001). This method can be used to reach a larger population as the researcher can advertise and interview candidates that responded to the advertisement (Neuman, 2011). The sample candidates share information freely at their own discretion (ibid). This method works best when the information shared belongs to individuals, however in this study the information is more institutional, and controlled, therefore self-selection sampling is not an appropriate method.

3.5.2.4   Snowball

This is a network linked sampling method (Babbie, 2010), as the researcher must find the candidates that meet the research criteria and those candidates can recommend others who meet those characteristics (ibid). Snowball sampling is mostly used in a population that is difficult to access (Neuman, 2011). This study does not depend on personal information and it is not possible for the participants in this study to know all their colleagues in other institutions. It is therefore not appropriate to use this method.

3.5.2.5   Purposive

This method is purpose driven, and is also referred to as judgmental. The interviewer must always have a plan of what they want beforehand (Neuman, 2011). In this method the selection of participants is based on the subjective assumption and the goal of the study (Babbie & Mouton, 2001). The purposive sampling method is the most appropriate one to use for this study, as the samples are chosen based on achieving the goal of this study. Data in Table 2 outlines the purposive sampling method used in this study, which reflects the questions, data sources, tools,

units of observation and number of participants. The sampling process in this project is outlined in Table 2 in the next page. The application of this sampling process is reflected in more detail in chapter 4.

Table 2: Sampling Table

Question/Variable	Data sources	Tools	Unit of Observation	Number of participants	
Goals & objectives, current guidelines, procedures, best practices, other background information	• Literature • Internet	• Reading & analysis	• Books • Journals • Policy & strategy documents		
Adequacy of the paper-based and electronic information system processes to enable **data accuracy**	• Public Hospitals • Public Clinics System	• Interviews • Indirect observation of paper & electronic processes	• Clerk (2 per hospital) x 2 institutions • Nurse (1 per institution) x 1 • System administrator (1 per institution) x 3		
Adequacy of the paper-based and electronic information system tools to enable data accuracy	• Public Hospitals • Public Clinics System	• Interviews • Indirect observation of paper & electronic processes	• Clerk (2 per hospital) x 2 institutions • Nurse (1 per institution) x 1 • System administrator (1 per institution) x 3		
Adequacy of the paper-based and electronic information system processes to enable **data confidentiality**	• Public Hospitals • Public Clinics System	• Interviews • Indirect observation of paper & electronic processes	• Clerk (2 per hospital) x 2 institutions • Nurse (1 per institution) x 1 • System administrator (1 per institution) x 3	4 Clerks 1 Nurses 2 System administrators (public hospitals' systems) 1 Central manager (public clinics' system)	Tygerberg Hospital; Victoria Hospital
Adequacy of the paper-based and electronic information system tools to enable data confidentiality	• Public Hospitals • Public Clinics System	• Interviews • Indirect observation of paper & electronic processes	• Clerk (2 per hospital) x 2 institutions • Nurse (1 per institution) x 1 • System administrator (1 per institution) x 3		
The **competency** of paper-based and electronic information system tools to enable quality access, storage and sharing of data tools (**tool efficiency**)	• Public Hospitals • Public Clinics System	• Interviews • Indirect observation of paper & electronic processes	• Clerk (2 per hospital) x 2 institutions • Nurse (1 per institution) x 1 • System administrator (1 per institution) x 3		
Adequacy of the paper-based and electronic information system processes to enable **data integrity**	• Public Hospitals • Public Clinics System	• Interviews • Indirect observation of paper & electronic processes	• Clerk (2 per hospital) x 2 institutions • Nurse (1 per institution) x 1 • System administrator (1 per institution) x 3		
Adequacy of the paper-based and electronic information system tools to enable data integrity	• Public Hospitals • Public Clinics System	• Interviews • Indirect observation of paper & electronic processes	• Clerk (2 per hospital) x 2 institutions • Nurse (1 per institution) x 1 • System administrator (1 per institution) x 3		

In order to obtain information regarding goals and objectives, current guidelines, procedures and other background information, the researcher used the internet and the existing literature concerning data quality in the public healthcare sector. The interviews and observations in the public hospitals and an interview with the system administrator of the public clinics system contributed towards the findings on data accuracy, data confidentiality, and data. These institutions, where the observations and interviews were done were selected according to their years of experience in using the electronic hospital information system, their geographical location and the number of the population they serve. One hospital is a district hospital, meaning it is a small and has limited services and the other one is an academic hospital which is large and offers all services that a patient requires in a medical facility. Both hospitals have been using the electronic hospital information system for more than 5 years. However the data handling structure is not the same in both these institutions, (the regional and academic hospitals).

The main objective of this study is to comprehensively understand the causes of data corruption in the current public healthcare information systems, within local contexts, hence a need for qualitative techniques. Data collection techniques used in this study are outlined in the section below

3.6   Data Collection

Data collection is a logical strategy used to collect information from one or many sources (Patton, 2002); this involves the art of listening, asking accurate questions and the recording of information (*ibid*). These techniques help researchers to get all the valuable information from different valued sources. The data collection methods used in the qualitative methodology includes focus groups, literature study, observations and interviews (Neuman, 2011).

3.6.1   Focus Group Discussion

When using focus group discussions, the researcher assembles a group of participants to discuss the topic of interest (Babbie, 2010). This method is mainly used for political and market research, it is important that the participants feel comfortable in the environment where the meeting is held so that they are able to share (the) information freely (*ibid*). The challenge of assembling the group for discussions and the complexity of managing a group, are the main disadvantages of this method (Leedy & Ormrod, 2001). Another disadvantage is not being able to control the interviews as it can be difficult for the interviewer to manage a discussion group (*ibid*). Using the focus group discussion method in this study was not necessary as all the required data was available through the normal interview methods. As this study seeks to understand data corruption in the public healthcare sector in an interpretivist manner, this can be done using other

data collection methods, such as a literature study which is discussed further in the section below.

3.6.2   Literature Study

A literature study is the process of finding, collecting, and reading some relevant background for the study, it involves reviewing books, documents, journals etcetera; these sources are considered to be rich sources of information (Zakaria, 2004). The literature study helps to understand the background and history of that specific area of interest being investigated, as it is likely to have been studied before. As history is mostly found in documents, literature studying is regarded as the main source of data collection since most important information is found in written documents (Marrelli, 2005). A literature study also assists researchers to compare their opinions and findings with those of others, as well as to understand those topics that have been investigated in that discipline, and to look at the possibilities for future research (*ibid*). In researching the background of this thesis this method was used mostly as it involved reading of policies, journals, books etcetera in finding detailed information on the current status of the quality of health data.

3.6.3   Observation

Observation is a systematic method of selecting a sample and closely monitoring all the processes and movements associated with that sample (Patton, 2002). This method requires the observer to be trained and prepared before going to the site (*ibid*), so that the observer does not miss collecting any valuable information. In the observation method the researcher is part of the population, which gives him/her the opportunity to gain first-hand information (Neuman, 2011). For this study, the observations were done in two public healthcare institutions (Tygerberg and Victoria hospitals). The researcher observed the information handling processes within these institutions, and later recorded the findings, so that the act of making the observations would not interfere with operations of the healthcare institutions.

3.6.4   Interview

In this method the researcher must have a structure or plan, of who is going to be interviewed, how the interview is going to be conducted and must ensure that all the questions are based on the study (Leedy & Ormrod, 2001). The main goal of conducting interviews is to understand and find the meaning of what the interview candidates are experiencing (Patton, 2002). There are many types of interviews namely: informal, online, open-ended, fixed response, telephone etcetera (Neuman, 2011). Another way of conducting interviews is to provide the participants with questionnaires listing all the questions the interviewer wants the participant to answers (*ibid*).

Interviews are a rich source of information, as not only does the researcher get the answers to the questions, but they are also able to observe the participants and the environment during the interview sessions (Babbie, 2011). In this method the researcher is able to obtain all the information they want if they can ask the appropriate questions (Patton, 2002). Along with other data collection methods, this method was used in this study where interviews were conducted with stakeholders who are primarily involved in the maintenance and/or the monitoring of data quality namely: the clerks, medical doctors, nurses and systems administrators.

3.7   Data Analysis

Data analysis is the process of transforming raw data which has been collected though documents, interviews and observation etcetera into meaningful data (Neuman, 2011). This data analysis process starts after the researcher has completed data collection, in order to try to find meaning in and understanding of the data that were collected. There are two types of data analysis, namely the quantitative and qualitative. Since this study is qualitative, the focus will be on qualitative data analysis (Babbie, 2011). There are three types of qualitative data analysis methods namely text (documents), narrative (interviews) and visuals (photographs, videos and observational field notes) (*ibid*). A researcher can use all these types in one study; and there are a number of methods used to analyse the data collected. The main ones are; constant comparison, hermeneutical, matrix, narrative, heuristic and content analysis:

3.7.1   Constant Comparison Analysis

It is used in studies where documents and codes are compared to find consistency and/or differences (Ratcliff, 2010). Data is compared here with the goal of finding a specific theme; this method is mainly used in grounded theory studies as it is about investigating human behaviours (Neuman, 2011). This is a good method, however since this study will not be doing any data comparison it cannot be used. Other methods are described below.

3.7.2   Matrix Analysis

This analysis method uses diagrams and flow charts to analyse data (ibid). Data is arranged such that it is easy to visualise and compare relationships between variables (Michalski & King, 2005).

3.7.3   Narrative Analysis

Is a story telling method where persons share stories about what happened; this can be done verbally or in written form and then presented (Myers, 1997).

3.7.4   Content Analysis

This is a method used to analyse texts, concepts and documents, which can be broken down into smaller parts so that they can be managed easily (Webber, 1990). Content analysis is a theory driven method that is used to analyse and interpret the meaning of data in documents, text, images etcetera (Neuman, 2011). The analysis is done to find what themes emerge and the relationship(s) between the themes in what is being analysed. The text is not analysed as a whole but is broken down into manageable parts (Hsieh & Shannon, 2005). Through the years content analysis has been used in many disciplines such as media, sociology, and psychology (*ibid*). The main goal for content analysis method is to find themes in the data analysed. Content analysis is suitable for this study as there are many texts to analyse, which are in the form of literature, interviews, observations, discussions, and speeches among others. Therefore it will be used in this study.

3.8 Research Designs

A research design is a plan that the researcher uses to conduct the research, and to answer research questions (Babbie & Mouton, 2001). As a qualitative methodology is used in this study, the following section discusses the different types of qualitative design: the ethnographic, grounded theory, phenomenological and case study.

3.8.1   Ethnographic

The ethnographic approach is a method used to study a specific group of a population, whose members have the same beliefs, on their cultural behaviours. This is conducted by observing and describing the phenomena (Neuman, 2011). In the beginning this approach was mainly used in the anthropology and sociology disciplines, however now it is used in many other disciplines such as education, marketing, public healthcare (Genzuk, 1999).

In ethnographic studies the researcher must be part of the phenomenon being studied for the duration of a year or more, as this approach's investigation depends on first-hand experience (*ibid*). This involvement helps the researcher to understand things better. This study is not about monitoring any cultural behaviours of a specific population therefore this method is not appropriate for this study.

3.8.2   Grounded Theory

A grounded theory design is used to study social phenomena with the goal to discover and develop a new theory (Goulding, 1999). It grants the researcher an opportunity to learn new detailed findings without any limitations or restriction (Neuman, 2011). This design is mainly used

in the sociology discipline (*ibid*). It is also important that the researcher must be part of the investigation so that it is easy to describe the phenomena (Williams, 2007).

Grounded theory is regarded as a design that is more information based as it involves observations that can be used in the new area of interest, in trying to understand social challenges (Jones et al, 2005). This design grants the researcher the freedom to take any direction in their studies as it is driven by data rather than theory, and is able to compare similarities over the range of phenomena (Neuman, 2011). This study is not comparing any similarities in phenomena; therefore it is not appropriate to use this design in this research. Instead, phenomenology and case study designs are more relevant and therefore, preferred.

3.8.3   Phenomenological

The phenomenological study places emphasis on individual personal experiences and subjective assumptions, with the goal of describing phenomena (Lester, 1999). It is used in social studies that investigate phenomena within their context, this method starts by affirming and accepting that there is a challenge that needs to be addressed (Hancock, 1998). This design uses a lot of information that is gathered from different sources such as interviews, observation, focus groups etcetera (Williams, 2007). The large amount of data collected must be analysed, sometimes this comes as a disadvantage, as data analysis requires a lot of time for thorough analysis. It allows researchers to investigate the phenomena within its environment.

The aim of this study is to investigate the causes of data corruption in the current public healthcare information systems. This requires a detailed understanding of context specific (subjective) accounts of the status quo in local hospitals and clinics, which calls for qualitative and explanatory interview data from related stakeholders. Unlike approaches that focus on objective claims to reality, and ultimately, non-contextual (rigid) methods of enquiry, phenomenology acknowledges a subjective reality in varying contexts. As such, it follows methods that allow subjective interpretation of phenomena, thereby empowering a researcher to work with contextual, qualitative and interpretative data. Therefore, the phenomenology approach (using a case study method) is found appropriate and is adopted in this study.

3.8.4   Case Study

In the case study design, investigations are done on a small population sample or single unit using various sources (Babbie & Mouton, 2001). It allows the phenomenon to be investigated within its real context. Here, the aim is to understand the challenges of the specific area of interest where the researcher is expected to spend time with the population group being studied (Noor, 2008). It is also useful when the study is answering the 'what' and 'why' questions and is aligned to the interpretive paradigm (Babbie & Mouton, 2001).

Multiple sources such as interviews, direct observations, documents, reviews etcetera can be used for data collection in this method (Neuman, 2011). This study uses multiple case studies, i.e. healthcare institutions (Tygerberg and Victoria hospitals) where observations are made and interviews conducted with the stakeholders involved in the data quality process.

3.9 Conclusion to Chapter Three

Research methodology guides how the researcher will conduct the study; it describes what has to be done and the research techniques that are to be used to achieve the objective of the study. This chapter begins by describing the information systems discipline, giving a clear background of this discipline that has been given little attention in the past. The chapter goes on to discuss in detail a range of research philosophies, paradigms, purposes, methodologies, data collection methods, and research designs. In this section the researcher discusses methodologies, methods and techniques available in research, and after a clear elaboration, chooses those that will be used in this study and gives reasons that support the decisions. Chapter four that follows discusses theories in research and chooses the one that will be used in this study.

CHAPTER FOUR – THEORETICAL UNDERPINNING ANALYSIS

4.1 Introduction - Definition of a Theory

A theory is a structural system that is used in research to explain certain aspects of phenomena and provide answers to the why questions of the study (Pettigrew & McKechnie, 2001). It is a well-established body of knowledge that has been developed and tested by experts in the field (*ibid*). Theory is trusted by researchers because of its analytical abilities and for simplifying the phenomena (Pettigrew & McKechnie, 2001). A theory must be able to identify constructs; specify relationship(s) between constructs, and test those relationships (Gregor, 2006). The analytical abilities in theories allow the researcher to breakdown a complex structure for a clearer understanding by giving detailed insight (DiMaggio, 1995). For example in this study the healthcare sector is complex. Therefore there is a need to understand the complexity of the structure so that things can be understood as they are. In this case, this required the identifying of stakeholders in the public healthcare information systems environment, their relationships, goals, and factors that lead to their success or vice versa.

In research terms this can be achieved by identifying constructs and their variables. Constructs are a mental notion (Laerd, 2012), an abstract idea and fundamental themes that can be measured or observed (Lavrakas, 2008). Constructs are used to express events, people, organisations, and objects that the researcher is interested in, that also helps a researcher explain the components of theories (Laerd, 2012). Sometimes constructs are confused with variables; in research a variable is an entity that can change its value (Trochim, 2006b). They are used to measure the constructs (Laerd, 2012). There are two types of variables; the dependent which is an outcome phenomenon of the investigation, which is affected by the measurement phenomenon or the independent variable in an investigation. In a broader sense, a theory is used to describe, analyse, explain, predict the future and prescribe the phenomena (Gregor, 2006). A theory in research also works as a lens to the viewing and understanding the phemonena (Pettigrew & McKechnie, 2001). As it is demonstrated in sections that follow, a theory in this study was used to formulate a framework that simplified different variables and respective constructs in the public healthcare information handling processes.

4.2 Theories in the Information System Discipline

As a multi-discipline, IS has three categories of input theory which are the sensitising, deductive, and inductive. In the sensitising category, the theory is used without emphasis on testing it (Flynn & Gregory, 2004). The deductive category on the other hand, tests the hypothesis and set up laws which make it aligned with the positivist epistemology (*ibid*). It supports the natural science studies whose focus is on the objective reality which does not depend on social factors (Wahyuni, 2012). This approach is not commensurate with the non-positivist approach followed in this

thesis. Instead, the inductive category which supports the observation of the phenomena, and then comes up with assumptions which are presented in a theoretical framework, was more appropriate in that it is associated with the interpretive epistemology (Flynn & Gregory, 2004) that is followed in this study. Early in the history of IS its focus was mainly on positivist epistemology, largely based on deductive theoretical logic, with almost no attention paid to social theoretical aspects (Tatnall & Gilding, 1999).

When compared with older disciplines such as computer science or sociology, there has been limited usage of theories in information systems research over the years. For example, only 10% of 449 research articles in 37 journals used theories in 1990 (Pettigrew & McKechnie, 2001). Nevertheless, there has been an increase in theory usage in the IS discipline since then (*ibid*). During this time, Information Systems has been importing theories from other disciplines hence, it has become known as a multidiscipline (Lim et al, 2009). Psychology theories are the most used theories in IS, followed by the theories from the sociology and economics disciplines (*ibid*).

As a research field, information system is a fairly young discipline with theoretical roots in natural sciences (i.e. computer science), management studies and social science (Flynn & Gregory, 2004). There has been growth in the development of social theories within IS, which is needed to establish it as a theory-developing discipline (*ibid*). With the increasing acceptance of the socio-technical nature of this young discipline, IS has seen an increasing balance between the use of computer science, and social science theories since 1984. For example, the social theories such as Actor network theory (ANT), Structuration Theory (ST) and (the) Activity Theory (AT) were ranked in the top 10 theories used in 381 papers published by the IFIP WG8.2 in 17 conferences between 1984 and 2003 (Flynn & Gregory, 2004).

4.2.1 Actor Network Theory

Actor network theory (ANT) is a tool used to explore the socio-technical processes collectively, and acknowledge that in transformation the social, technical, conceptual and textual aspects are part of the process (Tatnall & Gilding, 1999). It was established in the early 1980's by Bruno Latour, Michel Callon and John Law, in their attempt to understand the technological and scientific aspects (*ibid*). ANT is used mainly in technology and science studies. The main terms used in this theory are the actors (also referred to as actants or agencies), translation and network, among others (*ibid*).

Actors refer to human or non-human aspects such as people, animals, organisations, objects, machines (Law, 1992). The network is formed by joining the aspects or actors, without the actors in the ANT there is no network, the actors are the main aspect of the ANT (Czarniawska & Hernes, 2005). The ANT addresses the shortfall of the IS discipline which only focuses on the technical (positivist) part of things, neglecting the social (interpretivist) part (Latour, 2005). ANT is

about the integration of actors and how they form different types of networks, which demonstrate how the social and technical elements function together in the transformation process (Czarniawska & Hernes, 2005). In addition to a technical focus, ANT also encourages the exploration of the social aspects of a network that focuses on socio-technical phenomena (Latour, 2005).

This theory is mostly used in ethnography studies (Tatnall & Gilding, 1999). It would have been useful to use ANT in this study as it is concerned with the working relationships between different actors. Out of personal preference however, the researcher was concerned with the supposed symmetry status afforded to human and non-human actors. Further, since the aim of this study is to understand not only the activities of respective actors, but also the intentions that can only be linked to the cognitive capabilities that only human actors possess (Vygotsky, 1978), a systems analytical approach is preferred. This approach is explored further in structuration and activity theories discussed in the sections that follow.

4.2.2   Structuration Theory

Structuration theory (ST) is a social theory that outlines the form and dynamics of societal, organisational and personal structures (Giddens, 1984). This theory is built on the two epistemological assumptions about the nature of social structures, the positivist (structuralist) perspective with emphasis on the structure, and the phenomenological (as well as hermeneutic) presuppositions with emphasis on the human agent (Rose & Scheepers, 2001). The key aspects of ST therefore, are structure and agency, which are seen as interdependent due to their mutual recursive coexistence *(ibid)*. This is referred to as the duality of structure, meaning that the structure and agency will define and recreate themselves over time. The emphasis in this respect is that there is no structure without agency, nor agency without structure (Jones & Karsten, 2003). The structure is referred to as resources and rules in society. Thus in ST dimensions, the resources are represented by the facility, whereas the rules are represented by the norm (Rose & Scheepers, 2001). For example, the agency, which refers to the transformation capacity in this case, will encompass dynamics and flows, through which the structure defines, creates and recreates itself.

The recursive nature (where structure creates and recreates itself) is defined by the three dimensions of structure, namely the signification, domination and legitimation, as linked to the interpretive scheme, the facility and norm modalities, respectively *(ibid)*.The structure is introduced in a blank state at the signification dimension; however the interpretative scheme modality helps to clarify things when they are communicated to the public. In the same way in domination structure, the facility as a resource gives a source of power to develop this structure. Further norms (laws, rules, policies, procedures etcetera) establish processes to be followed, this

is referred to as sanctioning; all of this contributes to the development of the legitimation structure.

In essence ST deals with the social structure/s "at a high level of abstraction rather than their particular instantiation in a specific context; offering a way of seeing the world rather than an explanation of its mechanisms" (Jones & Karsten, 2003:5). However, the focus of this study cannot be limited to the high level, as it seeks to understand all levels in detail without omitting any vital information. Secondly, the explaining of mechanisms comes as a limitation, as this study's main objective is to understand the factors that influence data corruption in the healthcare sector, which is far beyond just explaining aspects. Therefore, what can be more useful for this study is to use a more systematic analytical theory. To this effect this study uses the activity theory which is described in detail in the sub-section below.

4.2.3   Activity Theory

Built on Vygotsky's (1978) concepts of mediated action, the Activity Theory (AT) is an analytical tool to understanding human activities, dialogues, multiple perspective (Mlitwa, 2011) "and networks of interacting activity systems" (Engeström, 2001:4) as mediated by artefacts (tools), rules, processes and human interactions (Hardman, 2008) towards a common object/motive (Engeström, 1999).

The main argument in the activity theory is that artefacts (tools) are an integral part of, and should therefore be inseparable with, human activity (ibid.). In fact, human activity which is the basic unit of analysis in the AT (Uden et al, 2007), should be seen not as an isolated component but an integral part of what Engeström terms the "activity system". The activity system according Engeström (1987) refers to a combination of the subject, the object, rules, the community, the mediating factors and the division of labour. In this respect, emphasis is placed on the goal-oriented activity and the examination of such activity at macro level of collective action of various actors. On this basis, it is not just human activity – but joint activity or practice that is the main unit of analysis in the activity theory (Engeström, 2001).

The AT thus, is concerned with phenomena that are larger than the individual goal-directed activities. In other words, the theory acknowledges complex system with multiple actors, tools and activities – that are drawn and linked together by a common motive. Since the subject of investigation in this study was based on a national phenomenon, a phenomenon that pursues motives larger than the ends of an individual, the AT was seen as a relevant theoretical approach upon which a complex national healthcare information system environment can be analysed.

In this complex activity system, Engeström's (2001) account remains loyal to the conventional principle of mediated action, but extends the mediation of individual activities by tools, into the mediation of multiple activities. In this respect, not only the mediating artefact (tool/s) but also the rules, community and the division of labour, equally determine the joint human activity in the

activity system. By emphasis on "conceptual tools to understand dialogues, multiple perspectives, and networks of interacting systems" (Engeström, 2001:4), the AT also offers analytical solutions to the understanding the complex and multifaceted environment of the public healthcare information systems in South Africa. Actors in the public healthcare sector operate in different levels such national, provincial, municipal and institutional healthcare levels. In each level there is management which develops strategic plans that must be carried out by the actors at the operational level. At the national level the actors there develop strategic plans which are implemented in all provinces. At the provincial levels the plans are simplified according to the province needs, which are broken down to municipalities as well as hospitals and clinics. These levels might have different objectives but their goal is the same and it feeds to the main national healthcare sector goal which is to improve the quality of healthcare services (DoH, 2008). However, it will not be possible to achieve this goal if there is no clear communication between actors. Though in the activity system there are multiple actors with different objectives, the joint activity emphasises on dialogue between different actors. In other words, they must work under the same set of rules – towards the same goal. Otherwise a lack of dialogue in the activity system will result to no success in joint activity as actors will be pursuing their individual goals.

The use of healthcare information systems in local public healthcare institutions is determined by multiple policies and dialogues between stakeholders at the national, provincial and even municipal departments of health, as well as administrative bodies of public hospitals and clinics. The AT focus on understanding this, positioned it as an ideal analytical tool for this thesis. Further, the phenomenon of the public healthcare services cuts across various social, political and economic spheres of the public, and with multiple stakeholders, multiple perspectives are unavoidable. The same logic applies to multiple networks of other interacting systems – that influence, and are influenced by the public healthcare sector and its healthcare information systems. On the latter point for example, the local healthcare information system would be directly affected by internet availability, the availability of electricity, income levels of different sectors of the public the facility serves, and many other factors and their related system. So, the AT focus on conceptual tools to understand not just a certain activity system – but the dynamics of its interaction with other systems offered a useful analytical aspects of the complex phenomenon of investigation in this thesis.

The activity system also has principles that it can be viewed under: historicity; central role of contradictions and transformation principles. The historicity principle acknowledges that it takes time to achieve an expected outcome (Engeström, 2001). Therefore it is important to understand the history of a phenomenon of enquiry and its objects in the activity system (*ibid*). Thus, investigating the background of information systems in the healthcare sector would start from the old to the existing systems. For example the requirements of the healthcare users, how the systems are used and what informed the need to change from the old systems to the current.

Through examining the history of these systems one is able to, and should identify contradictions (tensions) that exist within the system, and between it and other interacting systems (Engeström, 2001).

The principle of the central role of contradictions focuses on the tensions/contradictions that exist within the activity system. A clear knowledge of the activity system history makes it easy to understand the root causes of the tensions that exist (*ibid*). Based on this logic, understanding contradictions in the activity system of the healthcare information systems domain is necessary. In fact the main contradictions that face the public healthcare sector are: usage of the paper-based system, system security limitations, information and data corruption, systems availability, limitation of skills and resources within the sector. In this technology driven generation, the public healthcare sector still uses the paper folders to store patient clinical data (Kahn, 2011). The paper based system limits the sharing of data by multiple users, as paper files can only be in one point and cannot be used in multiple areas at the same time (*ibid*). On the other hand in the computer based systems, the main contradiction is that the data that exist in the system is incomplete and inaccurate (Power, 2009). Such data is not useful to the system users as it cannot be used in any reports.

These contradictions inform the principle of transformation, as the contradictions within the activity system create a need for change or development (Engeström, 2001). For example challenges of system availability lead to needs of upgrading systems and ensuring that they are available so that they can be efficiently used by the actors. The existence of contradictions should not only be viewed as negative influences in the activity system. Instead, they are also an indication that over the continuous process of dialogue between actors, that the existing activity system may be open to improvement and change. New requirements and developments inform the exploration of new and broader horizons, and even changes in the activity system (Engeström, 2001). The same logical applies to the context of the public healthcare information systems. In the HIS perspective for example, the ever evolving government policies on healthcare service delivery, the emergence of new technological innovations, advanced technical skills, the changing and growing nature of information needs of the sector could jointly dictate revisions in the HIS activity system over time. In this instance, a transformation process becomes feasible when this leads to the goals, motives, mediators and activities being revised through a process of dialogue (Mursu et al, 2007), to ultimately determine how systems can be enhanced to better the healthcare service for patients in the sector.

From the activity system perspective then, five key terms determine the work-activity (the activity of). The work activity involves **actors**, **goals**, **activities**, **mediators**, **transformation** as well as the **outcome** (*ibid*). Information flows and linkages between the five components of the activity system are important in the success of the work-activity (Mursu et al, 2007). In the healthcare information system (HIS) data quality work-activity there are a number of main actors which are at

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the institutional level, the Department of Health (DoH) represented at the national and provincial levels, the hospitals and clinics. At the individual level the major actors are the HIS project team, which include the project manager, system managers, systems analysts, trainers, system controllers, information officers and users. The goals and objectives are to improve patient care by providing high quality patient information handling processes within and between hospitals, improve health system management in general, and beyond patient care. The activities relate to actors having the responsibility to perform their duties successfully; the accomplishment of the goals is based on how the enabling and inhibiting factors affect the actors in their work. This framework is used to clarify the investigation and the data collection of this study.

Beyond understanding the human interaction that is explained in the activity theory, the focus is also on society transformation (Hardman, 2008). Therefore activity theory is the most suitable theory for this study, as the focus is to understand and explain the status quo of the information handling processes in the healthcare sector. Section 4.2 below elaborates how this theory is used in the study. Further Figure 1 below section 4.2 draws on the activity theory to present the HIS data quality program as work-activity in the activity below section 4.2 draws on the activity theory to present the HIS data quality program as work-activity in the activity system.

4.3 Theoretical Framework

The AT is built on several key concepts: actors, actions, mediation, subject, object (goal & motives), tools, transformation (process), rules, and outcome. Both the activity and context feature strongly in the vocabulary of activity theory (Mursu et al, 2007). An activity is seen as a factor that ties the actions to the context; hence an activity is a basic unit of analysis in Activity Theory (Engeström, 1987). Since human actions derive their meaning from the context, *"actions without context are meaningless"* (Mursu et al, 2007:6), actions must be viewed within a context. AT work-activity concepts are used to present the HIS data quality programme as an activity system in Figure 1.

Activities/ Actions

D.o.H:
Delegate a team to ensure a proper implementation of the HIS.

Hospitals and Clinics:
- Clearly communicating their needs of the system to the HIS project team, system managers and analysts.
- Ensuring that personnel get HIS training and follow the policies and procedures.

HIS project team, System Managers & Analysts:
- Clearly document hospitals and clinics needs.
- Implement the HIS.
- Consistently enforce data quality policies and procedures.

Medical Personnel:
Use HIS together with the Paper-based system to record, retrieve & to share diagnosis and prognosis data.

Clerks:
Interact with patients and ensure that they collect and capture accurate data in the HIS and paper-based system.

Transformation

Actors (D.o.H., HIS project team, hospitals, clinics, and system users) use the HIS to improve patient information management and provide proper healthcare services.

Positive Outcome:
- Accurate information, collection, capturing & storage.
- Effectively sharing of information.
- Improve healthcare services.

Negative Outcome:
- Loss or corruption of patient information.
- Poor healthcare services to patients.
- Inaccurate patient data.

Mediators

Enabling Factors
- Full usage of tools potential.
- Appropriate Budget.
- Clear policies and procedures.
- Skilled personnel
- Positive attitudes for users.
- Adequate hardware and software.
- Technical support.
- Skills support.
- Sound access control measures.
- Data security.

Tools
- Computer system.
- Software.
- Computer networks.
- Stationery (paper , files etc).

Inhibiting Factors
- Underutilisation of tools
- Insufficient funds.
- Ambiguous policies and procedures.
- Unskilled personnel.
- User's loss of interest.
- Scarce resources.
- Unsuccessful implementations.

Motives/ Goal

DoH, Hospitals & Clinics:
- Improve patient care by providing patient information within and between hospitals.
- Improve health system management in general, beyond patient care.

HIS Project Team:
- Assess, deploy and support HIS implementation.
- Integrate electronic & paper-based systems.

HIS Manager & Analysts:
- Develop HIS & maintain its optimal functionality.
- Support HIS & paper-systems usage.

Medical Personnel
Effective recording, keeping and sharing of diagnosis and prognosis data.

Clerks
- Effective collection, capturing, storage & retrieval of patient information.
- Maintain integrity & accuracy of data.

Actors

D.o.H.

Hospitals Clinics

Hospital Information System (HIS) Project Team.

System Managers & Analysts
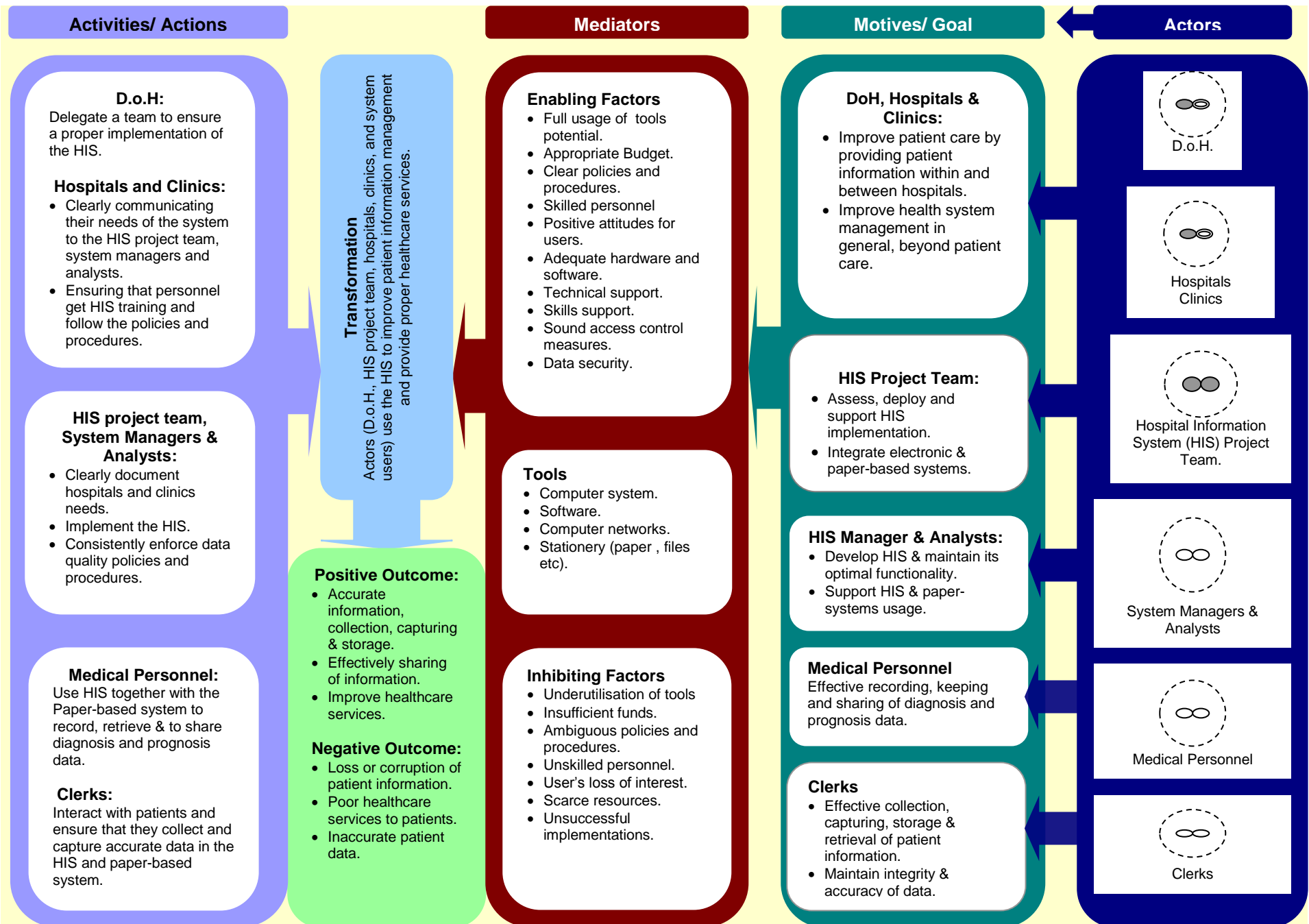
Medical Personnel

Clerks

Figure 1: Healthcare Information System (HIS) Data Quality Activity Theory Analytical Framework, adapted on the Actor Framework of Mlitwa (2011)

4.4 Conclusion to Chapter Four

The IS discipline started as a natural sciences focused field, such that the social part of it did not receive much attention. Only later did philosophers start raising concerns about this area that was neglected. The concerns of social science were addressed as now there was growth in the social science field. History shows that theories were not used very much before 1984 in the IS disciplines. Only recently has an increase in theory usage been seen in this discipline. Researchers in the IS discipline also started focusing on developing their own theories, rather than borrowing from other disciplines, such as sociology and economics.

A study that was conducted indicates which theories are commonly used in the IS discipline. Actor network theory (ANT), Structuration Theory (ST) and Activity Theory (AT) are ranked in the top 10 theories used in 381 papers published by the IFIP WG8.2 in 17 conferences between 1984 and 2003 (Flynn & Gregory, 2004). This chapter looks at theories and their usage within the IS discipline. Finally activity theory is found to be the most suitable theory to be used in this study, and an AT framework is developed and aligned with this study. Chapter 5 that follows discusses the findings of the study and links them to the theoretical framework used for this study.

CHAPTER FIVE – FINDINGS

5.1 Introduction

The main objective of this study was to understand the factors of data quality and related processes in the public healthcare information systems in South Africa. The idea was to outline challenges, so as to inform solutions towards the enhancement of the quality of public healthcare service delivery. In as much as there has been improvement in the information handling systems of the public healthcare sector, there are still challenges of patient data duplication and data security failures, among others. Because of this situation it is important that the following data quality dimensions in the public healthcare sector are investigated: data accuracy, duplication, integrity, along with the aspects that support them. In investigating these data quality dimensions, a main research question for this study was developed, which is 'What are factors affecting the adequacy of the paper-based and the electronic information systems to support the effective handling, storage and exchange of patient data in the public healthcare sector in South Africa?'.

In addressing this question, institutional stakeholders: clerks, nurses, information officers, and systems managers were interviewed to collect information on data handling processes in the public healthcare. The activity theoretical framework Figure 1, together with the content analysis tool was then used to analyse and interpret data.

5.2 Presentation of Findings

Data in this chapter is presented according to the six themes of investigation: usage of tools, user skills/competencies, functionality, user access control, data integrity and data sharing. The section draws on the activity theory framework (as analytical tool) to present the public healthcare information handling processes as an activity system. Such a system is composed of actors, the object, goals, mediating factors, activities and outcomes. The framework further provides for the process of transformation, where goals interact with mediators to transform activities into outcomes. According to the analytical framework in Figure 1, the "object" (representing a common purpose held by all actors) in the public healthcare sector is to provide patients with a good quality of healthcare services. The object is then broken down into different goals, activities and responsibilities for each actor in the system. The goal and related responsibilities of the main actor, the national Department of Health (DoH) in South Africa, is to improve patient care in general, by providing efficient healthcare services in public hospitals and clinics. Among the main mediators according to the activity theory framework (Figure 1), public healthcare institutions need enabling tools, related competencies, financial resources, rules and procedures. Since information is significant as a basis for effective delivery of healthcare services, not only must the healthcare information handling tools be adequate, but such tools must also be put into effective use, if the quality of the public healthcare is to be improved.

5.2.1 Usage of Tools

The findings reflect a promising level of development in terms of information handling facilities in public hospitals and clinics in South Africa. In fact, hospitals are using a combination of "the Clinicom system" (VHW, WC-R1; VHW, RC-R1; VHW, MN-R1), the "Sinjani…" (VHW, IO-R1) and "…paper-based…" (VHW, RC-R10; TBH, WC-R10; VHW, MN-R5; VHW, WC-R10; VHW, IO-R5) systems. The Clinicom is an electronic system used for patient data management, whereas the Sinjani is used to generate and "… draw reports on the quality of our data and … also [to] draw reports on [data] validation, [and] unrecorded admin attendance reports" (VHW, IO-R1). The paper system is mainly used to store "… the medical information everything that the doctor has written on and things they requested so it's more the medical part…" (TBH, WC-R10). On the other hand; the clinics are using the Primary HealthCare Information System (PHCIS) for patient data management and reporting (TBH, PM-R11). New developments help in streamlining activities according to different roles and responsibilities of respective healthcare workers. On this point for example, the clerk explained that they capture patient's data "at arrival when the patient comes to the ward…"(TBH, WC-R12). The reception clerk mostly deals with the "the demographic and billing information and when there is data missing I get to fill it as I spend more time with the patients" (VHW, WC-R7). However this depends on the work load of the clerks, as she further explained that "… some other times its quite busy then admissions are done the next day when you get the chance to go through the ward..." (TBH, WC-R12). In clinics they don't have any in-patients modules, the system manager mentioned that they only have "… the appointment, maternity, Routine Monthly Report (RMR), those are the 3 modules …they hope to grow and have more in the future" (TBH, PM-R11).

The progress that has been made with the current innovations reflects commendable foresight in the public healthcare sector. For example, in the past they were mainly using the paper-based system as well as an old electronic system which became obsolete (Y2K non-compliant)[9] towards the beginning of the 21 millennium. As the innovations were made there were new requirements that the old electronic system could not meet. For example the system analyst explained that "Data was not centralized in the old system and were also not compatible or didn't meet new requirements in the healthcare sector" (TBH,SA-R2). Because of these positive developments in healthcare information handling processes, the overall feeling among healthcare workers in public hospitals and clinics is that efficiencies in public healthcare information handling processes have

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[9] Y2K is referring to millennium of year two thousand. The system was not built in such a way that it can operate in the new millennium.

Responses abbreviations: VHW = Victoria Hospital Wynberg; IO = Information Officer; MN = Medical Nurse; WC = Ward Clerk; RC = Reception Clerk, TBH = Tygerberg Hospital, WC = Ward Clerk; PM = PHCIS Manager, SA = System Analyst; SM = System Manager.

changed for the better (TBH, SM- R10), with a lack of skill being the only hindrance for users with minimal computer literacy (VHW, WC-R4).

5.2.2 User Skills/Competencies

Though the presence of relevant systems reflects a positive development in the findings, these systems can only add value if their potential is fully exploited in the public healthcare sector (Presidential National Commission, 2012). On this point, the theoretical framework in Figure 1 suggests a need, not only for the presence of mediating factors, such as the tools and systems, but also the willingness and skill of respective actors to put the tools into effective use.

User competencies refer to the understanding, literacy and ability (including dexterity) to put the system into effective use (ALA, 2000). In other words, whilst it is important to have relevant information systems, a system can only add value to the organisation if the users are aware of those systems; and are adequately skilled to put them into effective use. According to the framework; the goal of the clerks and medical personnel is to support healthcare service delivery through effective use of tools, rules and processes. For the clerks, information systems such as Clinicom and PHCIS, according to the findings, are the main tools (and mediators) – to effectively collect, capture, store, share as well as to maintain integrity and accuracy of patient data. The same tools are used by the medical personnel to efficiently record, and share patient diagnoses and prognoses in public hospitals and clinics. A realisation of these operational goals, according to the AT framework Figure 1 however, depends on the adequacy of skill, relevant training and related technical support for users. The logic of this argument is that unless users are competent to use a tool, they cannot put it into effective use. For example, knowing that the Clinicom and PHCIS systems can help improve data collection, storage and sharing processes, means nothing to the clerks if they are not competent to use these tools.

The findings show limitations in terms of skills among system users in the public healthcare sector. As a result, users find it hard to put the systems into effective use. Some of the problems, according to the users, are that the system is complex and "…it took a while to understand the system such that we were struggling to work in the beginning…" (VHW, WC-R4). System complexity does not seem to be based on the structure of the system, but on background and computer literacy of some users who admit that it is because they "… don't have any computer background" (VHW, WC-R4) which then at the beginning stages makes it "… not easy to use the system…" (VHW, WC-R4). The system itself, nevertheless, is reported by the computer literate users to be fairly easy to use. A number of these respondents said that they were comfortable and encountered no challenges while working on the systems (VHW, MN-R3; TBH, CS-R8).

Because of the different levels of skills, there were a variety of views on the quality of the training that was provided to the users, before they started working on the systems. Some respondents felt that the training was "… not sufficient ..." (VHW, RC-R3), as it was only "…two days …" (TBH,

WC-R3), then later there were "…updated training sessions which are a day long" (TBH, WC-R3).While the other respondent felt that "…the training … was very informative." (VHW, WC-R4). Even though some users might have struggled to work with the system, due to minimum skill levels, they eventually learnt to work in the system, but only after extensive practice. Therefore, the system is useful to the few who have computer skills and are comfortable to work with it, however for others; their limitation of the skill hinders the effective usage of the system.

5.2.3   Functionality

In addition to the users skills, the theoretical framework in Figure 1 also emphasises the significance of relevant systems with continuous availability, and unbroken functionality. Reliable systems improve confidence, as users can count on their quality and accessibility in the pursuit of their operational objectives.

5.2.3.1 System functionality

Given the significance of system reliability (continuous availability and functionality), institutions are expected not only to put correct systems in place but also to ensure their undisrupted presence (Fichman et al, 2011). Continuous updates therefore, are important in ensuring relevance, so that systems can always react to the current operational needs of the entity (*ibid*). In the theoretical framework Figure 1, the functionality of systems is presented as one of the key enablers (mediating factors) of system usage, without which, users cannot effectively achieve their goals.

Unfortunately, the findings indicate clear limitations in the functionality of existing electronic healthcare information systems in public hospitals and clinics. For example, administrators complain that the system often goes off-line and at times it can be very slow (VHW, RC-R8). Although electronic systems improve efficiencies, these functionality failures are disturbingly disruptive and annoying. The same administrator admits that Clinicom is "…a nice system…" (VHW, RC-R8), but complains that "the slowness of the network at times gets to [them]", adding that "… periods we wait while the system is taking you to another function or while waiting for the system to give you information [can be very long]...it's slow" (VHW, RC-R8). As the theory emphasises that systems must be constantly available in order to ensure proper usage, the converse is also implied in the theory. In other words, the absence of or interruptions to system functionality is bound to infringe on user interest, to reduce usage or to limit the value that can be derived from continued usage. As a result of the system being down frequently, most users are losing confidence on the quality of data in the Clinicom and Sinjani systems, and are turning to paper-based downtime procedures as an alternative. This has reduced the time spent on these electronic systems, and thus the experience gained, to the extent of a visible reduction in the skills of users. Voicing this concern, one official even complained that they now "… need to re-

educate people to work from [the computer] system, [and to]… start trusting the data that … [they capture, both in terms of] the quality as well as the quantity" (VHW, IO-R7). Functionality failures are serious nevertheless, with various unfortunate implications to work processes. These include "long waiting periods for patients, and the backlog of work" (VHW, RC-R9). The biggest frustration is that users even "…get behind in [their] work; you must now wait until everything is on again …so you can't finish it..." (TBH, WC-R10).

Nevertheless what has emerged in these findings is that, in spite of these functionality limitations, the overall user-attitudes towards the system have not been significantly impacted. In fact, it emerged in the findings that users are very fond of the Clinicom system. Sentiments are that "besides the performance" hick-ups, "Clinicom is very helpful to look up that information, to print stickers and sometimes to look up patients telephone number or if the patient is in the ward and which ward is the patients" (VHW, MN-R2). Another respondent said that apart from the network slowness issues, Clinicom "…works like a dream…" (VHW, IO-R10). Nevertheless, the fact that system users found the challenges to be noteworthy (to the extent of mentioning them), shows these functionality limitations to be an unwelcome irritation. Thus, one can only anticipate an increase in value, output and impact of system usage on the public healthcare sector – should the functionality limitations be eradicated.

5.2.3.2 Extent of utilization

System functionalities, according to the analytical framework, can add full value to organisational processes only if their potential is fully exploited. In other words, users need to take full advantage of all the relevant system applications and capabilities in order to derive maximum benefits from its use. On this point, one respondent admits usage limitations, saying in his confession: "I think we are failing the system as we are not utilizing it to its fullest" (VHW, IO-R10). In confirming that the system is not utilised fully, the medical practitioner agreed that she is using the system only "…to print stickers and sometimes to look up patients' telephone numbers or if the patient is in the ward and which ward is the patients..." (VHW, MN-R2). The system has the capacity to do much more than just the printing of stickers, meaning that it is grossly under-utilized. In the words of another respondent "… there is a lot of potential in Clinicom…" but "…we are not using everything in Clinicom. Currently I'm busy with the … project which is another function that Clinicom provides us but we never use it which will be an advantage for the hospital to use for accurate reporting purposes on disease classification" (VHW, IO-R8). As argued in the theoretical framework, the findings indicate a direct correlation between functionality and usage limitations in these healthcare information systems.

5.2.3.3 How do system failures affect other functions?

System functionality failures have an inhibiting effect on the efficiency of healthcare handling processes in the public healthcare sector. In fact, it is not only the system users that are affected by system usage, but also other practitioners who depend on other system users for relevant information. To clarify this point, the information officer said "…I don't use Clinicom that much. However I do get a lot of frustration from the users, as they use the system more…" (VHW, IO-R11). Doctor-patient consultations can be adversely affected. In the words of the information officer for example, "say for instance a patient has an appointment, but before they could do an attendance … we get it a lot when there is network slowness then the doctors cannot wait for the patients. They will come and get the patients, then the nurses put the sticker on the clinic list, if that patient is not captured on the system with the appointment they will be filed in the unrecorded admin attendance report then from there the reception clerk will add it on to Clinicom" (VHW, IO-R4). In other words, the doctor is compelled to take risks and override key steps in the information gathering process to attend to patients in distress during these disruptive system delays. This reflects not only to disruptions in procedures in place, but also in the duplication of work with an increased margin for error. For example, the fact that users have to update the paper-based lists and then later capture the data on the system, threatens the data quality, in terms of accuracy and integrity.

5.2.3.4 Causes to system failures

In explaining the causes which lead to system functionality failures, participants cite, limited capacity of the network relative to the ever-increasing traffic and human errors, as the leading causes of system failures. Considering limited capacity, a high volume of transactions can result in network congestion. This has often compromised network performance and increased system errors. In terms of the increasing volume, one hospital official acknowledged that even if "Clinicom … worked like a dream … [while there] were 4 hospitals on the system … "system performance started to suffer when the number increased. In his own words, he complained that it was when "… more hospitals came on board that affected the performance" (VHW, IO-R10). There are many cases also, where systems failure has been due, mainly to human error. For example, if a system operator enters incorrect data, then inaccurate records will be kept in the system (TBH, CS-R5; VHW, IO-R12).

In the theoretical framework, technical support is presented as one of the key mediating factors. As an enabling factor therefore, it is important that technical support is constantly available, and that support personnel are adequately skilled, proactive and responsive. Proactive in the sense of making sure that networks are functional, in the case of servers for example, that they are upgraded in time, and before potential depletion. On responsiveness, support teams should not

take an unnecessarily long time to attend to service requests. Needless to say, technical support procedures and policies must be in place to support timeous responses to calls for help.

On this point, the findings show the technical support to be not as proactive and responsive as expected by the healthcare sector. For example, users "...log calls with Helpdesk if there are any issues with the system performance or any other errors..." (VHW, IO-R11). Various methods are also used to resolve the most frustrating issues such as the network slowness. For this process, calls are logged and the queries are assigned to network technologists to investigate, in order to resolve the problems. However, difficulties are caused if some of these queries don't get resolved immediately in some healthcare institutions. As one of the respondents explains, "… it's quite difficult for [the users] when the system is down and IT is taking long to resolve our problems after we logged calls…" (TBH, WC- R8). This reflects a lack of responsiveness in the technical support.

The findings also show that, frustrations over a lack of foresight in preparing network capacity for the growing usage, suggest that support divisions are not proactive. One of the key enabling mediators to system functionality, according to the analytical framework of this thesis, is the adequacy of systems and networks. A slow or non-responsive network, as experienced in some of the public healthcare institutions, clearly shows an element of network inadequacy which, in turn, inhibits operations. On this point, a clerk complained of "… the slowness of the network at times [it's annoying], the long periods [they] wait while the system is taking you to another function or while waiting for the system to give information…" (VHW, RC- R8). Other failures are system bugs or new user requirements that require further corrections, improvements and additional developments.

5.2.4 User Access Control

Data protection is vital for organisations and this cannot be fulfilled if the system is not designed in a way that is security compliant (Corporate Executive Board, 2010). Organisations therefore, must allocate access rights appropriately, only to officials with authority to operate in respective tasks (Hau, 2003). As a mediating factor in the theoretical framework, the usage of tools by users must be managed properly. This is important, as the lack of proper systems usage can be an inhibiting factor for the healthcare sector to achieve their goals. According to the findings, access rights are appropriately granted according to individual user responsibilities in the public healthcare sector, with slight variations between clinics and hospitals. In the clinics for example, "the reception staff … and …employees" such as "nurses, doctors, data capturers, project facilitators …and controllers" that work with patient folders have full access rights to tasks within their areas of operation in the system (TBH, PM-R2). The only difference in hospitals is that it depends on the setup of the institution. In the case of academic hospitals for example, only a few medical personnel have access to the Clinicom system for management purposes. In regional

hospitals on the other hand, all medical personnel can perform some tasks in the system. There is a control in place where the " … users can only share information about the patient data according to the access they have in the functions such as inpatient, outpatient or medical records, users only have access to that information and can only share in that specific module..." (TBH, SM-R1). This ensures user accountability as there is no benefit to be gained if the users have access to modules that they don't work with and have no understanding of. The policy of separating access rights according to user responsibilities is a good practice. However, there are users who neglect these controls, because there are loopholes in the process. According one system manager, there are still instances where people use "…the same username to access the system…" (TBH, PM-R2) and the other respondent said that "…I was a core trainer I have access to all the functions on Clinicom..." (VHW, WC-R6). Even though this user has changed positions their profile has never been updated accordingly. These failures to comply with the access control procedures create gaps in system logs, as therefor the logs are not able to be the true reflection of who exactly was working on the system and when. This situation poses a huge threat to data integrity in the system.

5.2.5 Data Integrity

Data integrity is the most important factor in data quality (Gollman, 2005). Organisations use their data for decision making; therefore it is crucial for systems to provide decision makers with accurate data (Barquin, 2007). In the theoretical framework the clerks are directly involved with information handling operations, with the maintenance of data integrity being their principal goal Figure 1. Although electronic systems are not perfect in the public healthcare sector, the findings in the current study suggest a promising status. Existing information systems are considered useful in that they improve the process of data integrity in the sampled institutions. For example, users are granted access to the system, strictly according to the nature of their duties and responsibilities. As one respondent puts it "… [It's] the information officers or system controllers who give access to the users in their institutions" (TBH, SM-R3). In other words, the use of Clinicom enforces accountability and control on who accesses the system, amends data, how and when. For example, "if you are amending a duplicate, no user has rights to amend duplicate [records] in the system... It's only the system controllers that have the rights to amend duplicates…" (TBH, PM-R8). Even for those with rights to amend data, they remain fully accountable as there are logs that store evidence of the whole transaction. The accountability mechanism is that "by making amendments on the Clinicom system it automatically updates on PHCIS system" (TBH, PM-R8), reducing manual processes that may be prone to errors in the final record. So, "users in the PHCIS system can [only] make changes on their side…" without being able to "update what is in the Clinicom system" (TBH, PM-R8). Safeguards are not only limited to procedures, but are also built into the operational programmes of the electronic systems themselves. For example, "… when a user enters a correct number the system will accept it...

[but] if the incorrect number is entered the system is built in such a way that it will reject the incorrect combination of number." (TBH, PM-R10).

With these operational safeguards, factors that could compromise the integrity of the patient data are minimized. The downside of this safeguard mechanism however is that the PHCIS system in clinics and the central Clinicom system in hospitals do not always have identical data details between amendments. Nevertheless, the need for data integrity safeguards seems significant enough to warrant separate system updates. These positive sentiments however, do not in any way imply the absence of system discrepancies towards ensuring the integrity of patient data in the public healthcare sector. When asked to indicate whether there are discrepancies in the accuracy and integrity of data in the system, most respondents said "...it's a reality sometimes a system does have problems... [but]…it also comes down to human errors..." (VHW, IO-R12). Another respondent said, "Yes there are data discrepancies that we experienced on the systems" (TBH, SA-R3), which are mostly outcomes of human error (TBH, WC-R6). Complaints in this respect are that sometimes "everything has not been captured… It could be human error on both sides where everybody has captured everything in register [but have] not captured [it] properly" in the system (VHW, IO-R11). In fact, some users would "…misspell patient information… [and there are cases the system] will allow users to insert numbers in fields that should allow characters only" (TBH, SA-R4), which does once again, come down to human error. These shortfalls often lead to backlogs that do, directly or indirectly, affect the processes of data quality (VHW, IO-R12). The integrity of data needs to be improved so that data sharing can be made possible, and adds value to the quality of service in the institutions'.

5.2.6 Data Sharing

User competencies refer to the understanding, literacy and ability (including dexterity) to put the system into effective use (Lemmetty et al, 2009). In other words, whilst it is important to have relevant information systems, a system can only add value to the organisation if the users are aware of those systems; and are adequately skilled to put them into effective use (*ibid*). One of the central goals of the major actors such as clerks and medical personnel in the activity system, according to a theoretical framework, is to ensure effective recording, keeping and sharing of diagnosis and prognosis data Figure 1. In this respect, data sharing processes should support rather than impede the integrity of data being shared. Thus, the quality of systems and the skill of the actors to effectively use these systems are both important.

 Some of the problems, according the users, are that the system is complex and "…it took a while to understand the system such that we were struggling to work in the beginning…" (VHW, WC-R4). System complexity does not seem to be based on the structure of the system, but on background and computer literacy of some users who admit that it is because they "… don't have any computer background" (VHW, WC-R4) which then at the beginning stages makes it "… not

easy to use the system…" (VHW, WC-R4). The system itself, nevertheless, is reported by the computer literate - to be fairly easy to use. A number of these respondents said that they were comfortable and had no challenges in working on the systems (VHW, MN-R3; TBH, CS-R8). Because of the different levels of skills, there were different views on the quality of the training that was provided to the users before they started working on the systems. Some respondents felt that the training was "… not sufficient ..." (VHW, RC-R3), as it was only "…two days …" (TBH, WC-R3), then later there were "…updated training sessions which are a day long" (TBH, WC-R3).While the other respondent felt that "…the training … was very informative" (VHW, WC-R4). Even though some users might have struggled to work with the system due to minimum skill, they eventually learnt to work in the system, but only after extensive practice. Therefore, the system is useful to the few who have computer skills and are comfortable to work with it, however for others their lack of skill hinders the effective usage of the system.

5.3 Conclusion to Chapter Five

In summary, the aim of the study was to understand the factors affecting the adequacy of the healthcare information systems in the public healthcare sector, with particular emphasis on how these systems support the handling, storage and exchange of patient data in public hospitals and clinics. The activity theoretical framework Figure 1 was adopted and used as an analytical framework in this respect. The framework presents the healthcare information handling process as an activity system composed of the actors, goals, mediators, activities, transformation and outcomes. Findings in this chapter are presented according to six themes of investigation (usage of tools, user skills/competencies, functionality, user access control, data integrity and data sharing) with a focus on actors and their roles in information handling processes. Obviously the tools, which are information systems (electronic and paper-based systems) – are central in this discourse.

Findings showed that public clinics and hospitals use two different systems which are partly integrated. The system integration has improved the data centralisation in the healthcare sector; on the other hand there are challenges such as user skills limitations due to disadvantaged user backgrounds. System slowness, failures and frequent unavailability, are hindrances, and reduce the trust that users put in the system. The conclusion and recommendations of this study are drawn and discussed in the next chapter, chapter six.

CHAPTER SIX – RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

This chapter draws on the findings in the previous chapter to present the conclusion and recommendations of the current study. The chapter opens with a summary of the findings in Table 3, followed by a brief analysis of the causal factors. The author then draws on the activity theoretical framework to inform recommendations. The chapter closes with the conclusion, the limitations of the study and suggestions for future research.

Table 3: Summary of findings and recommendations

Issue of investigation	Medical personnel & clerks			Information officer, system managers & system analyst		
	Summary of findings	Explanation	Recommendations	Summary of findings	Explanation	Recommendations
Usage of tools	• Hospitals & clinics are using different systems: Clinicom (hospitals), PHCIS (clinics) & paper-based systems. • Clerks partly use the Clinicom system for patient data management & medical personnel use the paper-based system to capture & store medical information. • Clinic users are unable to update data in Clinicom.	• Structure setup differs between hospitals and clinics. • Paper-based system are used as backup as not all patient data is stored in the computer systems. • Clinic(s) users are not allowed to write data into Clinicom, but only the PHCIS system.	• Clinics & hospitals should: • Use one system so that data is integrated. • Introduce a paperless environment. • Institutional administrators should enable clinic users to also update patient data in Clinicom – so that all data can be timeously updated in the central healthcare systems	• Information officers, system managers & analysts are mostly working on Sinjani reporting system.	• Limited system development & improvement. • Limited reporting functions in the Clinicom system.	• Healthcare sector must develop innovations to improve systems usage. •
User skills / competencies	• Most clerks have limited / no computer knowledge.	• Poor computer background • Inadequacy of existing training programmes	• Institutional administrators must clarify & implement skills development programmes, especially for those in greatest need.	• The training sessions provided are limited in time & not detailed enough. • Lack of detailed information on training provided.	• Limited resources & budget allocated to projects. • Lack of a proper & complete training plan in place.	• Institutional administrators must allocate enough funds and resources so that projects are not limited. • Provide frequent structured training sessions.
Functionality	• The availability of the system is limited as it is constantly down. • There are system bugs that yield to data corruption.	• Computer network congestion, causing system slowness. • Human error due to limited skills	• Institutional administrators must implement continuous system maintenance & upgrades of network technologies in public healthcare institutions.	• Users lack trust in the systems. • Systems are not utilised fully to their capacity. • Unreliable data in the system.	• Loss of interest in system by the users (clerks & medical personnel) • Users lack knowledge for the functions in the system. • Users capturing incorrect data.	• Implement data quality improvement processes. • Provide training on system functionality.

User access control	• Some users share their user accounts with their colleagues to access the systems. •	• Users lack understanding of data security. • System access controls are ignored by the users.	• Healthcare sector must provide training on data management & quality for clerks & other system users.	• Users' accounts are not maintained properly. • Systems logs are not accurate to track who used the system & what they were doing on the system.	• Lack of user profile updates. • Negligence & non-adherence to access policies, where multiple users use one account to access the system.	• Improve user accounts profile management. • Provide data security education.
Data integrity	• Existence of incomplete & incorrect data captured in the system. • Clerks are regularly struggling with system backlogs.	• Caused by system outages and human errors. • High volume of work in a limited resources environment	• Institutional administrators must implement policy & measures of accurate data capturing to improve data quality. •	• Most reports extracted from the Sinjani reporting system are inaccurate. • Limited data quality validations on the Clinicom system, thus corrupting data • Not all data is captured in the systems, yielding to system backlogs.	• Lack of advanced system development. • System failures that disrupt operations. • Human errors due to limited skills also disrupt operations.	• Systems upgrades and advance the development of systems. • The healthcare sector must provide users with training on data integrity. • Institutional administrators need to implement strict data validations when developing their systems.
Data sharing	• Many clerks lack understanding of data sharing in the healthcare sector.	• No training or guidelines on data sharing, no clear training programmes.	• Institutional administrators must develop & implement proper data sharing policies.	• Poor handling & sharing of data resulting in corrupt data in the system. • Limitation of data sharing between systems	• Limited understanding & implementation of sound data sharing practices. • Corrupted data that cannot be trusted.	• The healthcare sector must implement & maintain proper data security policies and processes. • Institutional administrators must implement active data cleaning processes.

6.2 Discussion and Recommendations

The objective of this study is to understand the status of information handling systems in the public healthcare sector, with particular reference to the efficiency of healthcare processes and issues of data quality in the existing healthcare information systems. For this purpose, clerks, medical personnel, information officer, system managers and analyst in hospitals were identified and interviewed. Activity theory was used as a framework to understand and analyse tools and processes related to the existing healthcare information systems. In this respect, the framework offers a holistic approach to viewing the public healthcare information systems environment. The theoretical framework presents the public healthcare information processes as an activity system consisting of the major role players in the healthcare sector, their goals, the enabling and inhibiting factors within the sector, tools used, transformation processes that they go through, activities and actions that they perform to achieve outcomes.

For the healthcare sector to operate successfully, clerks and medical personnel must adequately use existing tools to capture, retrieve and share patient data. The assumption in the framework is that with clear goals, adequate tools (relevant applications and systems), diligent activities as well as enabling processes and procedures, information handling processes will yield intended outcomes. Intended outcomes in this respect refer to efficiency in healthcare information systems, with minimal or no data corruption, in order to improve the quality of public healthcare service delivery.

The summary of findings Table 4 however reflects discrepancies in healthcare information handling processes in public clinics and hospitals.

6.2.1   Discrepancies in Healthcare Information Handling Processes

Whilst the theoretical framework calls for enabling processes that are supplemented by diligent activities, users in clinics and hospitals use two different systems to handle one form of data (i.e. PHCIS for clinics and Clinicom for hospitals). This leads to data duplication at the central integration point, compromising the centralisation and integration of data between systems in the healthcare sector. System users in clinics also complain of not having rights to access the Clinicom systems, meaning that they cannot amend any patient data in this system.

The adequacy of information handling tools is also questioned in the findings. For example, users complain that computer-based systems are not designed to accommodate all the data in the patient records. For this reason, healthcare institutions have continued to also use paper-based systems to store patients' medical information such as lab results, diagnosis, and medical prescriptions. Whether the use of both systems is the best solution to the information handling needs of the public healthcare sector is questioned in this study.

On this point, the proponents of the paper based system argue that information on paper cannot be altered as easily as it can be on an electronic record. For example, if a patient has been incorrectly diagnosed, a medical practitioner cannot easily alter the paper subsequently in order to escape the blame and related consequences. Despite this argument however, a paper system does have limitations. Manual back-ups, in the form of massive storage archiving, are tedious and time-consuming. Further, paper records can also be easily destroyed or misplaced. In addition, paper records cannot be shared by multiple users simultaneously at different work stations.

On the other hand, the electronic systems have improved innovations, as backups can be setup to run automatically and to restore lost data. They also simplify the sharing of data, which makes it possible for multiple users to use the same patient record at various workstations at the same time. In as much as electronic systems have these advantages, they can also fall short when not wisely developed and implemented. If the system design and structure is not compatible with the nature and requirements of work, it can frequently crash. For example, a sub-marginal system that is pushed   to handle larger volumes and formats of data than its capacity is designed to handle, particularly in an environment with limited bandwidth, is likely to fail. Using both the electronic and paper-based systems has its own shortcomings; it increases the users work load since users must work jointly on both systems.

6.2.1.1 Recommendations on Healthcare Information Handling Processes discrepancies

From the perspective of the theoretical framework, the information handling processes must be effective. This ensures that the collections, capturing, storage and retrieval of patient information can be trusted. The lack of effective information handling processes can lead to corrupt data in the systems. The existence of corrupt data in any systems is a proof of existing loopholes on the systems functionality and has a negative impact on the decisions taken based on that data. Due to the healthcare data being so sensitive, these challenges all have negative impacts on the sector.

The findings are that the healthcare institutions are using both paper-based and electronic systems because they are concerned about the security of their data. Considering the adequacy of information handling tools, to strengthen data security in terms of making it just as hard to alter data in the electronic system as is on paper; a new technology, that uses an electronic pen, can be used to write on a specially designed electronic device that can automatically transform the written data into electronic documents. The Digipen (www.digipensa.co.za) technology uses a paper form with a special micro raster and an electronic pen to write on paper. Records can automatically be updated, can be integrated into existing electronic records and into the electronic system as a whole. The advantage with electronic systems is that data logs can be traced to reflect any activity on data records. That way, activities and related responsibilities can be traced. Therefore, the healthcare sector must work towards having a paperless environment as this will

reduce the users' workloads. Such an environment will improve the quality of the users' systems, the data quality and subsequently the healthcare services for the patients. Challenges such as data duplication can be reduced by integrating the systems used in clinics and hospitals so that all data feeds to one database.

6.2.2   Limited User Skills

One of the key assumptions of the activity theoretical framework is that diligent activities are necessary for information handling processes to succeed in the public healthcare sector. The connotations associated with diligent activities are that actors perform their activities with a purpose in mind, and that they have adequate dexterity to utilize tools to achieve desired outcomes in the best possible way. The skill to use a tool is central in this respect. In other words, the successful usage of tools depends on knowledge of the systems and users' skills. That systems users must be trained properly so that they can adequately comply with the data management policies and procedures, therefore, is presented as one of the key mediating factors in the theoretical framework. If this situation does not exist, users will fail to use the system properly, which may in turn, affect the patterns of the actual usage, with a negative impact on the quality of healthcare service delivery. As noted before, the findings reflect cases of poor computer skills among many system users. Along with this statistic are numerous human-made errors in systems processes, resulting in the corruption of data and inaccurate patient records. There are different levels of user skills and the current training provided does not adequately address all of them. The most in need of training are those with limited computer background. Whilst these users need basic, more detailed and extended training, the assumption at the training sessions is that all users are at a same high level. This then results in the needs of the less-than-literate users being compromised.

6.2.2.1 Recommendations on Limited User Skills

The theoretical framework suggests that users must be skilled so that they are able to carry out their tasks and achieve healthcare goals. This is the most important part of the framework, that actors are able perform their responsibilities and achieve their goals. Lack of skilled users in the sector has an impact on the system operations, which results in negative outcomes in the framework. The findings indicate that there are two problems in this instance; firstly limited skills and secondly inadequate training to address them. Users with a limited computer background are not able to learn quickly and work comfortably on the systems

As a recommendation, the existing training sessions must be re-structured into multiple streams that cater for different levels of training needs. Greater emphasis must be placed on the needs of the semi computer-literate and the illiterate. The healthcare sector must implement compulsory skills development programmes, so that users can improve their skills and gain confidence in

using the existing systems. This will improve the usage of tools, boost users' confidence in working with systems, and this will have a positive impact on processes and outputs.

6.2.3   System Failures

According to the theoretical framework, tools are the mediators that support actors to carry out their activities, so that they can achieve their goals. In all organisations, especially the public healthcare sector, users rely on the availability of systems to fulfil their activities of capturing, retrieving and storing patient data. Therefore, systems are expected to be available and operative at all times. Compromises to system availability, thus, inhibit the smooth operations and good quality service delivery to the patients in clinics and hospitals. According to the findings, the systems are constantly slow or down, due to a limited capacity of networks compared to the workload they need to carry on a daily basis. The absence of stable systems has even reduced users trust, and thus the usage of electronic systems, resulting in users returning to paper-based systems as an alternative. A consequence of this is that users tend to forget system processes, because their experience has been reduced. Hence many errors occur when they attempt to use the system again. Common human errors include incorrect and incomplete capturing of information, which threatens the integrity and quality of data in the systems.

6.2.3.1 Recommendations on System Failures

The theoretical framework suggests that the systems must be appropriate and functioning; meaning that they must meet user's needs and be working all the time. The lack of functional systems disrupts the operations of the healthcare sector and service delivery to the patients. The findings show that the healthcare sector is faced with a challenge of systems that are constantly failing due to the limited capacity of networks. On the other hand other system failures are caused by human intervention.

The first suggested solution for the system failures are that the healthcare sector must invest in an upgrade of their network capacity in clinics and hospitals, to avoid network congestions. Secondly, since systems failure are not only limited to network congestions, the users must be formally sensitised on the importance of good quality data and be trained on correct data handling procedures over electronic systems in healthcare institutions. Thirdly there must be an effective implementation of operational processes on data cleaning, so as to improve the data quality in healthcare systems

6.2.4   User Access Control

The theoretical framework suggests that the compatibility of mediators with activities will result in a transformation of such activities into positive outcomes, which is a realisation of intended goals. Therefore it is not sufficient for systems in the healthcare sector just to be available; they must

also be accessible to users. This is made possible through users having accounts to access systems. Currently there are two systems that are used in the clinics and hospitals. Here, the PHCIS users in clinics can only read data but cannot make any amendments in the Clinicom system, meaning that they cannot update data in the central system. Whilst this access limitation maybe a data security measure, it is also a disadvantage to the healthcare sector as data is not updated regularly, since patients visit the clinics more often than the hospitals. On the other hand a complete lack of a proper user access control could result in data being exposed to the wrong people, which might threaten the confidentiality of patient healthcare data. The findings show that some users share their accounts with their colleagues. This loophole affects the system transaction logs as they are not a true reflection of who accessed the systems and when. Further, accounts management is not up to date; some users still have credentials based on their previous positions, because when they changed positions their access profiles were not amended.

6.2.4.1 Recommendations on User Access Control

According to the theoretical framework, access to the systems must be controlled properly. To improve accountability, users must not only have access to the systems but user's roles and access responsibilities must be matched and controlled. With these measures in place, systems administrators can draw on system activity logs to see who is accessing the systems, when and for what purposes. Thus a lack of access control measures increases security risks in terms of user accountability. This logic of the framework is that such omission will in turn compromise the integrity of processes, and weaken data security in the systems.

However, the findings indicate loopholes in the access control measures in the public electronic healthcare processes. In fact, some users share their accounts with their colleagues, meaning that they share passwords. This means that the user who owns that access account may end up taking responsibility for actions of several other users who have worked from the one workstation at different times. This reveals a serious accountability loophole. Such loopholes reflect that either the current access control policies are bad, not clear for users to understand, or they are not well communicated. This also shows a failure of access control policy enforcement in the public healthcare sector. As a recommendation then, institutional administrators must improve access control policies by making sure that they are communicated clearly to the users; and that proper adherence to these policies is enforced, in order to help improve accountability and responsibility of all the users that access the healthcare systems.

On the system access point, administrators must grant access to users according to the duties they perform, and ensure that each user has an access account. This will help reduce the sharing of accounts; improve the accuracy of system logs trails as the logs will be a true reflection of who accessed the system. Clinic and hospital healthcare systems must also be integrated so that users in these institutions can work together to improve the quality of data. Currently there are

two systems that are used in the clinics and hospital. The PHCIS users in clinics can only read data but cannot make any amendments in the Clinicom system, meaning that they cannot update data in the central system. Whilst this access limitation maybe a necessary data security measure, it is also a disadvantage to the healthcare sector as data will not be updated regularly since patients' visits are more to the clinics than the hospitals. Training programmes need to be updated to assist users understand their roles in data security and system access management. Most importantly, user accounts must be maintained regularly so that users do not end up with more or fewer access rights after a change of positions within the sector.

6.2.5   Data Integrity

According to the theoretical framework, a realisation of the healthcare information system (HIS) goals implies a positive transformation of activities (through the mediating factors), into intended outcomes. In other words, positive outcomes are the evidence of activities performed by the actors. On this point, the data that exist in the healthcare systems is a true reflection of the entire data handling process. This includes the quality of tools and other mediating factors, as well as the activities. Thus, the final data in the work-activity system is the product of what users have captured, and how they have done so. In this respect, the findings reflect inconsistencies in the quality of data in the public healthcare systems. One of the causes appears to be the frequent downtime of the systems. As a result, users end up with a backlog and are not able to capture all the data into the systems. Data integrity is also threatened by the existence of incorrect data in the system where important patient data, such identity numbers, are incorrectly captured, and patients are recorded as deceased while they are still alive. Incomplete and incorrect patient records have a negative impact on the statistics when drawing reports used to make important decisions in the healthcare sector.

6.2.5.1 Recommendations on Data Integrity

The theoretical framework, suggests that working systems, skilled personnel and adherence to data handling procedures results to correct processing of data. The integrity of data depends on these, systems must be available and operational, users must be skilled and data handling procedures must be communicated to them so that they know what is expected. The absence of these features can lead to corrupt data that cannot be used for decision making. Findings indicate that corrupt data exists and that there is a lack of advanced system developments in the healthcare systems.

According to the theoretical framework the presence of corrupt data suggests a lack of skilled personnel and proper adherence to data handling procedures which threatens data integrity. Therefore to improve data integrity in the HIS, the healthcare sector must implement policies for accurate data capturing which will improve the quality of data in the systems. Users must also be

educated on data integrity, in terms of what it means and how the lack of it impacts the healthcare data. Development of strict data validations must be enforced; to ensure the correctness of data.

6.2.6   Data Sharing

The assumption of the theoretical framework is that together the mediators and activities can lead to an outcome supported by the transformation process. The healthcare sector implemented the existing systems so that they can centralise data. The sharing of data is a good practice in organisations; however it should not pose a threat. Data must be shared responsibly, meaning it must be shared by the right people with the same goal and purpose. The findings reflect that the users have no understanding of data sharing and their responsibility in this process. Therefore, this lack of knowledge in the data sharing process is a threat to the healthcare data, as a result the existence of corrupt data in the systems, is the proof of the poor handling and sharing of data. Further the sharing of data between PHCIS and Clinicom systems is limited as users of these systems are not able to freely share data between their systems.

6.2.6.1   Recommendations on Data Sharing

From the theoretical framework perspective, users should be able to share data in the healthcare sector to improve the healthcare services. However data sharing should not threaten the security and confidentiality of patient healthcare information. According to the findings, a lack of proper training and poor data handling processes are the main challenges in the systems. This situation badly affects the quality of data sharing in the healthcare systems.

To improve data handling processes it is therefore recommended that the healthcare institutions should implement training programmes, to educate users about sound data sharing practices. In addition, data cleaning process must be enforced to enhance the quality of existing data. In line with efforts towards telemedicine (www.telemedafrica.co.za), data sharing training is of prime importance to the users. Telemedicine is a technology where medical personnel and patients communicate through the use of telephone and the Internet, without needing a physical face-to-face consultation. The medical personnel also share patient information with each other to investigate patient cases and find diagnoses for patients. Therefore, the security of systems must continuously be improved so that they are up to date and do not easily become victims of data theft or any other data threats.

6.3 Conclusion

This study sought to investigate the adequacy of data handling processes in the public healthcare information systems. The aim was to understand the challenges (including the issues of data quality), so as to inform improvements. In this respect, activity theory was used to formulate an analytical framework, the "healthcare information system data quality activity theory framework".

The framework was very helpful in understanding the healthcare information handling process as an activity system. Of utmost significance was the ability to apply a holistic approach into understanding, contextualising and analysing this phenomenon as a goal directed initiative. Understanding this as an activity system revealed the public healthcare information systems as a multifaceted, but objective focused system consisting of actors with respective goals. Although the goals may vary, they are joined together by the common objective. The logic of the framework is that a realisation of goals in the activity system depends on a number of factors. At first, there must be a synchronous inter-linkage between the goals of the actors, the mediating factors, such as adequate tools, user skills, enabling policies, and the systematic procedures that are diligently enforced. The opposite is assumed to have a negative impact on the realisation of the sought objective. The framework therefore, was very helpful in informing questions, the data collection and ultimately, the analysis processes.

In short, in order to understand the current status of the healthcare information handling processes and systems, factors that affect data quality and corruption, key actors were interviewed. This translated into one administration clerk, two ward clerks, one clerks' supervisor, one medical nurse, two system administrators (information officer and system manager in the public hospitals' systems: Clinicom) and one system manager (public clinics' system - PHCIS). Findings revealed a lack of adherence to information handling procedures and processes which lead to corrupt data in the systems. Further, most users' have limited skills, which is a hindrance to them performing their duties as expected. In fact, the healthcare sector is also challenged by systems which are constantly slow or down, due to limited network capacity and human errors. The presences of these challenges suggests non-adherence to data handling procedures, which explains the existence of corrupt data in the current healthcare systems.

Therefore it is recommended that the public healthcare administration must enhance their training programs. The training must be re-designed to cater for all users' needs, regardless of their background. It needs to improve user skills and boost their confidence in using electronic systems. Obviously, any changes and improvements need to be sustainable, and the sector is unlikely to succeed without enforcement of new procedures. Therefore, adherence to data handling procedures must be strictly enforced, with policies thoroughly communicated to the users. That way, the sector will not only have systems and related policies, but also ensure their full exploitation for improved service delivery in the public healthcare sector in South Africa.

6.3.1 Limitations of the Study

To conduct studies in the healthcare sector the researcher must apply for approval from the provincial research board. Further, if interviews are going to be conducted in academic hospitals there must be another approval from the hospital's board. The researcher followed these processes which were time consuming; it took approximately six months for the provincial board,

and an additional three months for the academics hospital research board to approve. As a result of this waiting a lot of valuable time was lost. Another challenge was that some of the identified participants from clinics were not available for interview, forcing a revision of certain sampling elements. Although the alternative data sources were legitimate and informative a revision was both time consuming and inconvenient.

6.3.2   Suggestions for future research

In terms of practice, this study was conducted in regional and academic hospitals in the Western Cape. Similar research should be conducted in other provinces such as Gauteng, KwaZulu Natal, the Eastern Cape, and Mpumalanga, to compare and contrast the circumstances in healthcare handling processes nationally. The government (Department of Health) should also look into improving the process of granting researchers' permission to conduct studies in the healthcare sector, by reducing the waiting period as it is currently three months. It is discouraging for the researcher to wait this long for the board to meet and come up with a decision.

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APPENDICES

APPENDIX 1: Table 4: Findings

Main Research Question: What are factors affecting the adequacy of the paper-based and the electronic information system to support the effective handling, storage & exchange of patients' data in the public healthcare sector (public hospitals and clinics) in South Africa?		
Theme	**Response** Question = Q; Response = R, Respondent reference: Institution abbreviation, Respondent abbreviation & response number.	**Implication**
Usage of tools	**Q: What is a computer system that is used to collect & store patient's information?** R: "The Clinicom system" (VHW, WC-R1; VHW, RC-R1; VHW, MN-R1) R: "I work daily on Clinicom" (TBH, CS-R1) R: "Clinicom, that's the only system I'm using" (TBH, WC-R1). R: "Mostly its Clinicom system and then also Cognos report viewer ..." (VHW, IO-R1) **Q: Is there any other system that you use?** R: "Cognos report viewer…" (VHW, IO-R1) R: "It is the Clinicom system, that's the only system I work with" (VHW, RC-R1). R: "Clinicom is the only system I use, but not a lot" (VHW, MN-R1). R: "…hospitals are [also] using the paper-based system …" (TBH,SA-R7) R: "…paper-based system…" (VHW, RC-R10; TBH, WC-R10; VHW, MN-R5; VHW, WC-R10; VHW, IO-R5) **Q: Why are you using the current computer system/s?** R: "[The old computer]system was not compatible with the next millennium…change over to the year 2000" (TBH, SM-R9). R: "Data was not centralized in the old system and were also not compatible or didn't meet new requirements in the healthcare sector" (TBH,SA-R2). R: "[We use Cognos report viewer to] …access and draw reports on the quality of our data and … also draw reports on [data] validation, [draw reports of] errors that we have [on the system]. [We]do verification with the daily list, unrecorded admin attendances reports" (VHW, IO-R1). **Q: Why do you still use the paper system?** R: "…I just use the paper-based system for [reports] verification…" (VHW, IO-R5) R: "…the paper-based system [is used for] all the doctors and nursing documents, for us [clerks] we don't need paper because all the information we need it's on the [Clinicom] system." (VHW, WC-R10) R: "…the doctors' prescription, notes… and the administration side we print the attendance form, inlay, patients' pre-forma and labels." (VHW, RC-R10) R: "…it's used just for backup just for record keeping, as we don't write everything about the patient on the computer we have a patient progress report where we write the patient's progress." (VHW, MN-R5) R: "… the medical information everything that the doctor has written on and things they requested so it's more the medical part…" (TBH, WC-R10) R: "We need [it] for the doctors because they do not use Clinicom, [but] they write on the folder…" (VHW, RC-R14) R: "... I just use the paper-based and [computer] system for verification…I use my paper-based	UNDERSTANDING OF EXISTING TOOLS, SYSTEMS & PROCESSES The first question pertained to the understanding of systems and tools used in the public healthcare sector. It is clear from the findings that the public hospitals and clinics are both using a combination of computers and paper-based systems. However, hospitals are using different computer systems to those used by clinics. In responding to a question about the type of computer systems used for example, hospital clerks stated the names of computers they use to collect & store patient's information, all of them saying that they use a system called "The Clinicom system" (VHW, WC-R1; VHW, RC-R1; VHW, MN-R1). Hospitals' information officers also indicated the use of another system, the "Cognos report viewer system", for managerial purposes. On this point, one information officer said "[We use Cognos report viewer] … to access and draw reports on the quality of our data and … also draw reports on [data] validation, [draw reports of] errors that we have [on the system]. [We] do verification with the daily list, [and] unrecorded admin attendances reports" (VHW, IO-R1). The importance of paper based systems such as patient files and folders was also emphasised by both the clerks and information officers alike. In this respect, hospital clerks said "…the paper [is used for] all the doctors and nursing documents..." (VHW, WC-R10), and also for "[reports] verification…" (VHW, IO-R5). It is also used for "…the doctors' prescription, notes… and the administration side we print the attendance form, inlay, patients' pre-forma and labels" (VHW, RC-R10), as well as for backup just for record keeping, as we don't write everything about the patient on the computer we have a patient progress report where we write the patient's progress" (VHW, MN-R5). Emphasis were that it is needed to work with doctors systems, as doctors need to manually write diagnostic and prognostic information when working with patients (TBH, WC-R10). As one clerk indicated, paper-based systems are not a compromise but very much a necessity. It is needed"...for the doctors because they do not use Clinicom, [but] they write on the folder…" (VHW, RC-R14). The same logic for paper-based systems was also emphasized by clerks in clinics. A somewhat different computer-based system, the PHCIS (Primary Healthcare Information System) is used in public clinics – for similar functions as in hospitals. "Yes it is similar to that, the reason why I'm saying that it's because we now have the maternity module which is used in the maternity sites but the admission of patients is the same throughout. We have the appointment, maternity, Routine Monthly Report (RMR),

	reports for, is to see the gaps…between paper-based and system and then try to verify those gaps…" (VHW, IO-R5)	those are the 3 modules we currently have and we hope to grow and have more in the future." (TBH, PM-R11)
	Q: Do you see any improvements since you started using computer system? **R:** "Yes better revenue and stats, main ones I would say is the statistics for National ... And that now patients data is centralized, which allows users to be able to easily share data." (TBH, SM-R10) **R:** "Yes there have been improvements in terms of data sharing…" (TBH,SA-R5)	USEFULNESS OF EXISTING TOOLS & SYSTEMS Having established the type of systems used, it became logical to establish the relevance and usefulness of these information systems to information handling processes of the public healthcare sector. At the first instance, the very development towards the "Clinicom" and "Cognos report viewer" systems was necessary and urgent for the sector, for 2 significant reasons. At the first instance, it was a necessary upgrade from the pre-millennium into a post year 2000 compliant development. In the words of the hospital officials, the "[old computer] system was not compatible with the next millennium…change over to the year 2000" (TBH, SM-R9), so an updated system became not just an option, but a necessity. The second reason was to improve operational efficiencies. Given that public healthcare institutions are centrally administered by provincial and national governments, facilitating data centralisation was also urgent. In clarifying this point, one hospital system analyst stated that "data was not centralized in the old system and were also not compatible or didn't meet new requirements in the healthcare sector" (TBH_SA-R2). For this reason, an innovation towards this end resulted into the acquisition of the Clinicom and Cognos report viewer systems. In terms of efficiencies, the aim was to improve accuracy and the handling of larger volume of data as well as to simplify the sharing of data (TBH, SM-R10). With this background in the hindsight, participants were then ask to reflect on the adequacy of the current systems in terms of ease of use (complexity), available support measures (competencies and training arrangements) as well as on fitness for purpose in terms of functionality, data integrity and data sharing.
User skills/ Competencies	**Q: Do you find it difficult to work on the Clinicom system?** **R:** "…it took a while to understand the system such that we were struggling to work in the beginning… If you don't have any computer background it's not easy to use the system… but after a while it was fine" (VHW, WC-R4). **R:** "… [I have been] working with the system since it was implemented I'm now used to the system" (VHW, RC-R11). **R:** "Not at all ..." (TBH, WC-R11) [**R:** "[I'm] very comfortable [working on the Clinicom system]" (TBH, CS-R8). **R:** "No it's not difficult at all…" (VHW, MN-R3) **Q: Do you find it challenging to work on the Cognos report viewer system?** **R:** "No I don't, it is quiet straight forward as in all my reports I just select the options on the drop-down menu" (VHW, IO-R6). **Q: Did you attend any training course on using the system?** **R:** "There was training that was provided". (VHW, RC-R2) **R:** "Yes, there was" (TBH, WC-R2). **R:** "I think it was in the beginning" (TBH, WC-R3)	User competencies refer to the understanding, literacy and ability (including dexterity) to put the system into effective use. In other words, whilst it is important to have relevant information systems, a system can only add value to the organisation if the users are aware of those systems; and are adequately skilled to put them into effective use. According to the findings however, there are limitations in terms of skills among system users in the public healthcare sector. As a result, users find it hard to put the system into effective use. Some of the problems according the users is that the system is complex and "…it took a while to understand the system such that we were struggling to work in the beginning…" (VHW, WC-R4). System complexity does not seem to be based on the structure of the system, but on background and computer literacy of some users who admit that it's because they "… don't have any computer background" (VHW, WC-R4) which then at the beginning stages makes it "… not easy to use the system…" (VHW, WC-R4). The system itself, nevertheless, is reported by the computer literate - to be fairly easy to use. A number of these respondents said that they were comfortable and had no challenges in working on the systems (VHW, MN-R3; TBH, CS-R8). Because of the different levels of skills, there were different views on the quality of the

	Q: How long was the training? R: "I can't recall now it was way back but I would say not sufficient training" (VHW, RC-R3). R: "It was just a day, one day training" (VHW, MN-R4). R: "it was two days and they are updated training sessions which are a day long" (TBH, WC-R3). **Q: Was the training useful?** R: "…the training I received it was very informative" (VHW, WC-R4). R: "We got stuck for a little while and after a while only we got it right, and know how the system works but it took a while as the system was new to us…" (VHW, RC-R4) R: "…they are follow-up training sessions which are a day long which are helpful" (TBH, WC-R3). **Q: Is it necessary to use the computer system?** R: "Yes it is very important that they use it as the department's goal is to centralize the systems and improve the usage of the tools provided" (TBH, PM-R12). R: "… because the auditor general audits you on your Clinicom reports... so I just work on Clinicom for audit purposes…" (VHW, IO-R5)	training that was provided to the users before they started working on the systems. Some respondents felt that the training was "… not sufficient ..." (VHW, RC-R3), as it was only "…two days …" (TBH, WC-R3), then later there were "…updated training sessions which are a day long" (TBH, WC-R3).While the other respondent felt that "…the training … was very informative." (VHW, WC-R4). Even though some users might have struggled to work with the system due to minimum skill, but after extensive practice they eventually learnt to work in the system. Therefore, the system is useful to the few that has computer skills and comfortable to work with it, however those that lack the skill it results to hindrance of the effective usage of the system.
Functionality	**Q: What are the common system failures that hinder your work?** R: "It's a nice system but the slowness of the network at times gets to us, the long periods we wait while the system is taking you to another function or while waiting for the system to give you information...its slow." (VHW, RC-R8). R: "Basically it's on the performance to what I was used to when we went live with Clinicom it worked like a dream…Besides the performance there is no other failure, because I think we are failing the system as we are not utilizing it to its fullest" (VHW, IO-R10). R: "There are problems like for instance, sometimes it's not clerks' problems it can be computer error..." (TBH, CS-R5) R: "… I think it's quite difficult for us when the system is down ..." (TBH, WC-R8) **Q: How have the systems failure experiences affected your work?** R: "Long waiting periods of patients, and the backlog of work" (VHW, RC-R9). R: "Is doesn't really affect me that much, as I don't use Clinicom that much. However I do get a lot of frustration from the users, as they use the system more…" (VHW, IO-R11) R: "… you get behind in your work; you must now wait until everything is on again …so you can't finish it..." (TBH, WC-R10) R: "Say for instance a patient has an appointment, but before they could do an attendance … we get it a lot when there is network slowness then the doctors cannot wait for the patients they will come and get the patients' then the nurses put the sticker on the clinic list, if that patient is not captured on the system with the appointment they will be filed in the unrecorded admin attendance report then from there the reception clerk will add it on to Clinicom" (VHW, IO-R4). **Q: When you experience errors or failures on the system, who helps you to fix them?** R: "… I log a call with the IT [Information Technology] department" (TBH, CS-R10) R: "... I then log calls with Helpdesk if there are any issues with the system performance or any other errors..." (VHW, IO-R11) **Q: Do you only get access to the functions you use? And what are those functions?** R: "Yes, just the ones that we use, patient administration just the admissions and all of that and the accounts" (TBH_WC-R5).	SYSTEM FUNCTIONALITY Organisations put systems in place so that they can improve their services and work performance. This however, demands a continuous and reliable functionality of the system. Unfortunately, findings indicate clear limitations in the functionality of existing electronic healthcare information systems in public hospitals and clinics. For example, administrators complain that the system often goes off-line and at times it can be very slow (VHW, RC-R8). Though electronic systems improve efficiencies, these functionality failures are disturbingly disruptive and annoying. The same administrator admits that Clinicom is "…a nice system…" (VHW, RC-R8), but complains that "the slowness of the network at times gets to [them]", adding that "… periods we wait while the system is taking you to another function or while waiting for the system to give you information [can be very long]...it's slow" (VHW, RC-R8). However it emerged in the findings, that users are very fond of the Clinicom system. In this respect, sentiments are that "besides the performance" hick-ups, "Clinicom is very helpful to look up that information, to print stickers and sometimes to look up patients telephone number or if the patient is in the ward and which ward is the patients" (VHW, MN-R2). EXTENT OF UTILIZATION Another respondent said that besides the network slowness issues Clinicom "…works like a dream…" (VHW, IO-R10). Further, this respondent admits usage limitations, saying in his confession: "I think we are failing the system as we are not utilizing it to its fullest" (VHW, IO-R10). In confirming that the system is not utilised fully, the medical practitioner agreed that she is using the system only "…to print stickers and sometimes to look up patients' telephone numbers or if the patient is in the ward and which ward is the patients..." (VHW, MN-R2). The system has the capacity to do much more than just the printing of stickers, meaning that it is grossly under-utilized. In the words of another respondent said

R: "Fortunately because I was a core trainer I have access to all the functions on Clinicom except billing because we don't do finance..." (VHW, WC-R6)

R: "I used to be a systems controller so I have access to all the functions, but I'm currently working as a clerk but my access to all functions was not changed..." (VHW, RC-R7)

R: "…I just use it to print stickers and sometimes to look up patients' telephone number or if the patient is in the ward and which ward is the patients… Clinicom is very helpful to look up that information of where the patient is" (VHW, MN-R2).

Q: How many patients do you serve per day?

R: "On daily basis in my ward its 30 patients, an average of 25 on a normal day and 30 on peak days so it depends. The ward has 12 high care (ICU) and 18 general beds" (TBH, WC-R16)

R: "This is a 26 beds ward, but we have been full capacity for quite some time so today only physical interaction with the patients I estimate between 30 to 40 patients per day" (VHW, WC-R14).

R: "It differs from day to day, today was a hectic days I might have seen ± 50 patients on a normal day ± 30 patients…" (VHW, RC-R15)

R: "About 26 to 27 patients … each day" (VHW, MN-R10)

that "… there is a lot of potential in Clinicom…" but "…we are not using everything in Clinicom. Currently I'm busy with the … project which is another function that Clinicom provides us but we never use it which will be an advantage for the hospital to use for accurate reporting purposes on disease classification." (VHW, IO-R8). Due to the system being down most users are losing confidence on the quality of data in the Clinicom and Cognos report viewer systems, and are turning to paper-based downtime procedures as an alternative. This has reduced time and experience spent on these electronic systems, to the extent of a visible reduction in skills for users. Voicing this concern, one official even complained that they now "…need to re-educate people to work from [the computer] system, [and to]… start trusting the data that … [they capture, both in terms of] the quality as well as the quantity" (VHW, IO-R7). Functionality failures are serious nevertheless, with various unfortunate implications to work processes. These include "long waiting periods of patients, and the backlog of work" (VHW, RC-R9). The biggest frustration is that users even "…get behind in [their] work; you must now wait until everything is on again …so you can't finish it..." (TBH, WC-R10).

HOW DO SYSTEM FAILURES AFFECT OTHER FUNCTIONS?

In fact, this does not only affect system users, but also other practitioners who depend on system users for relevant information. To clarify this point, the information officer said "…I don't use Clinicom that much. However I do get a lot of frustration from the users, as they use the system more…" (VHW, IO-R11). Adverse effects on doctor-patient consultations are also compromised. In the words of the information officer for example, "say for instance a patient has an appointment, but before they could do an attendance … we get it a lot when there is network slowness then the doctors cannot wait for the patients. They will come and get the patients, then the nurses put the sticker on the clinic list, if that patient is not captured on the system with the appointment they will be filed in the unrecorded admin attendance report then from there the reception clerk will add it on to Clinicom" (VHW, IO-R4). In other words, the doctor is compelled to take risks and override key steps in the information gathering process to attend to patients in distress during these disruptive system delays. This reflects not only a disruption to procedures in place, but also a negative effect on the quality and integrity of data as users update the paper-based lists and then later capturing the data on the system.

CAUSES TO SYSTEM FAILURES

According to the findings, system failures are the main hindrances to smooth operations in the healthcare sector. Participants cite limited capacity of the network relative to the ever-increasing traffic and human errors as the leading causes to system failures. On limited capacity, a high volume of transactions can result to network congestion. This has often compromised network performance and increased system errors. In terms of the increasing volume, one hospital official acknowledged that even if "Clinicom … worked like a dream … [while there] were 4 hospitals on the system … "system performance started to suffer when the number increased. In his own words, he complained that it was when "… more hospitals came on board that affected the performance" (VHW, IO-R10). There are many cases also, where systems failure has been due, mainly to

			human error. For example, there are cases where a system operator makes incorrect data inputs into the system, resulting into inaccurate records being kept in the system (TBH, CS-R5; VHW, IO-R12). HOW ARE THESE TACKLED? In trying to resolve the problems encountered in the system, users "...log calls with Helpdesk if there are any issues with the system performance or any other errors..." (VHW, IO-R11). Various methods are also used to resolve the most frustrating issues such as the network slowness. In this process, calls are logged and queries are assigned to network technologists to investigate and resolve the problems. The problem however, is that some of these queries don't get resolved immediately in some hospitals. In many of these cases, solutions for both the network and system errors involve external third parties who are the service providers for the healthcare sector. Other failures are system bugs or new user requirements require further corrections, improvements and additional developments. New innovations are introduced in finding solutions and accommodating emerging user requirements.
User access control	**Who has rights to access and share patients' data?** R: "… the reception staff at the facility and …employees that work with patient folder information they have rights to the system that includes reception staff, nurses, doctors, data capturers, project facilitators …and controllers have access as well" (TBH, PM-R1). R: "Everybody that has access to the system can share patient data, the users can only share information about the patient data according to the access they have in the functions such as inpatient, outpatient or medical records user you only have access to that information and you can only share in that specific module..." (TBH, SM-R1) **Q: Do the user rights differ? And how so?** R:" Yes they differ in by roles. The system always allows them to perform their duties for example the clerk will have access to captures patient details and print stickers. Basically if the reception clerk's duties are to open patient folders the system will allocate right according to those duties" (TBH, PM-R2). R: "Its according to profiles, you set up profiles per user's job description, and according to that job description you will be linked to a specific profile and then you will get access to and you only access to that profile that gives you access to the patient data..." (TBH, SM-R2) **Q: Are there cases where users share profiles?** R: "Yes there are users who still allow their colleagues to use their usernames and passwords…" (TBH, SA-R8) R: "… Sometimes you find users using the same username to access the system; however we have tried to implement policies to manage that" (TBH, PM-R3)		Data protection is vital for organisations and this cannot be fulfilled if the system is not designed in a way that is security compliant. Organisations therefore, must allocate access rights, appropriately only to officials with authority to operate in respective tasks. According to the findings, access rights are appropriately granted according to individual user responsibilities in the public healthcare sector, with slight variations between clinics and hospitals. In the clinics for example, "the reception staff … and …employees" such as "nurses, doctors, data capturers, project facilitators …and controllers" that work with patient folders have full access rights to tasks within their areas of operation in the system (TBH, PM-R2). The only difference in hospitals is that it depends on the setup of the institution. In the case of academic hospitals for example, only a few medical personnel have access to the Clinicom system for management purposes. In regional hospitals on the other hand, all medical personnel can perform some tasks in the system. There is a control in place where the " … users can only share information about the patient data according to the access they have in the functions such as inpatient, outpatient or medical records, users only have access to that information and can only share in that specific module..." (TBH, SM-R1). This ensures user accountability as it would not add any value if the users have access to modules that they don't work with and have no understanding of. The policy of separating access rights according to user responsibilities is a good practice. However, there are users who neglect these controls, but there are loopholes in the process. According one system manager, there are still instances where people use "…the same username to access the system…"(TBH, PM -R2) and the other respondent said that " …I was a core trainer I have access to all the functions on Clinicom..."(VHW, WC-R6). Even though this user has changed positions the profile was never updated accordingly. These failures to comply with the access control procedures create gaps in system logs, as logs will not be the true reflection of who exactly was

		working on the system. The failure to maintain users profile also poses a huge threat to data integrity in the system.
Data integrity	**Q: Who grants access to users?** R: "… [Its] the information officers or system controllers who give access to the users in their institutions" (TBH, SM-R3). R: "… they are granted access by the system controllers" (TBH, PM-R5) **Q: Do all the users have rights to amend patients' data?** R: "It depends on what you are amending, for example if you amending a duplicate, no users has rights to amend duplicate [records] in the system... It's only the system controllers that have the rights to amend duplicates. By making amendments on the Clinicom system it automatically updates on PHCIS system, so users in the PHCIS system can make changes on their side however it will not update what is in the Clinicom system" (TBH, PM-R8). R: "Its according to profiles, you set up profiles per user's job description, and according to that job description you will be linked to a specific profile and then you will get access to and you only access to that profile that gives you access to the patient data that you can change/revise or share with anybody else" (TBH, SM-R2). **Q: How are the amendments in patients' data managed?** R: "… it gets managed by confirming data with the patient, that's the only way to amend patient data. Specifically patient related data ..." (TBH, SM-R6) R: "There is a way of tracing that; however users are not able to change patients' identity numbers when a user enters a correct number the system will accept it. However if the incorrect number is enters the system is built in such a way that it will reject the incorrect combination of numbers" (TBH, PM-R10). R: "The system itself got a transaction log..." (TBH, SM-R7) **Q: Are there data discrepancies' that you experience when using the Clinicom or Cognos report viewer?** R: "...[yes the] reports discrepancies…" (VHW, IO-R10) R: "correct [-ion of] the patients' data" (TBH, WC-R6). R: "Yes there are data discrepancies that we experienced on the systems" (TBH, SA-R3). **Q: What are the causes of these data discrepancies in the systems?** R: "It could be that everything has not been captured… It could be human error on both sides where everybody has captured everything in system or in the register they have not captured properly" (VHW, IO-R11). R: "I will say … in my case it's because of head injuries that the patient can't give the correct information and I think clerical that they just don't do their work properly..." (TBH, WC – R17) R: "Some are users' errors where they misspell patients' information, as well as system errors for example its will allow users to insert numbers in fields that should allow characters only" (TBH, SA-R4). R: "...it's a reality sometimes system does have problems and it also comes down to human errors..." (VHW, IO-R12) **Q: How do these data discrepancies affect your work?** R: "...you need to see that your entire backlog is captured timeously. If it's not captured of course your reports will be wrong, if you have frequent slowness even if you try to capture that, your backlog because of the system being slow you won't be able to complete the backlog. The	Data integrity is always regarded as the most important factor in data quality. Organisations use their data for decision making; therefore it is crucial for systems to sufficiently provide decision makers with the accurate data. Though electronic systems are not perfect, the findings suggest that they improve the process of data integrity in the public healthcare sector. For example, users are granted access to the system, strictly according to the nature of their duties and responsibilities. As one respondent puts it "… [It's] the information officers or system controllers who give access to the users in their institutions" (TBH, SM-R3). In other words, the use of Clinicom enforces accountability and control on who accesses the system, amends data, how and when. For example, "if you are amending a duplicate, no user has rights to amend duplicate [records] in the system... It's only the system controllers that have the rights to amend duplicates…" (TBH, PM-R8). Even for those with rights to amend data, they remain fully accountable as there are logs that store evidence of the whole transaction. The accountability mechanism is that "by making amendments on the Clinicom system it automatically updates on PHCIS system" (TBH, PM-R8), reducing manual processes that may be prone to errors in the final record. So, "users in the PHCIS system can [only] make changes on their side…" without being able to "update what is in the Clinicom system" (TBH, PM-R8). Safeguards are not only limited to procedures, but are also built into the operational programmes of the electronic systems themselves. For example, "… when a user enters a correct number the system will accept it... [but] if the incorrect number is entered the system is built in such a way that it will reject the incorrect combination of number." (TBH, PM-R10). With these operational safeguards, factors that could compromise the integrity in the patient data are minimized. The downside of this safeguard mechanism however is that the PHCIS system in clinics and the central Clinicom system in hospitals would not always have identical data details between amendments. Nevertheless, the urgency for data integrity safeguards seems significant enough to warrant separate system updates. These positive sentiments however, do not any way imply the absence of system discrepancies towards ensuring the integrity of patients' data in the public healthcare sector. When asked to indicate whether discrepancies in the accuracy and integrity of data in the system for example, most respondents said "...it's a reality sometimes a system does have problems... [but]…it also comes down to human errors..." (VHW, IO-R12). Another respondent said, "Yes there are data discrepancies that we experienced on the systems" (TBH, SA-R3), which are mostly outcomes of human error (TBH, WC-R6). Complaints in this respect are that sometimes "everything has not been captured… It could be human error on both sides where everybody has captured everything in register [but have] not captured [it] properly" in the system (VHW, IO-R11). In fact, some users

	deadline for capturing is the 6th or 7th of every month as statistics are run and published after the 7th, if you still busy capturing on those days of cause your reports will be incorrect as you would have not been able to complete capturing data for that month" (VHW, IO-R12).	would "…misspell patients' information… [and there are cases the system] will allow users to insert numbers in fields that should allow characters only" (TBH, SA-R4), which does once again, come down to human error. These shortfalls would often lead to backlogs that do, directly or indirectly, affect the processes of data quality (VHW, IO-R12). The integrity of data is improved so that data sharing can be made possible, and adds value to the quality of service in the institutions'.
Data sharing	**Q: What are the restrictions used to make sure that the sharing of data is efficient?** R: "… you set up profiles per user's job description, … will be linked to a specific profile and then you will get access to and you only access to that …" (TBH, SM-R2) R: "… the reception clerk is restricted to only access the system on the site where the clerk is located … And in terms of passwords the security is that the passwords life span is 28 days the user must then renew the password when it has expired" (TBH, PM-R3). **Q: How do you make sure that the data sharing & security procedures used are the same?** R:"… no user can walk through the door and just access the system. Sharing of information is via ...the training procedure, a person will be trained first, an access form will be completed where it states the confidentially of accessing the system where they will vow that they will not disclose any patient information unless it's was requested via management or the right channels and according to that they will get access to the system and they sign this as a declaration for them and that they will protect patient confidentiality…" (TBH, SM-R3) R: "Firstly training is provided by our training coordinator for everybody, and then we also have access forms to be completed when training has been given signed by the system manager and also by the user… sometimes users are using the system without a clear understanding of what they are doing, and we don't want to blame the user but we have to train and assist the users to understand so that the correct information is captured in the system" (TBH, PM-R5). **Q: Are those data sharing procedures followed?** R: "The user only gets access according to their job restriction, and they are trained according to that and the supervisor request for training" (TBH, SM-R4). R: "At times some sites do follow, in terms of getting to merge temporal numbers but what has happened is that if they are not followed we escalate the matter to the managers then we hope things can be done but currently we follow up with managers" (TBH, PM-R6). **Q: What are data security majors used to ensure that patients' data is protected?** R: "Let me explain the password security the system requires a combination of alphabets and numeric … it doesn't allow only alphabets or numeric it has a combination of both, wild characters can also be included. The way you created your password it will be the way you will access it meaning if it was in capital letters when accessing the system you will use capital letters. So it won't allow you to access the system unless you type you password like you created it" (TBH, PM-R4). R: "… set up [users'] profiles per … job description…" (TBH, SM-R2)	Data sharing is the usage of the same information by multiple users. Because of the significance of information in the healthcare sector, issues of quality, integrity and efficiency become central to information sharing processes. That is, information needs to be transferred easily, faster and without compromises to its integrity between the sharing parties. In this study, findings show the existing healthcare information systems are embedded with features and procedures that enhance data sharing. On the point of efficiency, with the use of systems it is now easier, faster, and accurate for users to share data. Compared to conventional methods, new systems enable central storage; retrieval and easily exchange of information between clerks and medical personnel, faster, accurately and securely. For example system users can capture new information, thereby generating a reliable record that can be retrieved by anyone who needs it (and has a right to access it), anytime. This would include critical information for in-patients "when … [they] are admitted in the ward … and when they are discharged..." (VHW, WC-R15). This way, delays in patient healthcare services can be minimised. Despite these positive enhancements, there are still some areas of improvement needed for data sharing in the public healthcare sector. The main challenge that the healthcare sector is currently facing with data integrity, as the respondent elaborates is that "… sometimes users are using the system without a clear understanding of what they are doing…" (TBH, PM-R5). "and we don't want to blame the user but we have to train and assist the users to understand so that the correct information is captured in the system" (TBH, PM-R5). A failure for the users to understand what they are doing and why doing, can result to data sharing being a disadvantage as it will create a lot data integrity problems in the systems.

APPENDIX 2: ETHICS APPROVAL LETTER

**Cape
Peninsula
University
of Technology**

Research Ethics Committee
Faculty of Informatics and Design
Cape Peninsula University of Technology
20 June 2011

To whom it may concern

"Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa", by Ms NN Mchunu (207220557).

Dear Sir/Mam

The above proposal submitted for a Master of Technology (MTech) degree in the Faculty of Informatics and Design at the Cape Peninsula University of Technology (CPUT), refers.

After careful deliberation by the research ethics committee, application for ethics clearance as well as the proposal to conduct this project,were approved.

We trust that you will assist the candidate with access to your institution to pursue the project further.

Regards

....

Jay Barnes

Chair, Research Ethics Committee

APPENDIX 3: APPROVAL LETTER TO CONDUCT INTERVIEWS AT VICTORIA HOSPITAL

DEPARTMENT of HEALTH
Provincial Government of the Western Cape

STRATEGY & HEALTH SUPPORT

healthres@pgwc.gov.za
tel: +27 21 483 9907: fax: +27 21 483 9895
1st Floor, Norton Rose House,, 8 Riebeek Street, Cape Town, 8001
www.capegateway.gov.za

REFERENCE: RP 100/2011
ENQUIRIES: Dr V Appiah - Baiden

111 The Diplomat
Hans Strydom Avenue
Tulbagh Centre
Cape Town
8001

For attention: Nokubalela Mchunu

Re: Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa.

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research.
Please contact the following people to assist you with any further enquiries.

Victoria Hospital   **Dr Anke Nitzsch**   **(021) 799 1183**

Kindly ensure that the following are adhered to:
1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final report within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (healthres@pgwc.gov.za).
3. The reference number above should be quoted in all future correspondence.

We look forward to hearing from you.

Yours sincerely

DR T NALEDI
DIRECTOR: HEALTH IMPACT ASSESSMENT
DATE: 17/11/2011

page 1 of 1

APPENDIX 4: APPROVAL LETTER TO CONDUCT INTERVIEWS AT TYGERBERG HOSPITAL

Western Cape Government
Health

Tygerberg Hospital and
Mitchells Plain & Tygerberg Oral Health Centres

REFERENCE: Research Projects
ENQUIRIES: Dr M A Mukosi

ETHICS NO: 207220557 (Cape Peninsula University of Technology)

Adequacy of healthcare information systems to support data quality in the public health care sector, in the Western Cape, South Africa.

Dear Ms Nokubalela Mchunu

PERMISSION TO CONDUCT YOUR RESEARCH AT TYGERBERG HOSPITAL

In accordance with the Provincial Research Policy and Tygerberg Hospital Notice No 40/2009, permission is hereby granted for you to conduct the above-mentioned research at Tygerberg Hospital.

DR D ERASMUS
CHIEF DIRECTOR: TYGERBERG HOSPITAL

Administration Building, Francie van Zijl Avenue, Parow, 7500
tel: +27 21 938-5966   fax: +27 21 938-6698

Private Bag X3, Tygerberg, 7505
www.capegateway.go.v.za

APPENDIX 5: SAMPLES OF INTERVIEWS DATA TRANSCRIPTS

Interview questionnaires and response scripts for Victoria Hospital are listed below:

Date: 09 November 2011

Interviewee: ▮▮▮▮▮▮▮▮▮▮

Interviewer: Nokubalela Mchunu

Institution: Victoria Hospital

Venue: Ward supervisor's office

My name is Nokubalela Mchunu, I am doing Masters in Information Technology and as part of my study I am conducting a research in Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa. The purpose of this study is to understand the causes of data corruption in the existing healthcare information systems.

Question

What is the name of a computer system that is used to collect and store patient's information?

VHW, RC- R1: It is the Clinicom system, that's the only system I work with.

Question

Is there a training course that you attended before starting to work on the system? And what was covered in that training?

VHW, RC- R2: There was training that was provided. It was before we started working in the system. I was one of the system controllers, so I attended the training that covered all the modules in Clinicom at that time. This includes the out-patient, admissions, in-patient, patient information etc…

Question

How long was that training? And how many sessions did you attend?

VHW, RC- R3: I can't recall now it was way back but I would say not sufficient training. I really can't remember the number of sessions as it was a few years ago. But every Tuesday morning we used to go to Tygerberg hospital for training and some training sessions were held here at Victoria hospital.

Question

Why would you say that the training was not sufficient?

VHW, RC- R4: We got stuck for a little while and after a while only we got it right, and know how the system works but it took a while as the system was new to us. So it took a while to understand the system such that we were struggling to work in the beginning, of course with a new system you will struggle but after a while it was fine. And I think they were supposed to give us more training in Clinicom as it was a new system to us. If you don't have any computer background it's not easy to use the system. Which make your work to be difficult, the training was not broad as I would have liked it to be, more time was needed.

Question

Was there a specific plan that was followed during the training? Was there any support you got when experiencing problems after the training?

VHW, RC- R5: Yes there was a plan that was followed as in Clinicom you cannot work on other modules without understanding the previous modules, so we were working according to how the modules are connected.

There was support for a little while, but as I said there was no sufficient time, it was limited.

Question

Who gathers the patients' demographic details?

VHW, RC- R6: It's the clerks, should it be a new patient you ask them their income, address, marital status, if they employed then the system calculates and charges them accordingly for the service they will be getting, collect money and then direct them to doctors that they must go to. And for old patients who are coming for appointment I capture the attendance on the system.

Question

How are the access rights assigned to the user? / do you only get access to the   functions you use? What are those functions?

VHW, RC- R7: I used to be a systems controller so I have access to all the functions, but I'm currently working as a clerk but my access to all functions was not changed. However I still assist people who are having difficulties working on the system, for example flushing invoices that are older than 7 or 14 days.

Question

What is the procedure of gathering and recording of the patients' information?

VHW, RC- R6: Yes, we can't force anything out of the patients, but we do adhere to hospital policies that we need to ask these questions and we tell the patients that it is what we need to have from then as proof of address, pay slip as proof of income, proof of unemployment and that is the information that we try by our outmost to get from the patients.

Question

Can you recall instances where you couldn't get all information from a patient using these procedures?

VHW, RC- R7: Not really there are no cases that people were unwilling to give information. If they don't have it at first hand there is always a follow up visit, and we give them a document of what they need to bring us and we also record it in the system of what they should bring next time they visit.

Question

What are the most frustrating experiences you come across when acquiring information from patients and working with the system?

VHW, RC- R8: It's a nice system but the slowness of the network at times gets to us, the longs periods we wait while the system is taking you to another function or while waiting for the system to give you information. I don't know what the causes are, but that's the most frustrating thing but you get used to the system after a while and all of the sudden its slow.

Question

How have those experiences affected your work?

VHW, RC- R9: Long waiting periods of patients, and the backlog of work.

Question

For what purpose are paper-based files (systems) used?

VHW, RC- R10: The paper-based system is used for the doctors' prescription, notes recording what is wrong with the patient and the administration side we print the attendance form, inlay, patients pre-forma and labels.

Question

Is it easy or challenging to use this system? (Please elaborate!)

VHW, RC- R11: Not really there are no challenges after 25 years in the institutions and been working with the system for since it was implemented I'm now used to the system.

Question

At what point do you record the patients' information on the system?

VHW, RC- R12: When they arrive before they go to see the doctors.

Question

Which language do you use to acquire information from the patients?

VHW, RC- R13: Mostly English, but we do get Afrikaans patients and they ask us if they can speak Afrikaans and we say yes they can speaking but should we get difficulties with Xhosa patients we get the translator to come assist us.

Question

Why is the institution only using the paper/ computer/ both systems?

VHW, RC- R14: We need to have the physical folder for the doctors because they do not use Clinicom, they write on the folder, it's just the patient details that we need to capture on the system.

Question

How many patients do you serve per day? Peak days, why?

VHW, RC- R15: It differs from day to day, today was a hectic days I might have seen ± 50 patients on a normal day ± 30 patients. At this moment we are short stuff and some clinics are closing (festive season) so the doctors try to see their patients before the clinics close before they go on leave, today being a Monday we have the Fracture clinic which is the busiest mostly in the morning, on Tuesdays and Thursdays its busy right through the day. We have been struggling for the last month and a half with the short of stuff the slowness of the system, we used to be six but now we are three and sometimes our supervisor helps us, such that we are unable to take lunch and break we must eat in between assisting patients.

Date: 09 November 2011

Interviewee: ████████████

Interviewer: Nokubalela Mchunu

Institution: Victoria Hospital

Venue: Ward supervisor's office

My name is Nokubalela Mchunu, I am doing Masters in Information Technology and as part of my study I am conducting a research in Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa. The purpose of this study is to understand the causes of data corruption in the existing healthcare information systems.

Question

What is the name of a computer system that is used to collect and store patient's information?

VHW, WC- R1: The Clinicom system.

Question

Is there a training course that you attended before starting to work on the system?

VHW, WC- R2: I was one of the core trainers.

Question

And how long was your training?

VHW, WC- R3: I was one of the core trainers. We actually built the system or not built it but revised in in Tygerberg Hospital, and that went on for about a year. Just before we went rolled out here at Victoria hospital we gave training to all categories of staff.

Question

Were you satisfied with the training you received and gave to the staff member?

VHW, WC- R4: With myself I was satisfied definitely yes; with the training I received it was very informative.

Question

As the ward clerk how does your work differ from the reception clerk's work?

VHW, WC- R5: In the wards you basically work more with the stock control, with the physical equipment that is with the patient. At reception you basically handle the patients' information, and accounts. You have got the medical side which is the wards and the practical side which is administration (reception) the two combined you will find it in the wards together. But you will have to know both sides to be able to work in the wards.

Question

Do you only get access to the functions you use? What are those functions?

VHW, WC- R6: Fortunately because I was a core trainer I have access to all the functions on Clinicom except billing because we don't do finance, the reception has finance it's not necessary for us to have billing in the wards.

Question

What is the procedure of gathering and recording of the patients' information?

VHW, WC- R7: At the ward level I deal with the patients' admissions, appointment booking, arranging transport, transfers, discharge, and case note tracking The reception clerks focus mostly on the demographic and billing information and when there is data missing I get to fill it as I spend more time with the patients.

Question

Can you recall instances where you couldn't get all information from a patient using these procedures?

VHW, WC- R8: For instances with the medical aid patients they won't have all the required information when they come to the hospital, but since they are admitted in the ward. I have more time with patients in the ward so if there is information missing I inform the patients and make notes on the system and also write on the patient folders so that the nursing staff can be aware, then when a family member visits the patient they can bring the missing documents required.

Question

What are the most frustrating experiences you come across when acquiring information from patients?

VHW, WC- R9: It depends on the willingness of the patients, you can say there are frustrations and you can also say there aren't this depends entirely on the patients like a lot of them don't want to declare how much they earn, unfortunately there is a function that requires the income maximum value for Billing purposes. In case where there is no proof of income the patients are requested to bring proof, if there is anything that needs to be changed the fees team does that an that's how the hospital supposed to work in getting in its revenue

Question

For what purpose is the paper-based systems used?

VHW, WC- R10: As far as the paper-based system is concerned it's all the doctors and nursing documents, for use we don't need paper because all the information we need it's on the system.

Question

Is it easy or challenging to use this system? (Please elaborate!)

VHW, WC- R11: I don't find any challenges as I was a core trainer before so I know my way around the system

Question

Which language do you use to acquire information from the patients?

VHW, WC- R12: English and Afrikaans its fine I don't have a problem with that, then for Xhosa and other languages that I don't understand I always get colleagues to translate for me.

Question

What are the most common difficulties associated with the language differences?

VHW, WC- R13: There no difficulties as I said when a patient can't speak English or Afrikaans I always get a colleague to assist me.

Question

How many patients do you serve per day? Peak days, why?

VHW, WC- R14: This is a 26 beds ward, but we have been full capacity for quite some time so today only physical interaction with the patients I estimate between 30 to 40 patients per day.

Question

When (at what point) do you record the patients' information on the system?

VHW, WC- R15: When the patients are admitted in the ward I do their admissions direct them where they are going to be and inform them about the visiting hour, and when they are discharged I do their discharges on the system.

Date: 09 November 2011

Interviewee: ▮▮▮▮▮▮▮▮▮

Interviewer: Nokubalela Mchunu

Institution: Victoria Hospital

Venue: Ward supervisor's office

My name is Nokubalela Mchunu, I am doing Masters in Information Technology and as part of my study I am conducting a research in Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa. The purpose of this study is to understand the causes of data corruption in the existing healthcare information systems.

Question

What is the name of a computer system that is used to collect and store patient's information?

VHW, MN- R1: Clinicom is the only system I use, but not a lot.

Question

Can you take me through when you working on Clinicom what is it exactly that you do on the system?

VHW, MN- R2: Well mostly I just use it to print stickers and sometimes to look up patients telephone number or if the patient is in the ward and which ward is the patients because many times visitors come here looking for patient and if we don't have them in our ward Clinicom is very helpful to look up that information of where the patient is.

Question

So you don't get to write any information in the Clinicom system?

VHW_MN- R3: No I don't do that.

Question

Are there any cases where it was difficult for you to use the Clinicom system

VHW, MN- R3: No it's not difficult at all, it's just that I did the Clinicom course they did show me how to do transfers and discharges, but we don't really do that as the ward clerk usually does that do that why I don't do it. But if I really have to do it, then it will just take me a bit of time but I'm sure I will be able to do it.

Question

How long was the Clinicom training?

VHW, MN- R4: It was just a day, one day training.

Question

I know you use the paper and Clinicom systems; do you know why you use both systems?

VHW, MN- R5: I think the paper-based systems is used just for backup just for record keeping, as we don't write everything about the patient on the computer we have a patient progress report where we write the patient's progress.

Question

Have you experienced any challenges with the paper system?

VHW, MN- R6: No, not at all because it's been like this forever.

Question

In terms of patients' assessment and diagnosis where is that information stored?

VHW, MN- R7: Yes it's usually in the folder, the patient's folder and the patient's record. You get the white folder where the doctors' notes and lab results are stored, and then the flip hard cover file where the nurses' notes are kept.

Question

When that folder goes to medical records does it go together or separately?

VHW, MN- R8 We take the contents out of the doctors' note and put it in one patient file which goes to medical records.

Question

Which language do you use to acquire information from the patients?

VHW, MN- R9: We use English the most as most people understand it, for those that don't we get one of the nurses to interpret.

Question

How many patients do you work with daily?

VHW, MN- R10: About 26 to 27 patients and I work from Monday to Friday from 06:45 to 16:00, so I work every day with a lot of patients unlike someone who works two days and be off. Because I see different patients every day as they come and go each day

Question

Are there days where you can say they are your peak days, where you work with a lot of patients?

VHW, MN- R11: Basically every day is the same as I see the same amount which is plus 26 patients each day.

Date: 09 November 2011

Interviewee: ████████████

Interviewer: Nokubalela Mchunu

Institution: Victoria Hospital

Venue: Ward supervisor's office

My name is Nokubalela Mchunu, I am doing Masters in Information Technology and as part of my study I am conducting a research in Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa. The purpose of this study is to understand the causes of data corruption in the existing healthcare information systems.

Question

Which systems do you work with mostly?

VHW, IO- R1: Mostly its Clinicom system and then also Cognos report viewer because it is a provincial data collecting programme where we do our submissions through to Head Office so whatever we capture on Cognos report viewer, Head Office can then access and draw reports on the quality of our data and then they can also draw report on validation, errors that we have, do verification with the daily list, unrecorded admin attendances reports and all those things.

Question

You talked about data quality and reporting on security, what kind of processes do you have in terms of data storage and processing?

VHW, IO- R2: Data storage basically each department has their various folders that they keep for example in OPD what they do with regard to quality data checks and data storage they do a daily clinic list whereby they will verify patients that arrived on the day and patients that are not on the system for that day so that they can be put on the system thereby they can add a label to the clinic list in order for the reception to put those people on. So just as the double check if they have bypassed the reception areas we can then go according to that and check whether all patients has been captured that is for data quality check that we use for our outpatients. For myself (Information officer) what I do I get my monthly reporting from the Cognos Viewer, Clinicom reports I then also do verification with the daily list, unrecorded admin attendances report that reception print which they also keep on file to see what patients, because sometimes you get patients that fall through the cracks where they get to the see the doctor without being registered in system but there is an appointment for that patient so what the reception will do they will draw unrecorded admin attendance to go and check whether those attendances has been captured on the system those reports gets filed for auditing purposes, then I also do the ZZZ reports to see that the specialties has been properly captured and then I also do accumulated discharge and admission reports that is all part of quality checks that I do to see that all patients are properly captured in the system.

Question

You said that in the ward list some patients that are not there, are you referring to new patients?

VHW, IO – R3: No it can be follow ups also because what can happen is a patient has an appointment then that patient will appear on that clinic list, then you get those patients with appointments written on the card but not in the system so those patient might fall through the cracks so those patients if they bypass the reception and get their folder somewhere what the nurses do they will take the sticker and put it in the clinic list then reception will verify for that clinic that all patients have been captured so that we don't miss out any patients at the end of the day. And that list they also keep on record as a data quality check.

Question

So basically there are cases where a patients cannot go the reception but be able to be in the ward?

VHW, IO- R4: Say for instance a patient has an appointment, but before they could do an attendance especially we get it a lot when there is network slowness then the doctors cannot wait for the patients they will come and get the patients' then the nurses put the sticker on the clinic list, if that patient is not captured on the system with the appointment they will be filed in the unrecorded admin attendance report then from there the reception clerk will add it on to Clinicom.

Question

Why does the institution use the paper-based and the computer systems used?

VHW, IO- R5: Currently what I'm doing is I just use the paper-based and computer system for verification but I don't report on the paper-based even if is more than the computer system, I report solely on one system and that's on the Clinicom system I don't use my paper-based reports for reporting purposes the only thing that I use my paper-based reports for, is to see the gaps. What are the gaps between manual and system and then try to verify those gaps, I just keep to one system especially because the auditor general audits you on your Clinicom reports so if I report on two systems that will reflect discrepancies on the audit so I just work on Clinicom for audit purposes. I just use the paper-based for verification to see where are the gaps that we need to close as an operational issue. . I just use the paper-based and [computer] system for verification…I use my paper-based reports for, is to see the gaps…between paper-based and system and then try to verify those gaps…" (VHW, IO- R5)

Question

Do have any challenges working on the Cognos report viewer system?

VHW, IO- R6: No I don't, it is quiet straight forward as in all my reports I just select the options on the drop-down menu.

Question

Which of the system do you prefer the most (please explain why)?

VHW, IO- R7: I use Clinicom even if it's wrong I use it because we need to start and educate people to work from one system, we should start trusting the data that we enter, the quality as well as the quantity.

Question

If there was another system available would you still prefer to use Clinicom?

VHW, IO- R8: Well now that I know what Clinicom can do, there is a lot of potential in Clinicom we don't use it as we are not using everything in Clinicom. Currently I'm busy with the ICD 10 coding project which is another function that Clinicom provides us but we never use it which will be an advantage for the hospital to use for accurate reporting purposes on disease classification.

Question

You mentioned having to train people to work on the one system (computer system), are you having challenges where users rely more on the paper system then the computer system

VHW, IO- R9: Not really it's just that it is like I said that we need unfortunately to keep manual records as well for auditing purpose, because we need to have source documents to verify where our data comes from and also for quality check, as it came out in the pre-audit that we need to have source documents and registers in place so there always be two systems but I only report on the computer. It would be fine if there can only be one system so that we don't have to worry about the registers.

Question

What are the common system failures that hinder your work?

VHW, IO- R10: Basically it's on the performance to what I was used to when we went live with Clinicom it worked like a dream, maybe it's because there were not many hospitals that were live then we were the first hospital that went live after the 3 academic hospitals, so then we were 4 hospitals on the system and it worked like a dream. And the more hospitals came on board that affected the performance. Besides the performance and reports discrepancies, there is no other failure, because I think we are failing the system as we are not utilizing it to its fullest.

Question

How do these performance failures affect your work?

VHW, IO- R11: It doesn't really affect me that much, as I don't use Clinicom that much. However I do get a lot of frustration from the users, as they use the system more. I then log calls with Helpdesk if there are any issues with the system performance or any other errors. I only use the system in the morning where I check my reports.

Question

What are the causes of the reports discrepancies, where more numbers reflect on the manual and less on the computer system?

VHW, IO- R12: It could be that everything has not been captured sometimes I have also proven the opposite where the system is more than the manual. It could be human error on both sides where everybody has captured everything in system or in the register they have not captured properly.

Question

How do these reports discrepancies affect your work?

VHW, IO- R13: That is one of the things that we cannot get pass, it's a reality sometimes system do have problem and it also come down to human errors where you need to see that your entire backlog is captured timeously. If it's not captured of course your reports will be wrong, if you have frequent slowness even if you try to capture that you backlog because of the system being slow you won't be able to complete the backlog. The deadline for capturing is the 6th or 7th of every month as statistics are run and published after the 7th, if you still busy capturing on those days of cause your reports will be incorrect as you would have not been able to complete capturing data for that month.

Interview questionnaires and response scripts for Tygerberg Hospital are listed below:

Date: 17 May 2012

Interviewee: ███████████

Interviewer: Nokubalela Mchunu

Institution: Tygerberg Hospital

Venue: Ward supervisor's office

My name is Nokubalela Mchunu, I am doing Masters in Information Technology and as part of my study I am conducting a research in Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa. The purpose of this study is to understand the causes of data corruption in the existing healthcare information systems.

Question

What is the name of a computer system that is used to collect and store patient's information?

TBH, WC- R1: Clinicom, that's the only system I'm using. Clinicom is a very user friendly system and not complicated to use.

Question

Is there a training course that you attended before starting to work on the system?

TBH, WC- R2: Yes, there was.

Question

And how long was the training? What was covered in that training?

TBH, WC- R3: I think it was in the beginning it was two days and they are follow-up training sessions which are a day long which are helpful. Training covered the specific part of Clinicom that was needed for you to know to do your job sufficiently

Question

Who gathers the patients' demographic details?

TBH, WC- R4: It depends where the patient starts if he came in via admissions then the admissions clerks supposed to do that otherwise it's the ward clerk if the patients came unconscious maybe then we as ward clerks need to follow up when they are conscious and ask the address and stuff like that it depends if they came in at first.

Question

Do you only get access to the functions you use? What are those functions?

TBH_WC- R5: Yes, just the ones that we use, patient administration just the admissions and all of that and the accounts.

Question

What is the procedure of gathering and recording of the patients' information?

TBH, WC- R6: I think you just start at the beginning, by the address, if the name and date of birth is correct, and address of where the people work, contact number, and you must correct the patients' data. Yah the basics things that you need for the accounts also.

Question

Can you recall instances where you couldn't get all information from a patient using these procedures?

TBH, WC- R7: Yah I'm working at Neuro surgery ward so a lot of those patients its head injuries so they are either unconscious or confused so they give wrong information or none at all so we need to wait for when family comes in so we can ask them what the right information is.

Question

What are the most frustrating experiences you come across when acquiring information from patients?

TBH, WC- R8: Yaaaaah, I don't want to put other people in bad books I think it's quite difficult for us when the system is down and IT is taking long to resolve our problems after we logged calls and you need to make changes in connection with the patient, print stuff that needs to be signed admission forms and things like that, also frustrating if you need to get the laboratories that is constantly not working that is also frustrating because usually the doctors ask to print out lab results for them.

Question

You talk about system being down, are there any procedures that you follow when the system is down? And are they easy to use?

TBH, WC- R9: Yes there are procedures that you must follow and pages that you must fill-in and then put in the system afterwards. Yes it very easy to use, that is straight forward.

Question

How have those experiences affected your work?

TBH, WC- R10: Yah it's like you get behind in your work, you must now wait until everything is on again or whatever so yah so you can't finish it. You must now hang on and wait.

Question

Why is the institution using both the paper and computer systems?

TBH, WC- R10: The paper-based system is mostly just for the medical information everything that the doctor has written on and things the requested so it's more the medical part and I think Clinicom is more administrative part like the address where the account my go and the billing on the Clinicom system. I think the file is for the medical information.

Question

Is it easy or challenging to use these two systems? (Please elaborate!)

TBH, WC- R11: Not at all, because when the doctors are finished the file always comes to the clerk and you discharge the patient and do all the administration then you can send the file to the medical records or to the auditors if it's the private patient to the accounts department. If the patient has an appointment with the clinic then you send it to the clinic if the patient has an appointment in the near future. Clinicom is a very user friendly system and not complicated to use.

Question

When (at what point) do you record the patients' information on the system?

TBH, WC- R12: At arrival when the patient comes to the ward usually you ask if all the information like the address and all the information in the file is still the same and from there the nursing staff takes over, if it's possible the day of arrival but some other times its quite busy then it's the next day when you get the chance to go through the ward. As we go through the ward everyday it's the first thing you do in the morning print the ward list and got through the ward to make sure that all the patients in the ward and in the ward list are the same.

Question

Which language do you use to acquire information from the patients?

TBH, WC- R13: Mostly I think English, I usually ask the patient which language you prefer to speak unfortunately I can't speak Xhosa but then it's English.

Question

What are the most common difficulties associated with the language differences?

TBH, WC – R14: Definitely so then I need to find someone who can translate.

Question

Where both the paper and computer-based systems are used: how is data integrated?

TBH, WC- R15: I think at the moment it works quite well, but I think there is a lot of room for improvement and it will be very nice if they can put everything on the computer system and let the doctor do they stuff on the system that will be wonderful that we don't have to look for file that is lost and everything.

Question

How many patients do you serve per day? Peak days, why?

TBH, WC- R16: On daily basis in my ward its 30 patients, an average of 25 on a normal day and 30 on peak days so it depends. The ward has 12 high care (ICU) and 18 general beds.

Question

In terms of data, earlier we talked about correcting patient data where is not correct, on how many cases where you have found that the data was totally incorrect?

TBH, WC – R17: I will say percentage-wise its 10 percent but I think in that 10 percent in my case it's because of head injuries that the patient can't give the correct information and I think clerical that they just don't do their work properly its 3 percent.

Date: 17 May 2012

Interviewee: ▮▮▮▮▮▮▮▮

Interviewer: Nokubalela Mchunu

Institution: Tygerberg Hospital

Venue: Ward supervisor's office

My name is Nokubalela Mchunu, I am doing Masters in Information Technology and as part of my study I am conducting a research in Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa. The purpose of this study is to understand the causes of data corruption in the existing healthcare information systems.

Question

What are the systems that are used to gather and record patient's demographic information (in the institution)?

TBH, CS- R1: I work daily on Clinicom

Question

Where are the patients' records stored for both systems?

TBH, CS- R2: No, I'm not clued up with that I don't work in that department, the storage of medical folders will be in medical records department say the patient has been in outpatients today this afternoon the folder will go down to medical records where they will file it in the file storages.

Question

For what purpose are paper-based files (systems) used?

TBH, CS- R3: We use them to store patients' notes and lab results.

Question

Do you know of any procedures that are put in place to ensure that the clerks capture correct information in the system?

TBH, CS - R4: Yah there is, we do spot check and if you do get faulty stuff you will call in the clerk and at about the 4:03… about the incident taking place.

Question

Would you take me through those problems you experience?

TBH, CS- R5: There are problems like for instance, sometimes it's not clerks problems it can be computer error as well where some sometimes it doesn't default for instance if it's a child the father will be a patient instead of the debtor or vice versa, the child will be a primary debtor and the father will be the patient where it is the child who is the patient and the father is the primary debtor. And those type of stuff and the classification if they classify the patient in a high bracket and reclassify to a low bracket without supporting documents those are type of thing you are looking at and do they do their charge entries on daily bases, do they have problems with the coding and charging of the patients those are the things you look at constantly

Question

When you do those spot checks are there any reports that you draw from the system or you do it manually?

TBH, CS- R6: I can do it manual and I can do it here on the computer system.

Question

Are those daily reports?

TBH, CS- R7: You get your inpatient ward list, ward list with diagnose, midnight lists all those type of lists that you use to sort of draw a spot check for instance if the patient has been discharged today, say two o'clock and the ward clerks doesn't do the discharge immediately if you print the late night report you are able to see who did the transaction and what time the transaction was done and why didn't she do the transaction on that particular day why did she keep it over until the next day.

Question

Do you feel comfortable working on the Clinicom system, do you find it user friendly?

TBH, CS- R8: Very comfortable.

Question

What are the common system failures that hinder you work?

TBH, CS- R9: Because I do work daily on it but not since the morning whenever I have a chance I do work on it, so that will able more on the people that work on Clinicom the whole day. I don't have much challenge because I do my office work and then will go to the system when I need to. What I normally work on its Excel, Word and those type of things.

Question

When you actually do work on Clinicom what is it that you do there?

TBH, CS- R10: I do spot checks and when people have problems I help them where I can and if I can't I log a call with the IT department but I don't attend or admit patients those type of things that the clerks usually does.

Date: 17 May 2012

Interviewee: █████████████

Interviewer: Nokubalela Mchunu

Institution: Tygerberg Hospital

Venue: Ward supervisor's office

My name is Nokubalela Mchunu, I am doing Masters in Information Technology and as part of my study I am conducting a research in Adequacy of healthcare information systems to support data quality in the public healthcare sector, in the Western Cape, South Africa. The purpose of this study is to understand the causes of data corruption in the existing healthcare information systems.

Question

Who has rights to access and share patients' files?

TBH, PM- R1: The rights to access and share patient file, aah people that have right for user access to the system or the reception staff at the facility and basically people who have rights on the system or employees that work with patient folder information they have rights to the system that includes reception staff, nurses, doctors, data capturers, project facilitators have rights as well and controllers have access as well.

Question

Do the user rights differ? And how so?

TBH, PM- R2: Yes they differ in terms of by roles. The system always them to perform their duties for example the clerk will have access to captures patient details and print stickers. Basically if the reception clerk's duties are to open patient folders the system will allocate right according to those duties.

Question

What are the restrictions used to make sure that the accessing and sharing of data is efficient?

TBH, PM- R3: The restriction that we use the reception clerk is restricted to only access the system on the site where the clerks is located meaning that for example if the clerks is creating under a specific clinic and for some reason move to another clinic that clerk will not be able to access the system in that clinic the system will indicate that the user does not have right to access the system in that site. Sometimes you find users using the same username to access the system; however we have tried to implement policies to manage that. And in terms of passwords the security is that the passwords life span is 28 days the user must then renew the password when it has expired.

Question

What are the passwords security majors when the user is creating the new password?

TBH, PM- R4: Let me explain the password security the system requires a combination of alphabets and numeric, now it doesn't allow only alphabets or numeric it has a combination of both, wild characters can also be included. The way you created your password it will be the way you will access it meaning if it was in capital letters when accessing the system you will use capital letters. So it won't allow you to access the system unless you type you password like you created it.

Question

How do you make sure that the data accessing and sharing procedures used are the same?

TBH, PM- R5: Firstly training is provided by our training coordinator for everybody, and then we also have access forms to be completed when training has been given signed by the system manager and also by the user, and then they are granted access by the system controllers. We then have process again in terms of handling challenges we have duplication management in terms of ensuring that duplicates are managed accordingly. And there is a policy that we have that applies to the system so those are tools that we use to ensure that data is correct we don't only stop there myself and the system controller have checks whereby we look at data to ensure that where the was down time temporary numbers are managed. We draw report to show us what is happening in the sites we will draw temporal numbers report to see if users are using temporal numbers where the system was down. We also draw a report called bad edit which shows us how data was inserted; if data was inserted incorrectly we then inform the site and give training to those users so they understand the

system. Because sometimes users are using the system without a clear understanding of what they are doing, and we don't want to blame the user but we have to train and assist the users so understand the correct information is captured in the system.

Question

Are those restrictions and procedures followed?

TBH, PM- R6: At times some sites do follow, in terms of getting to merge temporal numbers but what has happened is that if they are not followed we escalate the matter to the managers then we hope things can be done but currently we follow up with managers.

Question

You said some sites do follow the restrictions; in a scale of 5 please indicate how many sites?

TBH, PM- R7: I would say 2 out of 5 and the reason why in most cases there are reason why they don't merge temporal numbers, its due to the amount of workload that they have, you find that the temporal numbers are in congestion and site is highly busy and by the end of the day the users are tired and the backlog will be carried over to the next day.

Question

Who has rights to amend data in patients' data in the system?

TBH, PM- R8: It depends on what you are amending, for example if you amending a duplicate, no users has rights to amend duplicate in the system it's only the guys that we send duplication tools. It's only the system controllers that have the rights to amend duplicates. By making amendments on the Clinicom system it automatically updates on PHCIS system, so users in the PHCIS system can make changes on their side however it will not update what is in the Clinicom system.

Question

How are the amendments in patients' data managed?

TBH, PM- R9: Answered above.

Question

How do you trace changes made on the patients' files?

TBH, PM- R10: There is a way of tracing that; however users are not able to change patients' identity numbers when a user enters a correct number the system will accept it. However if the incorrect number is enters the system is built in such a way that it will reject the incorrect combination of numbers.

Question

In the Clinicom system the assigning of modules or functions differs per hospital for example psychiatric, tuberculosis hospitals etcetera, does that also apply on PHCIS?

TBH, PM- R11: Yes it is similar to that, the reason why I'm saying that it's because we now have the maternity module which is used in the maternity sites but the admissions of patients is the same throughout. We have the appointment, maternity, Routine Monthly Report (RMR), those are the 3 modules we currently have and we hope to grow and have more in the future.

Question

Is it necessary that the users must use the system?

TBH, PM- R12: Yes it is very important that they use it as the department's goal is to centralize the systems and improve the usage of the tools provided

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Question

Who has rights to access and share patients' files?

TBH, SM- R1: Everybody that has access to the system can share patient data, the users can only share information about the patient data according to the access they have in the functions such as inpatient, outpatient or medical records users only have access to that information and can only share in that specific module. We do have a common function in all the modules that is the episode activity enquiry, everybody it doesn't matter which module you are on, you will have access to that function and that will tell you about patient history in the hospital it will not give you specific details like diagnosis or treatment for that specific history but it will tell you about the date and time when the patient visited the hospital.

Question

What are the restrictions used to make sure that the sharing of data is efficient?

TBH, SM- R2: Its according to profiles, you set up profiles per user's job description, and according to that job description you will be linked to a specific profile and then you will get access to and you only access to that profile that gives you access to the patient data that you can change/revise or share with anybody else.

Question

How do you make sure that the data sharing procedures used are the same?

TBH, SM- R3: Everybody is using the same procedures it's the standardized procure across the hospitals where we work on profile specifically, no user can walk through the door and just access the system. Sharing of information is via a procedure called the training procedure, a person will be trained first an access form will be completed where it states the confidentially of accessing the system where they will vow that they will not disclose any patient information unless it's was requested via management or the right channels and according to that they will get access to the system and they sign this as a declaration for them and that they will protect patient confidentiality. These forms go to the information officers or system controllers who give access to the users in their institutions. I think the procedures are followed in the beginning stages when the system went live the restriction maybe was not followed that strictly as they were no processes in place we had to setup the processes from scratch but I think at this moment they are followed this is now 10 years later now we have set rules in place that nobody can access the system without training and without the access form completed.

Question

Are those restrictions followed?

TBH, SM- R4: The user only gets access according to their job restriction, and they are trained according to that and the supervisor request for training.

Question

Who has rights to amend data in patients' data?

TBH, SM- R5: (Already answered in response TBH_SM2)

Question

How are the amendments in patients' data managed?

TBH, SM- R6: The amendment on the patient data it gets managed by confirming data with the patient, that's the only way to amend patient data. Specifically patient related data and then the process we have patient administrative system meaning the patient will sign to confirm certain information on the system each and every patient with each visit their data needs to be confirmed that it's still the same patient demographic data, the visits and appointments data is operational it's not like you can just change it, as the patient pitch up you need to record it to say that patient was here or didn't come for appointments or follow up visits.

Question

How do you trace changes made on the patients' files?

TBH, SM- R7: The system itself got a transaction log; this is a physical report that you get out of the system its patient specific meaning you type a patient's unique number into this function then you will have a data range that you put in then for that range it will give you a report of the changes done in that specific range. The lack in the report is that there is no specific detail it will only give you what type of transaction was done (add, revise or delete), time, date and the user details who did that transaction. Some of the transactions do have details but its minimum it will just give you highlights of those details of what happened in the transaction.

Question

What was the system that you used before Clinicom?

TBH, SM- R8: CHS - Cape Hospital System and Delta9 was at some of the regional and district hospitals and yes Clinicom had some improvements.

Question

Why did you change from that system?

TBH, SM- R9: System was not compatible with the next millennium the change over to the year 2000

Question

Do you see any improvements since you started using Clinicom?

TBH, SM- R10: Yes better revenue and stats, main ones I would say is the stats for National as the IO is trying to complete the stats by the 7th of each month by checking the specialties and the attendance. And that now patients data is centralized, which allows users to be able to easy share data.

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Question

What was the system that you used before Clinicom?

TBH, SA-R1: There were actually two systems the Cape Hospital System (CHS) was used in the academic hospitals and Delta9 was used in the regional and district hospitals.

Question

Why did you change from that system?

TBH, SA-R2: Data was not centralized in the old system and were also not compatible or didn't meet new requirements in the healthcare sector.

Question

Are there data discrepancies' that you experience when using the Clinicom or Cognos report viewer

TBH, SA-R3: Yes there are data discrepancies that we experience on the systems.

Question

What are the causes of these data discrepancies in the systems?

TBH, SA-R4: Some are users' errors where they misspell patients' information, as well as system errors for example its will allow users to insert numbers in fields that should allow characters only.

Question

Do you see any improvements since you started using Clinicom?

TBH, SA-R5: Yes there have been improvements in terms of data sharing and also challenges.

Question

What are those system challenges?

TBH, SA-R6: Correctness of data, most of the time we deal with cases where our data is not clean for example the patients data duplication

Question

Why is the institution using the both the paper and computer systems?

TBH, SA-R7: Currently the hospitals are using both the paper-based and Clinicom systems, the paper-based system is mainly used to store doctors' notes and all the patients paper documents.

Question

Are there users who share profile on the system?

TBH, SA-R8: Unfortunately our systems are not built is such a way that it can only allow a user to connect in one work station at a time, so yes there are users who still allow their colleagues to use their usernames and passwords, however we try by all means to communicate that each person who access the system must have their own username and password. This helps us to know who access the system when and what were they doing on the system.