ELECTRONIC PATIENT RECORD (EPR) SYSTEM IN SOUTH AFRICA: INFORMATION, STORAGE, RETRIEVAL AND SHARE AMONGST CLINICIANS

Temitope Oluwaseyi Tokosi

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University of the Western Cape

Supervisor: Professor Visvanathan Naicker

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ABSTRACT

A phenomenological philosophy underlies this research study which attempts to understand clinicians' perception and understanding of an electronic patient record (EPR) system currently operational at a hospital in the Western Cape Province in South Africa (SA). Healthcare is a human right, thus patient records contain critical data and mostly paper-based in many SA hospitals. Clinicians are the EPR primary users and their attitude in its use is important for its success. This study explores, identifies and determines clinicians' cognitive attributes towards EPR with a technology use framework developed.

An initial quantitative approach was applied but unsuccessful due to low sample size. A pilot study was then conducted using 11 respondents. Purposive sampling was first initiated then snowball introduced later to improve the sample size qualitatively. Interviews were administered to 15 clinicians and tape recorded. Narrative content analysis was used as the preferred analysis technique because of the advantage of gaining direct information from study participants, unobtrusive and a non-reactive way to study the phenomenon of interest.

Research findings tested 12 propositions and found high impact relationships between attitude (ATT) and each listed theme namely: perceived usefulness (PU), perceived ease of use (PEOU), complexity (COM), facilitating condition (FC), use behaviour (USE). Use behaviour had high impact relationships with storage (STO) and retrieval (RET). There were moderate impact relationships between PU and USE; PEOU and PU; RA and ATT; job fit (JF) and ATT; USE and share (SHA).

The implication here is that any EPR system to be implemented should be tested using this framework to ascertain its usefulness and fit with a hospital's objectives and users expectations. By so doing, anticipated problems can be mitigated against and resolved before implementation. The study contributes to the information system (IS) body of knowledge through the technology use framework. The framework is for adoption by hospital management and its use by clinicians where EPR is operational. Traditional IS frameworks can be adopted for hospitals about to implement EPR because of the relevance of the "intent to use" theme.

KEYWORDS: Clinician, e-Health, EPR, ECM, HIS, ICT, Retrieval, Storage, Share.

DECLARATION

I hereby declare that: **Electronic patient record (EPR) system in South Africa: Information, storage, retrieval and share amongst clinicians** is my own work, that it has not been submitted, or part of it, for any degree or examination in any other university, and that all the resources I have used or quoted have been indicated and acknowledged by means of complete references.

Signature: ---------- Date August 2016

Temitope Oluwaseyi Tokosi

Witness: ---------- Date……

Professor Visvanathan Naicker

DEDICATION

This thesis is dedicated to the following persons:

Mrs Florence Ibim Tokosi

Wing Commander (Rtd) Samuel Babatunde Tokosi (late)

Comrade Theophilus Combrinck (late)

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CHAPTER ONE - BACKGROUND

1.1. Introduction

Healthcare is a human right (Department of Health, 2011) and it is vital that health problems are recorded accurately. Information aids clinicians and other healthcare professionals to accurately and timeously diagnose and treat the health-related problems of patients (Department of Health, 2007: 4). Information obtained from healthcare professionals is important for patients to enable them manage their health problems. Researchers and health officials need information as input for their research and for the surveillance of diseases. Health administrators and policy-makers rely on information to identify opportunities for improvement in healthcare systems (Department of Health, 2007: 4). According to Ruxwana (2010: 1) and the Department of Health (2007: 5), the introduction of Information and Communication Technology (ICT) into healthcare will promote equitable treatment, improve access to healthcare for all South Africans, improve efficiency in the delivery of healthcare, reduce cost and medical errors. It will also ensure the privacy and confidentiality of patient information. Some drawbacks to ICT in health include the cost involved in its adoption and use, lack of standardisation, privacy and security risks (Brown, 2012: 43-44), just to mention a few.

The sensitivity of health conditions such as HIV/AIDS necessitated the introduction of a Health Information System (HIS) known in this study as an Electronic Patient Record (EPR) at both the national and provincial levels of government. Some hospitals in South Africa (SA) are owned by the national and provincial governments in SA and so the burden of disease is at varying levels at these hospitals. In SA, the national health Information System (HIS) was conceived in 1995. It is aimed at improving patient care by providing patient information within and between hospitals. It forms an integral part of a larger quality management programme at the Department of Health and is intended to improve health management efficiency of all hospitals (Mbananga, Madale and Becker, 2002: 5–6). Odhiambo-Otieno (2005: 743) explains that the demand for reliable, accurate and timely data is essential for systems such as HIS. In support, Garrib, Stoops, McKenzie, Dlamini, Govender, Rohde and Herbst, (2008) say that if HIS is effectively used, it will benefit policy and decision-makers. South Africa (SA) introduced a District Health Information Systems (DHIS) in 1996 (Rohde, Shaw, Hedberg, Stoops, Venter, Venter and Matshisi, 2008: 196) to collect routine, survey and semi-permanent data (Rohde *et al.*, 2008: 204). Through DHIS software, data is collected from public

health facilities to support decentralised decision-making and health service management (Shaw, 2005: 632). Other developing countries in Africa, such as Zambia (Rohde *et al.*, 2008: 204) and Kenya (Odhiambo-Otieno, 2005: 734) and in Asia, such as India (Garrib *et al.*, 2008: 549; Health Information Systems Programme (HISP), 2009) all use DHIS. The DHIS allows healthcare workers to analyse their level of service provision, predict service needs and assess performance in meeting health service targets (Williamson and Stoops, 2001: 2; Garrib *et al.*, 2008: 549). A DHIS can be distinguished from an EPR as it collects its data from paper-based system of registers, tally sheets, and monthly data collation forms from all public health facilities in a country (Garrib *et al.*, 2008: 549) The EPR collects data directly from input by the healthcare practitioner after treatment of a patient at a single health facility and is electronically captured.

Garrib *et al.* (2008) highlights two broad parts of DHIS namely, data collection, collation and analysis. In this study, the focus is on data storage, retrieval and share. Although research has been conducted on HIS, attention in the current study will be given to data storage, retrieval and share within a hospital environment. Without proper storage, retrieval and share, a patient's record can be lost to fire, water or other forms of damage.

Clinicians are the primary users of hospital technology thus their attitude towards any technology adoption and/or use is paramount. In so doing, the problem identified in this study is explained in the next section.

1.2. Research problem

Hospitals in SA are introducing technology to help alleviate the problems faced in using manual systems. These technologies face challenges and so do the users. A hospital visited prior to this study indicated that an electronic record system was implemented years ago but the reliance on paper was still imminent. This is so especially when the electronic record system does not meet clinicians performance expectations. Few HIS researches in SA (if any) has addressed the issues regarding clinicians perception and use of technology and more particularly EPR at a health facility. The problem in this case is that EPR is not well implemented at the hospital. It does not meet clinicians' desired expectations. For this reason, this study will identify and address clinicians' problems regarding EPR adoption and use through interviews. Clinicians' views, opinions and perceptions

towards EPR were excluded before its implementation even though they are its primary users. Through this study, future EPR use will be improved.

Theoretically, there is also a concern especially when much research into ICT in health in SA is lacking. A few researches in SA with specialisation in functional areas have been conducted such as in analysis (Rohde, *et al.*, 2008; Gerntholtz, Van Heerden and Vine, 2007; Coovadia, Jewkes, Barron, Sanders and McIntyre, 2009; English, Masilela, Barron and Schönfeldt, 2011; Kumalo, 2006; Matshidze and Hanmer, 2007; Kerry, 2006). Other specialised areas of research include policy (Rispel and Barron, 2010), perspective (Mostert-Phipps, Pottas and Korpela, 2012; Rowe, 2008; Ruxwana, 2010; Stoops, Williamson and Braa, 2003; Williamson and Stoops, 2001) and recommendations (Shaw, 2005) as well as those explaining problems faced by hospitals (Littlejohns, Wyatt and Garvica, 2003). Few SA research involve implementation (O'Mahony, 2009; Jacucci, Shaw and Braa, 2006; Govender, Mueller and Basu, 2011), the evaluation of EPR systems (Scharpey-Schafer and Suleman, 2008; Garrib *et al.*, 2008; Hartmann and Sooklal, 2012; Govender, Letshokgohla and Basu, 2010) and factors that impact record system adoption and use (Mostert-Phipps, Pottas and Korpela, 2013).

With a paucity of research of this kind in SA, knowledge is not fully organised and packaged for research purposes. Understanding clinicians' perception towards the use of electronic record system is important in improving its performance in delivery better health service.

The research aims and objectives are mentioned in the next section.

1.3. Aims and Objectives of the study

The aim of this study is to describe the current Electronic Patient Record (EPR) system at a hospital in the Western Cape Province in SA and its function in storing, retrieving and sharing patient record. The objectives include:

1. Identify and examine clinician's attributes that influence clinician's use of EPR.
2. Examine clinician's attitude and its impact on their EPR use.
3. Examine clinician's use behaviour and its impact on information storage, retrieval and share.
4. Describe EPR and its function in record storage, retrieval and share.
5. To develop and synthesise a framework for EPR.

The rationale for undertaking this study is plausible and it is hoped that its contributions are significant as explained in the next section.

1.4. Rationale of the study

A review of researches undertaken in South Africa (SA) on Health Information Systems (HIS) indicate limited literature with little or no focus on its adoption and use, be it for information storage, retrieval and the share of patient information. A reason for EPR paucity could be attributed to the many failures of EPR implementation at various hospitals in SA and possibly, as a result, researchers have not been granted access by hospital authorities to investigate these failures. The gap in EPR literature in SA is on clinician's cognitive attributes in using EPR. So undertaking this study will show the relevance and significance of EPR in supporting clinician's task most especially when storing, retrieving and sharing patient information. This study's significance will contribute towards the HIS body of knowledge theoretically by developing a technology use framework for application at a SA health facility. In addition, its contribution in practice and methodology is through the use of a qualitative approach in data collection and analysis: a method hardly used within HIS research in SA.

Conceptually, Technology Acceptance Model (TAM) is a more commonly applied model in explaining clinician's cognitive attributes in adopting innovative technology such as EPR. Furthermore, the Unified Theory of Acceptance and Use of Technology (UTAUT) model is useful in suggesting determinants of clinician's use behaviour towards technology use. Also the model of PC utilisation identifies clinician's feelings (attitude) toward the use of technology. The themes (or constructs as they are known quantitatively) from these different models (rather than TAM alone) will be incorporated into this study as contributing significantly to explaining EPR impact on information storage, retrieval and share.

The significance of this study is described in the next section.

1.5. Significance of the study

Hospitals in South Africa (SA) face numerous challenges (Cline and Luiz, 2013: 13) including the burden of disease, healthcare costs, lack of personnel, ICT skills and patient mobility. The challenges

faced have not deterred some hospital authorities from adopting EPR considering its many benefits such as patient record mobility, the tracking of disease and better healthcare delivery. Electronic health (e-health) can help to overcome many of these challenges and yield benefits. Thus, the identified gap in the existing literature is the identification of clinician's cognitive attributes towards EPR adoption and use in South Africa.

The research questions guiding this study are listed here.

1.5.1. Research questions

The main research questions for this study are:

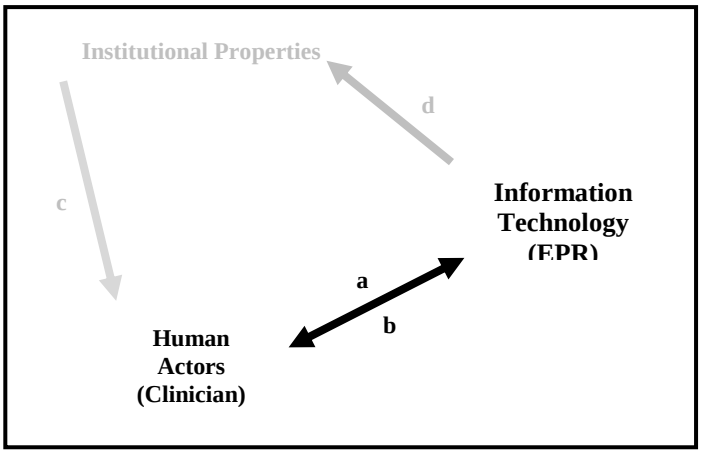
1. To what extent does cognitive attributes influence clinician's attitude to use EPR?
2. To what extent does clinician's attitude influence clinician's EPR use behaviour?
3. To what extent does clinician's use behaviour impact information storage, retrieval and share purposes?
4. How is EPR currently functioning in the storage, retrieval and sharing of patient's record?

The research questions were derived through an adaptation from prior studies on the introduction, adoption and use of technology in health. Some of the prior studies from which these questions was adapted include the works of Venkatesh, Morris, Davis and Davis (2003), Lærum and Faxvaag (2004) and Venkatesh, Thong and Xu (2012). The research model underlying this study is diagrammatised and explained in the next section.

1.6. Research model

The model used in this study is an adaptation of the structurational model of information technology shown below.

Figure 1. 1. Research model (adapted from the structurational model of information technology).



Source: Orlikowski, W.J., and Robey, D. (1991). Information technology and the structuring of organisations. *Information Systems Research*, *2*(2), 143-169.

In explaining the structurational model of information technology, the introduction of a technology (such as an EPR) to an organisation will have an effect on its structure. However, Barley (1990) posits that introducing technology to a workplace will not necessarily change the organisation's physical structure but its presence will provoke human interactions by virtue of work roles and social networks and thereby influence organisations. Technology may be expressed in terms of its duality. Firstly, technology is the social product of subjective human action within specific structural and cultural contexts (constituted nature). And secondly, technology is an objective set of rules and resources involved in mediating human action and contributing to the creation, recreation and transformation of these contexts (constituted role) (Orlikowski and Robey, 1991: 151).

An analysis of this model shows that arrow "a" depicts information technology (EPR) to be an outcome of human action. For example, healthcare experts, system developers, and computer scientist design and develop appropriate technologies. The technology is the product of this human action. The technology usage is only possible when humans interact with it to perform tasks. Arrow "b" indicates that EPR facilitates or constrains healthcare activities by either improving or enhancing user performance. However, it can also constrain user activities by removing some physical elements that paper-based activities provide. The institutional properties represented by arrow "c", in this context refer to healthcare (hospital) standards, process, culture, values and procedures of work that influence how healthcare practitioners will use the EPR system for their routine tasks. The institutional properties set the conditions and boundaries of interacting with the EPR system. Arrow "d" depicts the EPR system as being a consequence of the interaction with the EPR system by virtue of how this

system influences the institutional properties by either reinforcing existing structures or deviating from its structure of signification, domination and legitimation. An organisation's control over its resources (domination), user's rights and access to its resources (legitimation) and how it conveys the meaning of its structures (signification) will allow humans to either reinforce these existing structures or deviate from them when using EPR. These four (4) relationships between a technology and an organisation occur simultaneously and not sequentially, according to Orlikowsky and Robey (1991: 154).

For the purpose of this study, arrows "a" and "b" will be applied only. This will allow for a much narrow and focussed scope in order to achieve the study objectives but perhaps at the expense of a broader scope which can lead to policy change or improvement. The study pays particular attention to the human actors influence on information technology and vice versa. Information technology's influence over institutional properties and its subsequent influence over human actors will not form part of this study because of the nature of this study. The nature of this study focuses on clinicians and EPR only, thus narrowing the scope and improving the relevance of the study's outcomes to the decision-making process by hospital management. Therefore, institutional properties and its associated arrows ("c" and "d") are greyed out to isolate it from this study but it does not make it irrelevant. A presentation and explanation of the conceptual framework will made as it is adapted from the structurational model of information technology. This will be discussed in subsequent chapters.

Human actors (clinician) have attributes that influence EPR use. These attributes are represented as themes in the study and include perceived usefulness, relative advantage, job-fit, perceived ease of use, complexity, affect, facilitating conditions, attitude and use behaviour. Additional themes such as storage, retrieval and share are added to expand on existing knowledge of what this EPR technology was used for at hospitals. Subsequently, these themes can influence a clinician's attitude to use EPR which in itself is designed to store, retrieve and share patient information. The propositions formulated in this study are to show relationships and significance and will be explained in detail in chapter two.

1.6.1. Formulated propositions

The propositions formulated for this study are listed below:

> Proposition $1_{(a)}$: Perceived usefulness will have a significant impact on attitude toward EPR use.

Proposition $1_{(b)}$: Perceived usefulness will have a significant impact on EPR use.

Proposition $2_{(a)}$: Perceived ease of use will have a significant impact on attitude toward EPR use.

Proposition $2_{(b)}$: Perceived ease of use will have a significant impact on perceived usefulness.

Proposition 3: Relative advantage will have a significant impact on attitude toward EPR use.

Proposition 4: Complexity will have a significant impact on attitude toward EPR use.

Proposition 5: There will be a positive relationship between facilitating conditions and attitude towards EPR use.

Proposition 6: There will be a positive relationship between perceived job fit and attitude towards EPR use.

Proposition 7: Attitude towards EPR use will have a significant impact on actual EPR use.

Proposition $8_{(a)}$: System use will have a significant impact on information storage.

Proposition $8_{(b)}$: System use will have a significant impact on information retrieval.

Proposition $8_{(c)}$: System use will have a significant impact on information sharing.

The themes identified above are defined in accordance to their importance to this study.

a) Perceived usefulness [PU] is the degree to which a clinician believes that using EPR would enhance his or her job performance (Davis, 1989). This theme is adopted from the Technology Acceptance Model (TAM).

b) Relative advantage [RA] is the degree to which EPR is perceived as better than the idea it supersedes. Basically what matters here is whether a clinician perceives EPR as advantageous (Rogers, 1995: 250). This theme is an extract from the Diffusion of Innovation (DOI) model.

c) Job fit [JF] is how the capabilities of an EPR system enhance a clinician's job performance (Thompson, Higgins and Howell, 1991). This theme is taken from the model of PC utilisation.

d) Perceived ease of use [PEOU] is the degree to which EPR is perceived by clinicians' as being difficult to use (Venkatesh *et al.*, 2003). The theme is taken from TAM model.

e) Complexity [COM] is the rate to which EPR is perceived as relatively difficult to understand and use (Rogers, 1995: 242). This theme belongs to both the Diffusion of Innovations (DOI) model and model of PC utilisation.

f) Attitude or affect towards use [ATT] can be a positive or negative feeling that pertains to a clinician's desires and whether these desires are being met by EPR use (Thompson *et al.*, 1991). It is adopted from the model of PC utilisation.

g) Facilitating condition [FC] are objective factors,' out there' in the environment, perceptions of the resources and support available to perform a behaviour (Venkatesh *et al.*, 2012: 169). An example is technical support. Also adopted from the model of PC utilisation.

h) Use behaviour [USE] in the degree in which a clinician uses EPR. This definition includes both the rate of EPR use and the level of use. The rate of use means the frequency of using the systems e.g. once a day. The level of use means how well the system was used in completing a task e.g. system used in completing the documentation of a patient's treatment.

Other definitions associated with the general research study are mentioned below.

1.7. Definition of Terms

The following key terms are used in this study:

1. **Clinician** – a healthcare professional whose practice is based on direct observation and treatment of a patient. This includes doctors, psychiatrists, surgeons, paediatricians, physiotherapists, psychologists, dentists, pharmacists, radiographer, audiologists and so on.
2. **Data** – information in its raw form: unprocessed.
3. **e-Health** – the combined utilisation of ICT to generate, transmit, store and retrieve digital data for clinical, educational and administrative purposes (Department of Health, 2007: 10-11).
4. **Electronic Patient Record (EPR)** – sometimes known as the electronic health record, it contains all or most of a patient's clinical information from a particular hospital (Hayrinen, Saranto and Nykanen, 2008: 295).

5. **Health Information System (HIS)** – an integrated method of collecting, processing, reporting and using health information and knowledge to influence policy-making, programme action and research (AbouZahr and Boerma, 2005: 579).
6. **Information and Communication Technology (ICT)** – an umbrella term that includes any communication device or application including radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them such as video-conferencing and distance learning (Wee and Zaitun, 2006: 203).
7. **Patient** – a recipient or subject of health services

In the next section, a preliminary review of the literature on Information and Communication Technology (ICT), Health Information System (HIS) and Electronic Patient Record (EPR) is undertaken. A detailed literature review will be discussed later in chapter three.

1.8. Background of the study

Information and Communication Technology (ICT) access has improved across the globe and in Africa over the years (Bukachi and Pakenham-Walsh, 2007: 1625) and it is influencing our daily living (Rowe and Struthers, 2009: 32). Access to information using ICT at a rural level in South Africa (SA) is through broadband connections. An example of an access point is using the internet to access emails. Economic development in rural SA would require the use of ICT to combat poverty and improve health (Bukachi and Pakenham-Walsh, 2007: 1624), infrastructure, service and skills (Jacobs and Herselman, 2005: 57). ICT has led to the emergence of telecentres, cybercafés and internet cafés in rural communities although other factors still hinder its growth. Such factors include cost (Duncombe and Heeks, 2005: 38; Modimogale and Kroeze, 2011: 6), inadequate ICT skill force (Furuholt and Kristiansen, 2007: 9; Modimogale and Kroeze, 2011: 4-5) and the slow adoption of ICT among rural communities (Smallbone, North, Roper and Vickers, 2003).

A discussion on ICT use in health is contained in the next section.

1.8.1. Information and Communication Technology (ICT) Use

The acceptance of technology by healthcare practitioners should not be underestimated according to Ayatollahi, Bath and Goodacre (2009: 199-200) as it is the primary factor in the success or failure of

any ICT design, development and implementation for healthcare (Koivunen, 2009: 12). Technology for healthcare should arguably be easy to use (Kirkley and Rewick, 2003: 244; Ammenwerth, Iller and Mahler, 2006: 4), easy to access (Ruxwana, Herselman and Conradie, 2010: 19), beneficial to users and available at a reduced cost (Griffiths, Lindenmeyer, Powell, Lowe and Thorogood, 2006: 3). Technology offers benefits such as improved communication between professionals, accessibility of information, improved data quality and reduced medical errors (Kirkley and Rewick, 2003: 643). However, not all HIS implementations are success stories (Scott, Rundall, Vogt and Hsu, 2005: 1316, Ammenwerth *et al.*, 2006: 3).The reasons for unsuccessful implementation includes but not limited to cost (Scott *et al.*, 2005: 1313), limited user participation, a lack of information (Ruxwana *et al.*, 2010: 25) and perceived complexity (Greiver, Barnsley, Glazier, Moineddin and Harvey, 2011: 393).

In SA, ICT projects in health are mainly DHIS-related and of EPR type which is known as the National Patient Record (NPR) when implemented at a national level (Scharpey-Schafer, 2008: 1). The NPR strategy is aimed at digitising patient records in order to improve healthcare delivery by storing and tracking medical data over the lifetime of a patient (Scharpey-Schafer, 2008: 1). The NPR system allowed for the monitoring of healthcare delivery and diseases across the country and for nationwide access to patient histories, typically across multiple healthcare centres (Scharpey-Schafer and Suleman, 2008: 1). The term EPR was used in this study since the study is conducted in South Africa. An EPR was used in countries like Canada to improve the quality of care (Greiver *et al.*, 2011: 395) through information sharing, for better data retrieval in Denmark and SA (Kierkegaard, 2011: 515; O'Mahony, 2009: 2) and for automated analysis support. Contrary to its successes, EPR implementation costs are still considered high in the USA (Smelcer, 2009: 82; Accenture, 2010: 1), non-standardised in SA (Ruxwana *et al.*, 2010: 19) and complex in Canada because their implementation involves changes to many processes (Greiver *et al.*, 2011: 383).

More insights into access to a reliable NPR would make medical histories quicker to obtain and more comprehensive, giving healthcare workers more time and information with which to do their job (Scharpey-Schafer and Suleman, 2008: 2). Scharpey-Schafer and Suleman argues for EPR introduction as it would reduce the number of questions asked at each patient visit. An Accenture (2006) study in SA is in agreement with Scharpey-Schafer and Suleman's view when it claims that almost a third of all participants use multiple healthcare providers and half said that they answered the same questions on each visit to a new practitioner. This can lead to data duplication, inaccurate data and may be time consuming. EPR may reduce the time spent with each patient as well as potentially

improving patient care because a patient's history completed by another health professional would presumably be more accurate than that recounted by a patient. Scharpey-Schafer and Suleman (2008: 2) says a government can benefit from the implementation of NPR by having access to wider, consistent and up-to-date aggregate data. The argument at present is over what type of system to adopt that is cost-effective especially at the rural level and should maximise service delivery through information sharing. It is hoped that the NHI will assist in this regard through investment in the improvement of health infrastructure, both in buildings and equipment (Department of Health, 2011). While Scharpey-Schafer and Suleman (2008: 3) lists three types of healthcare systems and their characteristics namely, decentralised, centralised and hierarchical networks, their study failed to explain each one from the user's viewpoint;, users meaning clinicians.

Additionally, insights into information sharing at rural level involved the use of telemedicine. Telemedicine, according to Bukachi and Pakenham-Walsh (2007: 1626) and Wyatt and Sullivan (2005: 1391) is the delivery of healthcare and the sharing of medical knowledge by medical practitioners over a distance using telecommunications and technology. Pilot projects on the use of telemedicine in some parts of Africa (Bridges.org, 2006) and in SA (Bridges.org, 2006) in particular have been successful. Information has been shared by medical practitioners using technology such as handheld devices (PDAs) but problems encountered range from cost, connectivity, capacity to cultural differences (Bukachi and Pakenham-Walsh, 2007: 1627; Department of Health, 2007: 6). The cost of technological infrastructure at rural level is still very high (Adesina, Agbele, Februarie, Abidoye and Nyongesa, 2011: 4; Bukachi and Pakenham-Walsh, 2007: 1625). Internet and network connections are slow and unstable. Technological availability of computer, maintenance and network experts still remains inadequate in Africa and SA (Adesina *et al.*, 2011: 4). Finally, the ability of clinicians to use technology, especially those working at primary and district levels, is still a challenge primarily because of power interruptions, inadequate computing facilities (Smith, Bukirwa, Mukasa, Snell, Adeh-Nsoh, Mbuyita, Honorati, Orji and Garner, 2007: 6) and a lack of trained personnel (Adesina *et al.*, 2011: 4).

When deciding on an appropriate ICT tool in health for general operations, factors to consider include authenticity, integrity, security and accessibility. Each factor mentioned is core to ensuring a workable EPR. A brief explanation of these factors is provided below.

1. **Authenticity** involves the quality of documents. They must be a true copy of the original (van der Haak, Wolff, Brandner, Drings, Wannenmacher and Wetter, 2003: 119).
2. **Integrity** ensures the documents are complete and not altered through tampering or corruption (Adesina *et al.*, 2011: 4; van der Haak *et al.*, 2003: 119).
3. **Security** protects documents from unauthorised access, change or destruction, whether from a malicious act or from degradation over time (Adesina *et al.*, 2011: 4; van der Haak *et al.*, 2003: 119; Presidential National Commission on Information, Society and Development (PNC), 2006: 17).
4. **Accessibility** is the ability to locate and retrieve information for use (consultation) within the legally established restrictions of privacy, confidentiality and security clearance (Adesina *et al.*, 2011: 4; van der Haak *et al.*, 2003: 119; PNC, 2006: 17).

The factors mentioned above are grouped into administrative, fiscal, legal and archival categories. It is important to review the laws establishing EPR as set out by the SA Government Health Department.

1.8.2. Legislative framework

In the Constitution of the Republic of South Africa Act No. 108 of 1966/7, chapter 2 Bill of Rights and section 7 enshrine the rights of all people in SA and affirms the democratic values of human dignity, equality and freedom (PNC, 2006: 22). The right to protection including personal information forms part of this constitution and section 13 of the Health Act indicates that this is an obligation. The National Archives of South Africa Act (Act No. 43 of 1996) and the Promotion of Access to Information Act (Act No. 2 of 2000) are subject to the Health Act (Act No. 61 of 2003). The Health Act states that a person in charge of a health establishment must ensure that a health record containing information as prescribed is created and maintained at that health establishment for every user of the health services and those in charge must safeguard such records (Republic of South Africa, 2003: 11; PNC, 2006: 22). The National Health Council is established and comprises the Health Minister, Director Generals and heads of the Health Departments. One of the Council's functions is to develop, procure and use health technology such as EPR (Republic of South Africa, 2003: 13).

The Electronic, Communication and Transaction Act of 2002 have a significant impact on the health sector. The implication of this Act is that all departments are encouraged to implement electronic systems that are characterised by security, integrity and authenticity (PNC, 2006: 22-23). The PNC document goes further in saying that this electronic system must have elements of 'accountability,

transparency and good governance' all of which are in line with the basic principles of data protection. The Promotion of Access to Information Act supports the protection of data and gives powers to a private or public body information officer to refuse access to a record by a third party if such disclosure of personal information to the third party is not conscientious. By law, every information officer has a fiduciary duty to set up control measures to prevent unauthorised access to patient records and to its storage and retrieval facility or system (Republic of South Africa, 2003: 11).

Lastly, section 27 in the Bill of Rights of the Constitution states that everyone has a right to access healthcare services including reproductive healthcare and that the State must take reasonable legislative and other measures within its available resources to achieve the progressive realisation of these rights (Department of Health, 2011: 16). The National Health Insurance (NHI) is to operate on an electronic platform (Department of Health, 2011: 44) and all health information systems are intended to be integrated. EPR system can play a useful role here, for example, its use can formalise data standardisation.

1.8.3. The National Health Insurance (NHI)

South Africa has finally rolled out its innovative healthcare financing known as the National Health Insurance (NHI) with the objective of providing improved healthcare service to all its citizens (Department of Health, 2011: 4). The current healthcare financing system is two-tiered: medical schemes, hospital care plans and out-of-pocket payments and the other being the State financed healthcare (Department of Health, 2011: 4). Eleven (11) districts countrywide were chosen for the five-year initial pilot project based on key health indicators namely, health profiles, demographics, health delivery performance, the management of health institutions, income levels, the social determinants of health and compliance with quality standards (Department of Health, 2011: 52).

The KwaZulu-Natal province, which has two (2) pilot test grounds, added a third district at its own choice and cost (Sowetan, 2012). The Western Cape research setting on the other hand has only one (1) district apportioned as a pilot district (Department of Health, 2013: 10). According to the Health Minister, Dr Aaron Motsoaledi, the reason for KwaZulu-Natal having more pilot test grounds is that the province has a higher population and burden of disease compared to the other provinces in SA (Sowetan, 2012).

With an estimated cost of R1 billion and a European Union (EU) pledge of a further R1.26 billion (Sowetan, 2012), the NHI has financial backing in full force. Its objectives include but are not limited to improved quality healthcare service for all South Africans irrespective of employment status, the creation of a single fund to achieve equity and solidarity, procurement and efficient mobilisation of financial resources for the population and improved health system performance by strengthening the under-resourced public sector (Department of Health, 2011: 18). It is hoped that health information system such as EPR will benefit financially from this largesse.

With the introduction of ICT into health (also termed electronic health), this is discussed further in section 1.8.4.

1.8.4. Review of electronic health (e-Health)

It is important to understand ICT with regards health by adopting a working definition. ICT stands for Information Communication Technology. According to Michiels and Van Crowder (2001: 8), ICT is defined as 'a range of electronic technologies which when converged in new configurations are flexible, adaptable, enabling and capable of transforming organisations and redefining social relations. Yang (2001: 4) defines ICT as an 'electronic means of capturing, processing, storing, and communicating information'. More definitions include:

- Any technology that can be used to interlink information technology devices such as personal computers with communication technologies such as telephones and their telecommunication networks (Chapman and Slaymaker, 2003: 9).
- Any artefact, technique or knowledge used to create, store, manage and disseminate information (Gerster and Zimmerman, 2003: 6).
- The array of primarily digital technologies designed to collect, organise, store, process and communicate information within and external to an organisation (Ritchie and Brindley, 2005).

A working definition of e-Health (or ICT in health) for this study is,

> *"any tool that facilitates communication and the processing and transmission of health information by electronic means"* (Bukachi and Pakenham-Walsh, 2007: 1624–1625).

In different literature reviewed, ICT in health is referred to in many ways. For example, it is known as telemedicine (Wurm, Hofmann-Wellenhof, Wurm and Soyer, 2008: 106), telehealth (Koch, 2005: 566), health informatics (Ruxwana, 2010: 216; The Royal Australian College of General Practitioners (RACGP), 2007: 2; Hunt, Breckenridge-Sproat and Kitzmiller, 2004: 20) and e-Health (Bukachi and Pakenham-Walsh, 2007: 1625; Department of Health, 2007: 5). The more commonly used term is e-Health as it encapsulates telehealth and health informatics. The combined utilisation of ICT to generate, transmit, store and retrieve digital date for clinical, educational and administrative purposes is known as e-Health (Ruxwana *et al.*, 2010: 18; RACGP, 2007: 2; PNC, 2006; Department of Health, 2007: 10–11). e-Health gave birth to HIS and subsequently to EPR.

A review of EPR is now discussed.

1.8.4.1. Review of electronic patient record (EPR)

Electronic Patient Record is known by various names in different countries. In SA, it is known as the Electronic Medical Record (EMR) (Department of Health, 2007:39). Smit and de la Harpe (2008: 122) refer to it as EMR in their South African study that compares paper-based and electronic information systems in pharmacies. In Canada, (Greiver *et al.*, 2011: 392), Denmark (Kierkergaard, 2011: 503), the USA (Smelcer, 2009: 71) and the UK (O'Mahony, 2009: 1) the term EMR is also used. Other names include EPR which was used in Germany in the study of the legal requirements concerning data security and the protection of patient health information across institutions by van der Haak *et al.* (2003: 118). More names in the literature are given in table 1.1 below.

Table 1. 1 Other EPR names

Author(s)	Study	Definition	Electronic system
Jaspers, Knaup and Schmidt (2006). The computerised patient record: Where do we stand? *Methods of Information in Medicine*, 45 (Suppl. 1): 29-39.	To provide an overview of trends in research, developments and implementation of the CPR over the last two years.	Contains all or most of a patient's clinical information from a particular hospital.	Computerised Patient Record (CPR)

Kifor, Varga, Álvarez, Vázquez-Salceda and Willmott (2006). Privacy issues of provenance in electronic healthcare record systems. *First International Workshop on Privacy and Security in Agent-based Collaborative Environments (PSACE)*.	An investigation of the privacy aspects of introducing provenance into healthcare information systems (EHCR) and a proposal of methods to counter the new risks.	Contains all patient health information.	Electronic Health Care Record (EHCR)
Tang, Ash, Bates, Overhage, and Sands (2006). Personal health records: definitions, benefits, and strategies for overcoming barriers to adoption. *Journal of the American Medical Informatics Association*, 13 (2): 121-6.	This study summarises the College Symposium discussions on PHR systems and provides definitions, system characteristics, technical architectures, benefits, barriers to adoption and strategies for increasing adoption.	Controlled by the patient and contains information at least partly entered by the patient.	Personal Health Record (PHR)
Jordan, Porcheret and Croft (2004). Quality of morbidity coding in general practice computerised medical records: a systematic review. *Family Practice*, 21: 396-412.	This study assesses the quality in terms of its completeness and correctness of morbidity coding in computerised general practice records through a systematic review.	Created by image scanning of a paper-based health record.	Computerised medical record
Springmann, Bischofs, Fischer, Schek, Schuldt,	This paper addresses how services can be made	No authoritative definition	Virtual EHR

Steffens and Vogl (2007). Management of and access to virtual electronic health records. In *Digital Libraries: Research and Development* (338-347). Springer: Berlin, Heidelberg.	available in a distributed way, how physician to patient (P2P) infrastructures for the management of EHRs can be evaluated and how novel content-based access can be provided for multimedia EHRs.	available.	
Altman (2007). The clinical data repository: A challenge to medical student education. *Journal of the American Medical Informatics Association*, 14(6): 697-699.	This study deals with the implementation of comprehensive clinical data repositories that carry implications for the medical informatics curriculum for pre-MD medical students.	An operational data store that holds and manages clinical data collected from health service providers.	Clinical data repository
Mostert-Phipps, Pottas, and Korpela (2013). A South African perspective on factors that impact on the adoption and meaningful use of health information technologies. *South African Family Practice*, 55(6), 545-554.	This study has a purpose to identify factors that should be addressed to encourage the adoption and meaningful use of HITs in the South African healthcare landscape.	Employ hardware and software to process, store, retrieve, and share health information, data and knowledge for communication and decision-making in for healthcare.	Health Information System (HIT)

Source: Table developed by the researcher

Electronic Medical Record (EMR) was used interchangeably with Electronic Health Record (EHR) with the difference being that EMR contains an individual's medical record created by a hospital while EHR contains a patients' medical data from multiple healthcare providers where the patient has been treated (Kierkergaard, 2011: 603) and is also stored electronically (PNC, 2006: 12). The common denominator in the above-mentioned systems is the electronic storage, retrieval and share of patient records.

A synopsis of electronic record and the quality of the data it contains is undertaken below.

1.8.4.2. Data Quality and Healthcare records

In healthcare, data is the heart of the operation. It is a core priority in both ICT research and rural development (Jacobs and Herselman, 2006: 297). In the healthcare sector, data quality is an important ingredient as human lives are directly involved. Parker, Stofberg, de la Harpe, Venter and Wills (2006: 3) describe the healthcare sector as a myriad of stakeholders including, but not limited to, patients, healthcare providers and researchers. All of these stakeholders handle large amounts of different data types that they generate and collect but most of this data is not integrated (Alshawi, Missi and Eldabi, 2003: 289). Parker *et al.* (2006) further argues that much of the data generated is stored in different formats and is gathered from heterogeneous resources such as paper files, electronic files, databases and spreadsheets. Health practitioners accumulate an abundance of data from their patients during consultations and, even though they have access to this data, it is not being used to its fullest potential (Long, Seko, Robertson and Morrison, 2004: 198).

Data quality dimensions are contained in the next section.

1.8.4.3. Data Quality Dimensions

The quality of data is identified by its characteristics such as accuracy, accessibility, timeliness, format, use and meaning (Parker *et al.*, 2006: 7; Alshawi *et al.*, 2003: 288). As with paper-based patient record systems, data becomes unreadable over time, difficult to access and distribute, incomplete and insecure from non-authorised users (Smit and de la Harpe, 2008: 120). However, in Ayatollahi *et al.*'s (2009: 205) findings on the use of paper records versus EPR by emergency department staff, a substantial number of staff prefers a paper-based system because it is more informative, easier and quicker to access than finding an available computer to use.

Sørensen, Rivett and Fortuin (2008: 39) in their research discovered that paper-based systems in the form of data points collected at clinics in SA were standardised thereby making paper-use relevant. Although using paper-based system increases information transmission risk as it renders it slow and prone to errors (Clifford, Blaya, Hall-Clifford and Fraser, 2008: 6). Furthermore, the authors argue that aggregation of data is challenging as patient numbers rise into the hundreds, and near impossible with thousands of patients. This may result in the difficulty to impose consistent reporting indicators accordingly. Smit and de la Harpe (2008) suggest an electronic information system to reduce prescription errors in a pharmacy unit where a paper-based system is in place. These errors can have negative effects and data quality may be compromised. The quality of data is preserved using EPR as it converts paper documents into digital format. Large amounts of patient data can be stored on an EPR system, real-time access is possible as well as easy data storage, backup and better sharing capabilities (Adesina *et al.*, 2011: 3). A major disadvantage of EPR noted by Adesina *et al.* (2011: 3) is its vulnerability to unauthorised users through 'hacking' because it uses the internet. Patient records contain different data types which, if exposed to unauthorised users, can harm the patient involved. Data types are discussed in the next section.

1.8.4.4. Data types

Rohde *et al.* (2008: 204) classify health data into routine data, that is, data submitted from facilities on a regular basis including demographic, health survey and audit data and semi-permanent data about a population or data about a facility (i.e. staffing, equipment and services provided). These three (3) health data types are grouped into two (2) categories: information for business services and information for public consumption (Arai and Tanaka, 2009: 2). With information being so important to hospital management, it must move freely between the persons and departments needing it.

In the literature on information flow, information is understood in a technical way i.e. how information is physically delivered by ICT (Yang, 2001: 11). Using the information cycle theory (Yang, 2001: 7-10), information is categorised into three (3) stages namely, information creation, information flow and information storage. Information creation is how the information came into being. Information storage is the how and where the information is held. Information flow is the link between creation and storage. In reality, information creation and storage are not the start and end point of an information flow cycle (Yang, 2001: 9)

ICT plays a supporting role in information flow by transporting information from its source to the destination on time. "On time" means clinicians can get patient information as and when needed and in a presentable format. Patient data can be manipulated, updated and stored instantly where an EPR exists. Where data is needed at a national level, ICT using EPR can facilitate data transfer accurately, timeously, in large quantities and by means of a secure channel accessible by authorised users of EPR only who will be able to handle patient data for transmission.

Information flow is explained in other disciplines such as in psychology in the psychological information flow theory by Dretske (1999) and in management by Rolf Wigand (1997) using a management information production model. In information systems, Heeks (1999) explains the information chain and Duncombe and Heeks (2005) together developed an information flow model. The structurational model of information technology was developed by Orlikowski and Robey in 1991. The structurational model is a more suitable and integrative model for this study as it recognises four influences that operate continuously, simultaneously but not sequentially in the interaction between technology (EPR) and the organisation (hospital). Figure 1 above already illustrates and discussed the four influences. These aspects as a reminder are:

I. information technology is the outcome of human action (arrow a),
II. information technology is the means of human action (arrow b),
III. information technology is built and used within particular social contexts (arrow c) and
IV. interaction with information technology influences the social context within which it is built and used (arrow d) (Orlikowski and Robey, 1991: 152-153).

The first two influences (i and ii) will be used as it involved human interaction with technology and vice versa. The method to achieve the research study objectives using the adopted model is discussed in the next section with a detailed explanation in chapter four.

1.9. Preliminary research method and design

A mixed-method approach was initially proposed consisting of both quantitative and qualitative methods. Mixed-method research is simply adopting a research strategy that employs more than one type of research method (Brannen, 2005: 4). The use of multiple and different research approaches, methods and techniques are known as triangulation (Collis and Hussey, 2009: 74). For this study,

qualitative method was used because it has the ability to expose detailed information that quantitative method cannot. Data triangulation was used because data is collected from multiple sources in the study of the phenomenon (Easterby-Smith, Thorpe and Lowe, 1991). The sampling strategy adopted for this study is discussed.

1.9.1. Preliminary sampling strategy

The study population comprise of clinicians. A purposive sampling technique was initially used with snowball technique included at a later stage. This is because the nature of the research question requires in-depth information on EPR use and substantial sample size is expected to achieve this, Clinicians are the primary users of the patient record system. They are hands-on and familiar with the system, so are in a better position to assess and evaluate its functionality in relation to their work tasks. These work tasks includes but not limited to record storage, retrieval and share. The research design is discussed in the next section.

1.9.2. Preliminary research design

Research can be defined as a careful and systematic process of inquiry to find out answers to a problem of interest (Peh and Low, 2013: 133). Continuing, Peh and Low (2013) categorised research designs into six different types namely case studies, surveys, experiments, correlational research, causal-comparative research and historical research. Each research design is known to have its individual strengths and weakness in its ability to describe, predict, explain, interpret or demystify a phenomenon while some are more qualitative or quantitative than others. Case study and survey are appropriate for this study and justifications are provided as to the choice of these types in chapter four.

All researchers according to Naicker (2010: 147), irrespective of their intended research design type need to focus their efforts on answering two important questions namely: what methodologies and procedures will be used in the research: and secondly, how does one justify this choice and the use of these methodologies and procedures? It is imperative to choose a research design and procedure with an aim of achieving the research objectives of the study.

Taking note of the terminologies mentioned (research design and research methodology), distinction has to be made between these two terms. A research design is a plan or blueprint of how a research study is intended to be conducted while research methodology is the actual research process (Babbie and Mouton, 2001: 74-75). More distinctions between these two terms are stated below:

Table 1. 2 Differences between research design and research methodology

Research design	**Research methodology**
Focuses on the end-product: what kind of study is being planned and what kind of results are aimed at.	Focuses on the research process and the kind of tools and procedures to be used.
Point of departure is the research problem(s) or research question(s)	Point of departure is specific tasks (data collection or sampling) at hand.
Focuses on the logic of the research: what kind of evidence is required to address the research question adequately?	Focuses on the individual steps in the research process and the most objective procedures to be employed.

Source: Babbie, E., and Mouton, J. (2001). *The practice of social research*. Cape Town: Oxford University Press

An example of a research method is qualitative research which forms the main study while an example of a research design is a case study which will be explained further.

The study is a phenomenological study design that attempts to understand clinicians' perceptions, perspectives and understandings of a particular situation (Leedy and Ormrod, 2014). The research study looks at multiple perspectives on the same situation and then generalises. The researcher obtains and describes the views of the respondents with regard to their experience using EPR. A qualitative approach was used to gain an in-depth understanding of the context of storage, retrieval and share systems and of the contribution made by ICT when using EPR for access and sharing of information by hospital staff (Ayatollahi *et al.*, 2009: 201).

Questions from the pilot study questionnaire will be used to collect information regarding clinicians' perceptions, opinion and attitudes. The interview process will encourage interaction with clinicians further to explore their perspectives on electronic record system functions and expectations. Considering the research location of this study, interviews will be possible instruments to be used. This is because the researcher is closer to the study location and will have ample time to use both research instruments if and when necessary due to time availability and sample size issue. This will be a case study research design for the main study and survey for the pilot study.

1.9.2.1. Case Study

Myers and Burnett (2004) and Yin (2003: 13; 2008) explain that a case study is an empirical inquiry used for investigating an existing phenomenon in its real-life context, especially when the boundaries between phenomenon and context are not evident. In addition, a case study focuses on a single object or subject such as an organisation, a department, discussion forum, system developer, an information system and so on (Oates, 2006: 141). A hospital was identified for the pilot study and the EPR system is the case. Studying this case will allow for an in-depth understanding of what this system entails, its functionality and purpose for hospital adoption. Interviews with hospital management will be used as support tool to collect data that should answer one or more research question.

1.9.2.1.1. Case study data sources

In order to describe and understand the EPR system, clinicians' briefs, views, opinions and knowledge about EPR, its functionality for storage, retrieval and share will be sought. A semi-structured interview format will be used to yield primary data for this purpose. A semi-structured format will be more appropriate than a fully structured format because new material can be introduced into the discussion (Ruxwana, 2010: 128). Qualitative interviews are free flowing and permit the researcher to obtain information that cannot be obtained from direct observation (Ruxwana, 2010: 127-128).

1.9.2.2. Survey

A survey is a systematic method for gathering information from a sample of entities for the purpose of constructing quantitative descriptions of the attributes of the larger population of which the entities are members (Groves, Fowler, Couper, Lepkowski, Singer and Tourangeau, 2009: 2). Survey will contribute to the pilot study. This is true as questionnaire administration is faster and less intrusive. A questionnaire involving a combination of closed, multiple-choice, open-ended and Likert-scale questions will be applicable to clinicians.

1.9.2.2.1. Survey data sources

A questionnaire, according to Collis and Hussey (2009: 161), is a list of carefully structured questions chosen after considerable testing with a view to eliciting reliable responses from a chosen sample. It is made up of items which the users furnish answers to. A questionnaire is a quantitative method of eliciting, recording and collecting information (Ruxwana, 2010: 123). The choice of a questionnaire with closed questions for the pilot study group is to allow for honest replies without the fear of peer reprisal. Opinions, attitudinal and interpretational information can be gained through the questionnaire

(Ruxwana, 2010: 123). Ruxwana (2010) adds that the disadvantages of using a questionnaire include complexity, time and resource-consumption and participant's reluctance to go into detail in their answers.

Questionnaire items will be formulated in accordance with the research questions of this study (Ruxwana, 2010: 20) to gather information about the views of clinicians regarding their attributes that may facilitate EPR use for record storage, retrieval and share. Data will be collected using various research instruments identified in the next section.

1.9.3. Research instruments

The qualitative approach will involve an interview. A digital tape recorder as an instrument for collecting data will be used. Interviews will be conducted on the clinicians. Interview with open-ended questions will be used with the purpose of answering research question(s) by eliciting in-depth information. A questionnaire is a list of carefully structured questions chosen after considerable testing with a view to eliciting reliable responses from a chosen sample group (Collis and Hussey, 2009: 161). A group-administered questionnaire involving a combination of closed-ended questions in a Likert-scale format will be used. The research study is confined within acceptable study scope as discussed below.

1.9.4. Scope of the research

The research setting will be undertaken at a hospital in the Western Cape Province of South Africa. The hospital chosen is situated around the researcher's site of operation. A further reason for the choice of the hospital is because it meets the study profile. The hospital is situated in a semi-urban environment and offer primary healthcare services such as general medical care, surgery, radiology, physiotherapy and pharmaceutical services among others. The hospital has a wide range of clinicians, thus helping in generating various data types. Clinicians would be involved as they are the only users of EPR. All other healthcare practitioners will be excluded. The data will be analysed using technique(s) discussed in the next section

1.9.5. Preliminary data analysis

All fieldwork, according to Mouton (2005: 108), leads to the analysis and interpretation of a set of data, whether quantitative survey data, experimental recordings, historical and literary texts,

qualitative transcripts or discursive data. The analysis of this data involved breaking up the data into manageable themes, patterns, trends and relationships (Mouton, 2005: 108).

An analysis of interview data requires narrative content analysis. Narrative content analysis is a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns (Hsieh and Shannon, 2005: 1278). Hsieh and Shannon (2005: 1283) argues that narrative content analysis starts with identifying and quantifying certain words or content in a text with the purpose of understanding the contextual use of the words or content. The narrative content approach has the advantage of gaining direct information from study participants, unobtrusive and a non-reactive way to study the phenomenon of interest (Babbie and Mouton, 2001). However, findings using this approach are limited by its inattention to the broader meanings present in the data (Hsieh and Shannon, 2005: 1285).

The analysis of quantitative data involved the use of the Statistical Package for Social Sciences (SPSS) version 23.0 for Windows in order to make inferences about corresponding population properties. The choice of SPSS was made because it has the ability to perform cross-tabulations, chi-squared analyses of independence, regression and factor analysis. Cross-tabulation will describe each theme and compare the opinions of the different groups for certain questions. On the other hand, the chi-squared test is used to estimate the significance of an association or relationship between two variables (Babbie and Mouton, 2001: 481).

All research studies have boundaries or limitations and so does this. Limitations are discussed below.

1.10. Preliminary limitations of study

The study describes EPR systems only, not any electronic tool. Systems are different from tools because it allows for information storage, retrieval and share by electronic means. Data is collected from a hospital thus the results may not be representative of all hospitals in Western Cape or SA. Public and private hospitals have varying objectives so the results are only applicable to public hospitals with similar characteristics. The hospital identified is situated in the Western Cape Province that has a high population and burden of disease (Sowetan, 2012). The EPR study focusses on the patient record storage, retrieval and share processes only and ignores record creation since it is created from multiple sources other than by the clinician.

The researcher brings into this study certain assumptions, beliefs and bias which is discussed here.

1.11. Bias

Bias especially researcher bias is commonly understood as inevitable and important by qualitative researchers, thus, the notion of how one's self influences one's research interests is generally the issue of bias, according to Mehra (2002: 5). A researcher's personal beliefs can be reflected in the choice of methodology and interpretation of findings, as well as in the choice of a research topic as espoused by Mehra (2002: 6). The researcher's bias in this study is that technology can enhance health delivery optimally and thus, his belief determined the study. Researcher's bias was minimised by first piloting a questionnaire, then directly adapt some questionnaire questions to form the interview questions for the main study. Additions were made to the interviews to stimulate discussion by the clinicians. This minimised the influence of the researcher's views and beliefs in developing interview questions for the study.

1.12. Review of ethical consideration

Ethics are norms or standards of behaviours that guide moral choices about personal behaviour and interpersonal relationships (Cooper and Schindler, 2003: 120). An ethics committee is set-up to determine whether the research can be allowed to continue and reviews the research involving human participants (Olivier, 2004: 23). Cooper and Schindler (2003: 120) reason that ethics have the purpose of ensuring that no one is harmed or suffers adverse consequences because of research activities. A research protocol will be developed for approval by the University of the Western Cape Higher Degrees Committee and written application for permission to conduct this research study sought from the Western Cape Provincial Government Health Department. An information leaflet will be distributed to all participating clinicians informing them of their rights regarding the research study, the anonymity and confidentiality of all information obtained and the study objectives, purpose and benefits. An informed consent form is distributed to all participants to obtain their signatures and confirm their interest in participating in this study. Participation is voluntary with each participant having full rights to withdraw at any time during the study.

1.13. Chapter outline

The chapters are outlined in the following sequence depicted below.

Chapter 1	Background
Chapter 2	Literature Review
Chapter 3	Conceptual framework
Chapter 4	Methodology
Chapter 5	Analysis and Findings
Chapter 6	Conclusion and Recommendations

1.14. Summary of chapter one

The Electronic Patient Record (EPR) is a technological system that offers a hospital benefits such as adequate patient record storage, timely retrieval and secure share between clinicians. The cost of EPR as well as healthcare expertise remains an obstacle to its adoption and use. Research studies on the benefits of EPR are few in SA and the reason for this remains uncertain. The current study investigates clinician's attributes that enhance their EPR use for record storage, retrieval and share. A qualitative case study approach involving interviews with clinicians was used in order to address the research questions. A survey involving a quantitative questionnaire is administered to clinicians in a pilot study. A partial adoption of the structurational model of information technology was used to explain the influence of clinicians attributes over EPR in a hospital environment.

Chapter two is a review of the literature on health information systems, history, concepts and terminologies. A brief mention of the SA legislation that constitutes and enforces the introduction of an EPR system is discussed.

CHAPTER TWO – LITERATURE REVIEW

Chapter two has primary objectives to address key concepts and the varying terminologies surrounding health systems. Though not a new concept in the literature, health systems still remains an emergent technology in South Africa and so it is useful to understand its components comprising of the Electronic Health Record (EHR) and Electronic Patient Record (EPR) systems especially and its benefits. An exhaustive analysis of the literature on HIS, EPR and case study analysis to distinguish this study from others is undertaken. This chapter also highlights the relevant legislation associated with EPR establishment in South Africa.

2.1. Introduction

This chapter will involve an exhaustive literature review on health systems and drills down into current technology introduced into health. It highlights current research work undertaken regarding health systems, benefits and the risks faced in its adoption at medical facilities. Undertaking a review of the literature in this study is necessary in order to show that there is a gap in the relevant scholarly work related to the research topic as well as where the proposed research study will attempt to fill. A presentation of the literature review is also to demonstrate what is known and what is not known with regards EPR.

In his own words;

> *"...the literature review is not used to show why the research is needed to answer the question. Instead, the literature is reviewed to demonstrate that our understanding of the topic in question is somehow incomplete. Again it is not the case that we have a wrong understanding of some phenomenon, it is the case that we do not understand it well enough. But it is important to document the understanding that we do have"* (Shank, 2006: 117-118).

2.2. Background

With an ever rising increase in chronic illnesses and aging population in Africa and around the world, health management experts and institutions are tasked with disease prevention and cure. Cancer as an example, is predicted to increase by 50% to 15 million new incidences by the year 2020 (WHO, 2003) with a significant proportion of these incidences expected in developing countries where resources for prevention and management of such diseases are least affordable (Barretto, 2005: 2).

Disease management has led to the formulation of healthcare strategies by different countries to reduce healthcare cost and increase disease management effectiveness (Barretto, 2005: 2). One key initiative of Disease Management Centers (DMC) is to look for opportunities in the reduction in admissions and early dis-charge from the hospitals of patients in order to improve their quality of life. With an improvement in crisis-reaction approach, a reduction in overall costs, time and effort in the management of patients with chronic diseases can be achieved (Barretto, 2005: 2). Another key aim for DMCs' is the reduction of errors in which health technologies become important in this regard (Barretto, 2005: 2).

Wisdom has always been conveyed by word of mouth to future generations before the advent of written records (Stevenson, Nilsson, Petersson and Johansson, 2010: 63-64). So with the evolution of the written word according to Stevenson *et al.,* (2010), it still took centuries for written records to be kept in hospitals. As early as the 1800s, doctors have kept some records in ward notebooks, and in the 1850s, during the Crimean War, Florence Nightingale kept the first patient-oriented health records (Stevenson *et al.*, 2010: 64).

Technologies for health were noticeable in the mid-sixties (60's) because of the introduction of clinical information system projects for information storage and retrieval of medical documents (Hamidfar, 2008: 26). The core benefits of the use of technology in health is to improve patient care (Shekelle, Morton and Keeler, 2006), improved communication between caregivers and providers due to increased record portability, increased efficiency of care, reduced medical errors, reduced cost, links to medical knowledge and clinical decision support systems, simultaneous access to patient data, greater security, improved legibility, and more complete documentation (Rippen and Yasnoff, 2004; Morton, 2008: 3-4).

With the failures of many health systems implementations (Gater, 2005), the introduction of micro and mini computers led to a resurgence of interest in health system implementations once again in the seventies (70's) and eighties (80's) (Hamidfar, 2008: 36). In the current health environment, technology is integral to healthcare delivery and has resulted in the acceleration of digital applications and communication technologies development over the past decades (Hamidfar, 2008: 36).

2.3. Electronic Health (eHealth)

The introduction of Information and Communication Technology (ICT) to health started with telemedicine (Wurm *et al.*, 2008: 106). The term "telemedicine" is synonymous with "ehealth" and describes the use of telecommunication technologies for exchanging medical information for the purpose of diagnosis, consultation, treatment, and teaching (Wurm *et al.*, 2008: 106). Sometimes known as "medicine at a distance", telemedicine provides access to expertise that is otherwise not available at one particular location (Wurm *et al.*, 2008: 106). Patient data is its primary raw resource and exchanged between patient and health practitioner or between health facility and clinician.

2.3.1. Telemedicine

Telemedicine (or eHealth) according to Wurm *et al.* (2008: 106-107) was first used in 1970 leading to the common misconception that it refers to an advancement of the late 20th century. In actual fact, as Wurm *et al.* (2008) indicated, medicine has long made use of various communication technologies in the past. In simple terms, telemedicine had existed as far back as the invention of the telephone and radio. Notable telemedicine inventions and projects include:

- The Wilhelm Einthoven electrocardiograph invention which involved transmitting electrocardiograms via a telephone network from the clinic to his office, enabling him to monitor his patients' condition at a distance (Stanberry, 2000; Hsieh, Tsai, Yin, Chen, Yang and Jeng, 2004)

- The Nebraska Project in the USA in which an interactive, closed-circuit TV was set up between two hospitals located more than 150 km apart. Using a black-and-white TV monitor, doctors conducted interviews with psychiatric patients (Stanberry, 2000; Lim, Egerton and Shumack, 2000)

- NASA's (National Aeronautics and Space Administration) various projects of the 1960s and 1970s involving manned space flight made it possible to provide medical assistance in outer space using telemetric data transmitted from an astronauts' spacesuits, medical personnel on earth were able to continuously monitor physiological parameters such as heart rate, blood pressure, and electrocardiographic (ECG) signs (Lim *et al.*, 2000; Cipolat and Geiges, 2002).

- MEDLINE is another example of telemedicine developed during the 1960s but now a resounding success and is currently the most widely-used medical database (Wurm *et al.*, 2008: 107).

More telemedicine inventions and projects have evolved to include mobile communication. Mobile telemedicine is telemedicine applications in which the participants are located at a distance to each other as well as mobile. Unlike prior technologies used such as stationary equipment, small portable devices such as mobile phones and personal digital assistants (PDAs) are used for healthcare delivery (Wurm *et al.*, 2008: 107).

Mobile telemedicine (mobile ehealth) is better suitable to monitor patients at home and during transport, to provide care to patients who are travelling, and in disaster areas. It is no doubt that mobile ehealth will play an ever increasing positive role in medical informatics, surveillance and healthcare education in Africa and South Africa in particular (Ruxwana, 2010: 53). Although as Wurm *et al.* (2008) indicated, initial use of the Global System for Mobile Communication (GSM) was restricted to costs, low speed and low rate of data transmission. But with General Packet Radio Service (GPRS) technology, transmission capacity improved from 9.6 kilobytes to between 50 to 100 kilobytes with full internet access for a mobile phone connected to a handheld computer. The Universal Mobile Telecommunication System (UMTS) is a third generation technology with transmission capacity of 384 kilobytes. Other improvements involve the expanded High Speed Downlink Packet Access (HSDPA) with transmission rate of 3.6 megabytes thereby improving the quality of mobile communication devices.

2.3.1.1. Benefits of telemedicine

Telemedicine has the potentials of providing healthcare delivery in underserved regions by compensating infrastructural deficits related to geographical location is one of the central goals of

telemedicine. Many of the first pilot projects in telemedicine were conducted in remote areas with insufficient healthcare access. Telemedicine enabled people in rural areas (such as in South Africa), conflict and crisis areas and on airplanes and boats to be cared for and treated by medical facilities located far away (Schmid-Grendelmeier, Masenga, Haeffner and Burg, 2000).

Telemedicine enables the monitoring of home patients' through homecare or patients not near a hospital health status and allows monitoring at a distance. Home monitoring devices with integrated communication components send telemetric data (e.g. blood sugar levels or ECG signs) to clinicians treating them to effectively undertake necessary treatment adjustments. Such applications are increasingly used especially in the care of diabetic and heart patients. Special alarm systems in the homes of elderly and disabled patients when triggered will allow for faster health treatment (Düker and Elsner, 2002).

Telemedicine facilitates knowledge exchange through tele-consultation among specialists on diagnosis and treatment planning thereby giving health practitioners' rapid access to expertise instead of moving the patient to another location (Düker and Elsner, 2002). Telemedicine also enables medical professionals to communicate with colleagues across the globe in the exchange of expert opinion. Online forums provide doctors with an opportunity to discuss diagnostic and treatment issues, enhancing quality assurance in medicine (Wurm *et al.*, 2008: 109).

Telemedicine using e-learning has opened up new possibilities in education and continuing education. Rapid advancements in medical research require that doctors continually remain abreast of current developments. E-learning avoids restrictions imposed by time and location on attending training programs, seminars, and conferences in person. Access to medical literature, for example, is made easier by online databases (Ferrara, Argenziano, Piccolo, Zalaudek and De Rosa, 2004).

In South Africa where healthcare provision at rural level has greater shortcomings, telemedicine was used innovatively to bring healthcare to the dwellers in a more effective way (Ruxwana, 2010: 49). Although telemedicine has been noted to offer many benefits as indicated above, cost has been identified to be an issue. According to Greenberg (2005: 34), in a Swedish International Development Cooperation Agency (SIDA) report noted that telemedicine:

> *"……in its hi-tech implementations, it is unlikely to be cost-effective or affordable in widespread use."*

Notable projects in Africa and in South Africa includes the use of high-frequency radios in rural Uganda to help empower a network of traditional birth attendants and to partner with the public health service centres to deliver health care to pregnant women which led to a significant reduction in maternal mortality from 500 deaths per 100,000 population in 1996 to 271 per 100,000 population in 1999 (Musoke, 2002). Hand-held computers also called personal digital assistants (or PDAs) have been used successfully in Uganda, Kenya, and Ghana for the collection of health data and as effective tools for information dissemination (Bridges.org, 2002). The deployment of telemedicine at the Tsilitwa clinic in Qumbu village in the Eastern Cape Province in South Africa is another success story (Ruxwana, 2009) as well as the case where South African researchers have developed novel applications for mobile phone technology that improves adherence to HIV and tuberculosis treatments (Bridges.org, 2002).

With regards to ICT in health, telemedicine is understood in different ways such as:

> *"……the practice of medicine over distance through the use of computers and telecommunications. Telemedicine electronically transports the full range of medical care into remote areas"* (DOH, 2007: 41).

Telemedicine tend to be an appropriate system for rural health development, storage, retrieval and share of patient record, but it is doubtful if telemedicine can actually perform the full range of medical care envisaged. This is because of its limited storage capacity of the electronic equipment used in telemedicine such as a cell phone;

> *"……as the provision of medical services from a distance to include diagnosis, treatment and prevention of diseases"* (Ouma, Herselman and van Greunen, 2009: 120).

Though appropriate in understanding, telemedicine in this definition lacks the aspect of being a mobile communication tool that only reports medical diagnosis, treatment procedures and diseases prevention.

> *"The provision of various medical activities from a distance with benefits to include reaching the underserved population to provide medical services that was inaccessible"* (Wooton, Craig and Patterson, 2006: 1).

This understanding still lacks the specific aspect of medical activities. Medical activities vary and can include surgery which telemedicine cannot provide.

An appropriate understanding or definition of telemedicine is adapted from Wurm *et al*., (2008: 106);

> *"……describes the use of telecommunications technologies for exchanging medical information over a distance and providing access to expertise that is otherwise not available at a particular location for the purpose of diagnosis, consultation, treatment and teaching".*

In developing countries, telemedicine implementations are still lagging behind despite its positive potentials and offerings to the populace. A reason given for this by Samake and Mbarika (2007) is due to the fact that many developing countries are still dealing with current and past issues such as war, diseases and poverty which affect the provision of medical care for all its citizenry.

Telemedicine is of two types namely, the Store and Forward System (SAF) and real-time system. The SAF systems are images or video clips captured and stored on data storage device or pre-recorded then transmitted later for subsequent reply (Anthony, Bensik, Armfield, Stillman and Caffery, 2005: 288-293). The sender can enter the data at his or her convenience while the recipient can retrieve and analyse data at a later stage. A disadvantage according to Wurm *et al*., (2008: 109) is that there is no

direct communication. Participants are not able to ask questions directly and immediately when communicating; thus the health practitioner cannot obtain more thorough patient information.

Added to this, the recipient only views the selected portion of the image or video clip thereby can miss an important secondary diagnosis. In summary, the recipient must rely on the information chosen by the sender. Store and forward system considering its lower requirements in terms of bandwidth for data transmission and technical equipment is comparatively more affordable than real-time communication. Equipment necessary for operation includes digital camera, computer and a modem which are cheap and widely available (Wurm *et al.*, 2008: 109). Examples of SAF (pre-recorded) telemedicine include tele-electrography, tele-obstetrics and tele-radiology (Mea, 2006: 43-45; Ouma *et al.*, 2009: 120).

The other is Real Time (RT) where simultaneous communication between participants is mostly common in the form of video conferencing between patients and clinicians. Real time telemedicine according to Wurm *et al.* (2008: 109) has the advantage of direct interaction between a sender and recipient. It however requires all participants to be present at the same pre-determined time. Real time considering its higher requirements in terms of bandwidth for data transmission and technical equipment is usually higher than store- and-forward systems. A few RT systems combine features of both methods, allowing, for example, data to be sent ahead and then discussed in a video conference Examples of real time telemedicine include tele-consultation, tele-pathology, tele-dermatology, tele-surgical procedures and simple phone calls (Wooton *et al.*, 2006: 52-60)

The term "Telehealth" is synonymous with tele-homecare which is a two way interactive audio-visual communication between a healthcare provider and a patient in his/her place of residence (Koch, 2005: 566). Though virtual in nature, it involves physical assessment of the patient's heart, lung and bowel sounds and to obtain vital signs such as blood pressure and pulse through video-conferencing or over the web. Home TeleHealth (HTH) has replaced tele-homecare accordingly (Koch, 2005: 566) and is;

> *"the use of telecommunications by a home care provider to link patients or customers to one or more out-of-home sources of care information, education, or service by means of telephones, computers, interactive television, or some combination of each".*

Notwithstanding, in some literature, Home TeleHealth (HTH) and telemedicine are used interchangeably. Health Informatics is another term in the literature synonymous with telemedicine (Ruxwana, 2010: 216). It is the discipline focused on the acquisition, storage, and use of health information in a specific setting or domain as it is more about information than technology, with technology being a tool, albeit an important one, to make best use of the information (Hersh, 2009) . Of these terms, eHealth is the more commonly used term as with this study as well.

With the introduction of technology into health, eHealth comprised of health systems to include mobile Health (mHealth) systems which are prevalent in rural hospitals development in South Africa currently. In the literature of Oh, Rizo, Enkin and Jadad (2005: 36), eHealth was used in relation to health system. This study is more focussed on the electronic patient record system which is type of health system.

2.4. Health Systems

A system according to Stair and Reynolds (2009) can be understood to be an abstract representation of objects or processes, a model or a natural artefact in the real world. Furtherance to this explanation, a health system could be any of the three (3) interpretations highlighted below, combinations of them or all together (Coiera, 2003);

1. An interpretation of the health system based on an abstract representation;
2. A descriptive model representing the functionalities of a health system; and
3. The technological, logistical and administrative infrastructure which relates to the health system.

In a more simplistic form, Flores (2010: 18) explains a health system as a collection of resources (workforce, infrastructure, technology) with a functional structure put in place having the purposes of providing healthcare services to the community. She further stated that health systems comprise of components such as Health Information Systems (HIS) and other related technologies such as Electronic Health Records (EHR) and Electronic Patient Records (EPR). The HIS will be explained further.

2.4.1. Health Information Systems (HIS)

Computer-based information systems were noticeable in the sixties (60's) but limited to independent departmental applications (Haux, 2006a) that lack cohesion, complex, having been developed in a piecemeal way, fashioned by administrative, legal or donor sponsors (AbouZahr, 2005: 579). At present the foci is on the development of secure and safe healthcare systems as indicated by Flores (2010: 19) for the maintenance of electronic health records, share of information amongst health professionals and providers and the generation of medical knowledge.

A system in simple term implies a connected whole or organised process (AbouZahr, 2005: 579). Invariably a Health Information System (HIS) is an;

> *"integrated application to collect, store, process, provide, report and use health data, information and knowledge for the provision of multiple services in the healthcare domain* (Flores, 2010: 19-20) *such as policy making, programme action and research"* (AbouZahr, 2005: 579; Kumalo, 2006: 66).

An individual health information system has the characteristics of providing a variety of essential support services to all healthcare institution functions such as financial, management, human resource management (e.g. supply and storage), departmental management services (e.g. laboratory, pharmacy, radiology and clinical), decision support and health knowledge (Ayers, Soar and Conrick, 2006).

A multiple of HISs' that interconnects with more than one healthcare service provider according to Flores (2010: 20) is known as trans-institutional or inter-instructional health information systems (e.g. regional health information systems). The HIS helps in standardisation and the exchange of information between each healthcare service provider (Cayir and Nuri Basoglu, 2008; Lahteenmaki and Kaijanranta, 2009; Nagy, Preckova, Seidl, and Zvarova, 2010). But in a situation where the exchange of health information relates to national health indicators, then the system is known as a national information system (Haux, 2006b) even though both systems (regional health information system and national information system) integrates health information and shares it amongst health institutions.

A well developed HIS has the benefits of providing accurate, quality and timely health information to all health institutions and practitioners needing it for clinical purposes (e.g. diagnostic, therapeutic) as well as for decision making to benefit the patient (Conrick, 2006).

With the advent and evolution of health information system, the electronic health record and other types of systems were born. An electronic health record (EHR) system is a type of HIS and will be discussed further.

2.4.1.1. Electronic Health Record (EHR)

Electronic Health Record (EHR) is understood in many ways to include personal health information of historical value, longitudinal record of patient's health and healthcare, information ownership, the level of information collected, stored and retrieved and its subsequent use. There is a huge literature repository of research work such as by Cho, Staggers, and Park (2010); Gagnon, Desmartis, Labrecque, Legare, Lamothe, Fortin, Rancourt and Duplantie (2010); Karahoca, Bayraktar, Tatoglu and Karahoca (2010); Erdal, Catalyurek, Payne, Saltz, Kamal and Gurcan (2009); Pung, Gu, Xue, Palmes, Zhu, Ng, Tang and Chung (2009); and Vishwanath, Singh and Winkelstein (2010) that can be found concerning EHR implementations in various areas of health for example in paediatrics, nursery, family care, emergencies, radiology, elder care or outpatient consultation (Ginsburg, 2007). For this reason, many definitions (Gunter and Terry, 2005: 1; Kierkegaard, 2011: 503) have been made e.g.,

> *"….a systematic collection of electronic health information about individual patients or populations'.*

EHR is more than just a collection tool about individuals as some features within the system can also be used for data analysis.

An acceptable EHR definition is by the International Standard Organisation (ISO) (2003: 14) which is:

> *"……a repository of information regarding the health status of a subject of care in a computer processable form, stored and transmitted securely, and accessible by multiple authorised users".*

The acceptable definition encompasses patient, a system, its functions, users and so adequate for this study. The primary purpose of an EHR is the support of continuing, efficient and quality integrated healthcare as it contains information which is retrospective, concurrent, and prospective (1SO, 2003: 14). This purpose is in line with this study as patient's historical, current and futuristic information.

With this definition, EHR caters for health information security, storage, processing, retrieval standardisation and use although information ownership is unclear and thus leaves interpretation to the regional legislative health authority to determine (Flores, 2010: 25). The U.S. Institute of Medicine (IOM) explains EHR to have the purposes of improving accessibility to health records, facilitate communication between health practitioners (interoperability) treating patients, a health information repository which supports continuing patient treatment and a data rich source for advanced research and medical education (Coiera, 2003). EHR goes beyond being a health information repository as it was used for the delivery of healthcare services, financial and administrative processes, treatment management and patient self-management (Bakker, 2004; Safran, Bloomrosen, Hammond, Labkoff, Markel-Fox, Tang, Detmer and the Expert panel, 2007), development of quality management, medical education, research advancement, support for the development of public and population health policies (Heard, 2006).

Though EHRs are developed with intents to have positive impacts on healthcare delivery services through improvements of existing service delivery mechanisms, its adoption and implementation successes have remained very low (between 5% and 30%) owing to reasons such as unsupportive organisational culture (Ash and Bates, 2005: 9); software and hardware complexities (Ilie, 2009: 218) amongst other reasons. Health practitioners have been reluctant to adopt EHRs in both their individual practices and general hospital implementations have failed because of varying reasons such as more work for clinicians (Campbell, Sittig, Ash, Guappone, and Dykstra, 2006: 549-553); financial barriers (Menachemi, 2006: 103-105); no support for change (Simon, McCarthy, Kaushal, and Jenter, 2008: 45). The EHR benefits will be highlighted and discussed.

2.4.1.1.1. Benefits of EHR

Additional to the EHR purposes stated above, it offers new and modern ways of storing, manipulating, communicating medical information of all kinds to include texts, images, sound, video and tactile senses that are superior to paper-based systems (Flores, 2010: 27).

Burton, Anderson and Kues (2004) commented that another benefit of EHR is the time taken to make adequate and legible records has been shortened to take only a few minutes per patient especially when clinicians' time is tightly scheduled. In addition, Novak (2005) and Gates and Urquhart (2007) considered EHRs as time and space saving which can be life-saving, cost effective whilst maintaining confidentiality and, making transfers to other clinicians easy and immediate. Electronic records are more legible because the writing size and styles can be adjusted by the user to improve reading. Electronic records can resolve the problem of misplaced documents because of the ability of the system to create patient record backups for safe-keeping and future access (Abdullah, 2007: 47).

The ability of EHRs to handle a much higher volume of data helps to facilitate organisational and structural changes within healthcare service delivery due to better accessibility in time and space of patient information (Nikula, 2005). Large volumes of data can lead to system problems thus the value EHR offers could include providing alert reminders to hospital staff to particular problems which may arise, for decision making but also for clinical audit and research (Amatayakul, 2005; Jones, Henwood and Hart, 2005).

Healthcare routines can be simplified and structured using EHR as access to patient information can be undertaken from multiple locations by health practitioners with a higher level of security to restrict unauthorised user access. This leads to a reduction of paper and human energy cost as medical expertise becomes readily available regardless of patient location and this increases patient democracy and quality of care (Maass and Eriksson, 2006).

The technological, legal and ethical requirements of EHR pose challenges but if met can secure the privacy of patients' records from unauthorised user access. Technologically, EHR stores patients' records in a structured way for a long period without compromising its quality. Legally, patients' records stored in EHRs are protected by processes, procedures and laws against unauthorised user access or use. And finally, ethical requirements means health practitioners cannot access and divulge patients' information (principles of privacy and confidentiality) without proper procedures as stipulated by their professional codes of conduct (Flores, 2010: 30). This is because EHR has the ability to track access of patients' record, modification and storage by authorised user. EHR could be used as a tool to monitor and measure professional performance and standards because of its track-and-trace capabilities (Bakker, 2004).

Based on the principle of the "need to know", Flores (2010: 30-31) advocates for authorised users to access patient information in EHR in order to obtain relevant patient information to carry out their tasks. Access may also be construed as a challenge but when authorised users can access patients' record, it becomes a benefit as relevant and sufficient information will contain information necessary to help clinicians provide healthcare service (van der Linden, Kalra, Hasman and Talmon, 2009). Compromising patient information through access and use can cause harm to the private life of the patient (Conrick and Newell, 2006).

Other EHR benefits include the reasoning that electronic records are considered superior to paper records because they decrease medical errors due to handwriting problems and simultaneously leverage other error-reducing technologies and render them coherent (Gunter and Terry, 2005: 2). Other benefits of using EHR includes its ability to reduce prescription errors, reduced costs related to chart filing and transcription and improved communication (Smelcer, 2009: 71). Accessibility from any location by authorised health practitioners and patients renders EHR superior for example in Denmark, patients have the ability to electronically access all of their medical information including medical records and test from a website called Borger.dk (Kierkegaard, 2011: 504). The website alerts the patient by email if a doctor, pharmacist or nurse views their records, and allows patients to make appointments, set end-of-life wishes, and even email their doctor for advice illnesses that do not require an office visit. It is not entirely clear from the literature how medical records are captured in Borger.dk. But from observation of the website, it is safe to assume that data is captured by clinicians who physically input patient data.

At public care offices in the U.S., perceived EHR benefits in a study by Singh, Lichter, Danzo, Taylor and Rosenthal (2012: 23-24) on the adoption and use of health information technology in rural areas are numerous. These benefits includes but not limited to: less phone/fax time dealing with and tracking laboratory and radiology, medication safety (Kutney-Lee and Kelly, 2011; Hillestad, Bigelow, Bower, Girosi, Meili, Scoville and Taylor, 2005), capabilities for chronic disease management prompts, accurately capture services provided and time dealing with medication refills. EHR data can be used anonymously for statistical reporting in matters such as quality improvement, resource management and public health communicable disease surveys (James and Pascale, 2009).

There is no limit to the benefits that an EHR can offer an organisation and users. But it is not with its consequences, barriers to adoption as well as resistance by clinicians as explained in the next section of this study. Health systems such as EHR are not complete solutions to health issues but an evolving system that can only get better upon use. This is a reason why barriers to EHR are important to identify limitations and aspects for future debate and hopeful improvement.

2.4.1.1.2. Barriers to the adoption of EHR

Medical care is an expensive business (Smelcer, 2009: 17; Hatton, Schmidt and Jelen, 2012: 707). In the U.S alone, healthcare costs stand at $2.7 trillion per year or an average of $8,680 per person per year or about 17.9% of its Gross Domestic Product (GDP) (HHS, 2012). Although Schoen, Osborn, Huynk, Doty, Peugh, and Zapert (2006) in their publication claim that countries with wide-spread use of electronic medical records appear to have lower health care costs and better care. Other types of costs involve lost productivity and high training cost during EHR implementation (Brooks and Grotz, 2010).

A larger problem of EHR is health practitioners' adoption. Ilie (2009: 216) highlights their lack of adoption which directly inhibits the realisation of EHR benefits such as improved quality of care, reduced costs, data sharing, and enhanced overall efficiency along the supply chain (Davidson and Heineke, 2007). Without health users' acceptance of adopting EHR, implementation cannot be a success. Health practitioner's perception of the adoption of an electronic record system will be discussed more; some other reasons for health users' non-acceptance may vary such as:

1. EHR systems are complex in nature (Chiasson and Davidson, 2004). Complex meaning that the different methods and systems for obtaining and storing data has increased the level of complexity in the development of systems capable of sharing and exchanging medical data (Ammenwerth, Brender, Nykänen, Prokosch, Rigby and Talmon, 2004). EHR implementations and its use involve institutional transformational and clinical work-flow changes (Davidson and Chismar, 2007). Campbell *et al.,* (2006) state that often times EHR systems require individual clinician to perform new tasks and create more work processes that may be time-consuming such as entering new information or responding to system alerts.
2. Work incentives are mis-aligned in the healthcare and this context is an operationally and technically complex arena (Middleton, Hammond, Brennan, and Cooper, 2005). The healthcare industry according to Ilie (2009: 216) is characterised by a dual organisational

structure made of hospital administrators (oversee the management of the hospital including the primary IT-adoption decision) and clinicians (oversee patient care who make individual IT-usage decisions). The value-added benefits of using EHR in the long-run are counter-balanced by IT investment cost to health users in terms of the increased amount of time spent learning the system in their daily work (Berner, Detmer and Simborg, 2005; Ilie, Courtney and Van Slyke, 2007; Trimmer, Beachboard, Wiggins and Woodhouse, 2008).

3. Hospital clinicians are considered much freer than many other types of information system users to choose whether or not they want to use a system (Lapointe and Rivard, 2005). Few clinicians in community hospitals in the U.S. are fulltime employees as their contribution is through patient treatment to improve hospital revenues which allocates a space for such clinicians and thus EHR cannot be made mandatory on them (Ilie, 2009: 216- 217). Added to this, many clinicians are not yet computer-skilled enough to effectively and efficiently make use of electronic aids of this nature (Balen and Jewessen, 2004; Smit and de la Harpe, 2008: 121).
4. EHR system implementations may require changes in the existing hospital management structure (Campbell *et al.*, 2006). Traditionally, clinicians have enjoyed a significant degree of control and autonomy based on their status and role as healthcare providers, as well as their professional expertise as reflected by the "white coat" artefact (Fiol and O'Connor, 2006; Tang, Ash, Bates, Overhage and Sands, 2006). EHR systems may pose a threat to their professional autonomy by requiring them to perform some "clerical" tasks (through the use of EHR) and this may limit their flexibility through structured menus rather than free-text documentation as with the paper chart (Campbell *et al.*, 2006).
5. EHR adoption at hospitals or private practices are argued to benefit patients more as hospitals or clinicians have to absorb the total cost of such implementation as well as other costs such as lost time, and productivity due to learning process, staff training and risks associated with system failure or data loss (Funke, 2008).
6. System implementation is time-consuming as well as practitioners ability to learn and master the functionalities of the system can result in obstacles (Miller and Sim, 2004). As noted by Huston (2004), system implementation will result in change and such changes would need an agreed standard procedure and provision for such transition period to take effect.
7. Security issues such as "hacking" can pose a problem to an EHR system since it will be connected to the internet. Eavesdropping and skimming can also occur when sensitive data for remote patient monitoring are transmitted wirelessly (Adesina *et al.*, 2011: 3).

8. The heavy reliance on continuous power (electricity), technical support and network function puts the adoption of a sustainable EHR system in jeopardy especially if implementation is at a rural setting (Rohde, Shaw, Hedberg, Stoops, Venter, Venter and Matshisi, 2008: 206).

The barriers mentioned in this section are numerous as well as important issues that will affect EHR adoption at a hospital. Total cost of system implementation, its complexities, system training, organisational re-structuring, work role re-alignment, security risks and the time consumption involved in resolving all these issues are exhaustive. These summarised barriers are no different from Singh *et al's*, (2012: 23) study, where he also summarised the major five (5) barriers to EHR adoption irrespective of urban or rural settings to include: financial constraints, return on investment issues, initial data entry too labour intensive, initial loss of productivity while converting, and training burden for physicians and staff. The list of EHR barriers is exhaustive as it also includes patient information confidentiality issues (Abdullah, 2007: 57-62).

While EHR is a commonly used term in most of the literature consulted as well as used interchangeably with EMR, CPR and EPR (Al-Aswad, Brownsell, Palmer and Nichol, 2013: 154), electronic patient record (EPR) is the appropriate term for this study because it deals with patient record at a single health facility.

2.4.1.2. Electronic Patient Record (EPR)

The debate on Electronic Patient Record (EPR) holds two views: the first being the optimists and the sceptics (Greenhalgh, Potts, Wong, Bark and Swinglehurst, 2009: 730). The optimists claim that EPR is the cornerstone of a modernised health service as it offers a better, safer, cheaper, and more integrated healthcare (Institute of Medicine, 2009). The sceptics such as Avison and Young (2007), Hanseth (2007) and Kreps and Richardson (2007) cast a doubt over EPR being a technological utopia. The debate they claim is due to evidences of failed EPR projects and even successful ones are plagued by delays, escalation of costs, scope creep and technical glitches, including catastrophic system crashes (Greenhalgh *et al.*, 2009: 730).

The term EPR as mentioned in chapter one, section 1.8.4.1is understood by many names depending on country, professional use and purpose. The healthcare industry lacks a commonly acceptable terminology and definition for this clinical information tool. Other names used in the literature according to Hamidfar (2008: 27) and Hayrinen, 2008: 295) includes Automated Medical Record

(AMR) by Uslu and Stausberg (2008: 676); Clinical Data Repository (CDR) by Hamidfar (2008: 27) and Hayrinen, (2008: 295); Digital Medical Record (DMR) by ISO (2003: 16); Virtual Patient Record (VPR) by Malamateniou and Vassilacopoulos (2003: 131); Personal Health Record (PHR) by Tang *et al.*, (2006); and Summary Care Record (SCR) by Greenhalgh, Stramer, Bratan, Byrne, Mohammad and Russell (2008: 2)

With many names associated with EPR, there are some common characteristics from these definitions such as the use of technology and its ability to share patient information amongst authorised user. Technology does involve the use of a computer or mobile device. In this study, technology involves a computer. +

While many researches use the term EHR, EMR or EPR interchangeably, it is important to make a distinction here. The Electronic Medical Record (EMR) and Electronic Patient Record (EPR) is one and the same and contains encounter information of patients in a care delivery organisation while the Electronic Health Record (EHR) contains information from many or all care delivery organisations where the patient has been treated or has had an encounter (Kierkegaard, 2011: 503).

The EPR does not have a single definition although many definitions are quite similar in understanding and meanings while some have evolved over time. Some definitions include,

> *"The legal patient record created in hospitals and ambulatory environments that is the data source for the EHR"* (Kierkegaard, 2011: 503).
>
> *"Any record that contains all or most of patient's clinical information from a particular hospital"* (Samore, Evans, Lassen, Gould, Lloyd, Gardner, Abouzelof, Taylor, Woodbury, Willy and Bright, 2004).
>
> *"Any automated record system kept on a patient in an outpatient or inpatient department of a medical institution, which provides a history of a patient and serves as the basis for diagnosis and treatment of patients"* (Abdullah, 2007: 7-8).

The working EPR definition for this study adopts the (ISO) (2003: 14) definition which is;

"……a repository of information regarding the health status of a subject of care in a computer processable form within a health facility, stored, retrieved and transmitted securely, and accessible by multiple authorised users".

Irrespective of these definitions, EPR serves similar benefits and shares same barriers towards its adoption and use by healthcare practitioners. Healthcare practitioner's perception of such a system is same here. Since patient information (or data) is the raw material feeding this system, information quality is important to a successful system operation. Patient information must be consistent from input and should serve the purpose for which it is collected and processed to its users.

2.4.1.3. A review of electronic record system studies in South Africa

Studies have been conducted on electronic record systems in SA as mentioned in chapter one, section 1.12 but few. The areas of electronic record study vary and some examples will be highlighted here to distinguish these studies from the current study. Weeks (2013) study of electronic record system focussed on managing the transformation from a paper-based to an electronic based system. Weeks referred to this computer-based system as EHR and health practitioners as physicians. The study was qualitative of multi-disciplinary literature review and the interview of four (4) ICT practitioners and seven (7) physicians. Weeks (2013: 152) conclusion was derived from the discussion that the cultural attributes of a healthcare culture are deeply imbedded in an altruistic belief in the social value that emanates from the professional activities of healthcare professional. In addition, his suggestion using the Khayelitsha hospital experience is that, to implement an EHR system, serious thought needs to be made because where change comes into conflict with a well-entrenched, patient centred, ethically based healthcare culture, the implementation will be an act in futility.

2.4.1.3.1. Case one (Weeks)

Weeks' (2013) research study notes that beliefs, perceptions and culture of clinicians are important when adopting technology. His research exposes cultural attributes which are deeply engrained in clinicians and suggests a managed approach. A culture identified amongst clinician is the use of paper for storage and share. Though his research is within the change and transformation discipline, it offers insights into clinician's expectations of what EPR can do and what it is doing for them. Weeks' (2013)

research is an indication of how technology can be integrated into hospitals with minimal disruptions to clinician's way of work, that is, the use of paper. Weeks' (2013) research using interviews show that issues of storage, retrieval, share, security amongst the other problems previously encountered have been solved. This is a positive contribution to this study in understanding clinician's perception towards technology, whether for adoption or use. Although the gap here is in identifying actual attributes responsible for clinician's technology use.

2.4.1.3.2. Case two (Hartmann and Sooklal)

Another SA example is by Hartmann and Sooklal (2012) who undertook a study of EMR using case study approach of a tertiary hospital in SA and thus proposing a localised electronic medical record (EMR) system. Hartmann and Sooklal (2012: 192) critically evaluated the current state of a hospital's health record system; established a global best practice in record storage and management; as well as determine the desirability of introducing more technological record storage mechanisms and quantified the benefits of alternative systems. The qualitative method employed includes direct observation, data base extraction, and work studies. Hartmann and Sooklal (2012: 199) concluded that the use of document imaging, whether computer-based or on microfiche, is out-dated and ineffective because such images cannot be searched or edited. The authors proposed a tablet-computer-disseminated EMR system with the benefits of reducing space, infrastructure dedicated to medical record storage, maintenance and associated costs. In addition, risk of loss, misplaced, illegible, damaged, or otherwise useless documents will be eliminated. Furthermore, the reduced reliance on paper records should be able to save the SA government at least R10 million per annum and reduce a hospital's carbon footprint by at least 300,000kg of carbon monoxide per annum (Hartmann and Sooklal, 2012: 200).

Hartmann and Sooklal (2012) research proposes a hybrid approach to patient record management. This hybrid approach is based on the current record management at a hospital and possible improvements without compromising quality of care by clinicians. The authors' research highlights the potential benefits of introducing technology such as lower costs, improved service quality. But it is noteworthy to mention that the benefits of using the current paper system include its physical tangibility, edit ability and its contents easily understood by clinicians. In retrospect, Hartmann and Sooklal (2012) research proposes a system designed in conjunction with clinician's input. On the contrary, this EPR study attempts to understand an existing system already in use at hospitals and

clinicians perception of its impact on their daily work. The understanding and clinicians' perception exposes the gap within the SA literature in the health information system discipline.

2.4.1.3.3. Case three (Kerry)

The third example of SA studies is by Kerry (2006) who used an interventional study conducted in Kwazulu Natal Province in SA with the aim of assessing, documenting and improving the Patient-held Record (PhR) system. The author employed the quality assurance (QA) methodology which was qualitative in nature involving focus group discussions (Kerry, 2006: 18). In conclusion, Kerry (2006: 23) stated that PhRs are important at district health levels with the objectives of improving the standard of health care, as well as the continuity of care between the district hospital, the clinics and community health centres that the hospital supports. In addition, the PhRs form a vital link, not only between facilities, but as a link through time. Kerry suggests that patients need a definitive PhR for themselves, a record that is problem-orientated and tracks their health and illnesses throughout their respective lives.

The problems identified by Kerry (2006) are similar to those of Hartmann and Sooklal (2012) such as poor record storage and share amongst clinicians and facilities. In Kerry's (2006) research, PhR are completely paper-based records with the advantages of continuity of care, a sense of ownership by patients as well as it improves the quality of note taking by clinicians. Although confidentiality and PhR loss were major disadvantages, there was data quality issue where PhR cards and hospital record information at any given time did not always match. In synthesising Kerry's (2006) research, it is clear that within his research location, clinicians were comfortable with using a paper-based record system. This point to the observation made by Weeks (2013) in his research where he cautions for a radical change in hospital culture when adopting technology. The gap in Kerry's (2006) research is that it does not address a long-term solution to solving the problems associated with paper-based record system. The current study is aimed at understanding EPR and its impact in record storage, retrieval and share which are pending problems faced by paper-based record systems.

2.4.1.3.4. Case four (Mostert-Phipps, Pottas and Korpela)

Other South African researches are by Mostert-Phipps, Pottas and Korpela (2012) which is aimed at improving continuity of care using electronic records such as PHR and EMR. Mostert-Phipps *et al's* (2012: 327) research is based on a literature review to identify various types of electronic records that could be employed to improve continuity of care in the SA healthcare setting by developing a

technological model that employs several of these electronic record systems. A qualitative approach using secondary data sources was employed. Patients move between various healthcare providers, due to the fragmented nature of modern healthcare provision thus making the informational dimension of continuity of care increasingly important to ensure that some level of continuity is still achieved among healthcare providers (Mostert-Phipps *et al.*, 2012: 330). The research concluded that paper-based methods of recordkeeping are inadequate in supporting informational continuity of care, making the adoption of electronic methods of recordkeeping more important. A workable approach based on the adoption of standards-based electronic records was proposed for the South African healthcare sector.

Personal health records (PHR), electronic medical records (EMR) and electronic health records (EHR) are all electronic systems proposed by Mostert-Phipps *et al.* (2012) in solving paper-based record problems. Though they suggest a phased adoption of the electronic system, it will not eliminate clinician's culture of paper use overnight. This phased approach will constitute a hybrid system with an intent to transform all paper records into electronic at a future date. This research indicates the necessity of using an electronic record system over a paper-based system because of its many benefits. But Mostert-Phipps *et al's.* (2012) research does not address clinician's reason for wanting to adopt an electronic system. Clinicians attributes in choosing a record system is important for its adoption and so a gap in their research study.

2.4.1.3.5. Case five (Mostert-Phipps, Pottas and Korpela)

Mostert-Phipps, Pottas and Korpela (2013) conducted another research on the factors associated with the adoption and meaningful use of health information technologies (HITs) in the SA healthcare sector. A three-round Delphi approach that included 21 participants using a questionnaire was employed (Mostert-Phipps *et al.*, 2013: 546). Of a total of 58 factors uncovered by the participants, 42 factors were considered to have a direct to significant impact on the adoption and meaningful use of HITs in the South African healthcare sector (Mostert-Phipps *et al.*, 2013: 551). An example of a factor is that users are not properly trained and motivated to ensure buy-in into adopting HIT thereby resulting in resistance and lack of commitment. The authors concluded that the results of this Delphi study contributed to a clearer understanding of the factors that should be addressed to encourage the adoption and meaningful use of HITs in the SA healthcare landscape. In addition, the results of this study have raised awareness of the factors that need be taken into consideration when planning the implementation of HITs (Mostert-Phipps *et al.*, 2013: 553).

In identifying the factors associated with the adoption and meaningful use of health information technologies (HITs) in the SA healthcare sector, the respondents in Mostert-Phipps *et al's*. (2013) research were health informatics members of varying discipline such as computer scientists. The research did not specify the constitution of the health informaticians in the Delphi study and so one can only speculate on the impact of these factors. So while a computer scientist for example may speculate on a factor as being more important in the adoption and use of HIT, a clinician on the other hand may describe that factor as being less important. The current EPR study will engage with clinicians as they directly interact with the electronic record system to deliver continuity care.

2.4.1.3.6. Case six (O'Mahony)

O'Mahony (2009) in his study implemented an EMR system in a rural general practice in SA. Reasons for this included a very high patient engagement (68, 912 registered patients), each with a paper record. This resulted in the record system needing more storage space, records seemed increasingly misfiled, and thick records were falling apart (O'Mahony, 2009: 346). Other patient's chronic conditions such as HIV/AIDS, diabetes, hypertension and asthma were becoming increasingly frustrating to monitor by the author. These conditions according to the author generated data that needs tabulation to quickly follow trends over time. As a dispensing practice, the author and physician needed a program for stock control and compliance with dispensing regulations in line with the SA medical law where each medicine dispensed has to be recorded and have its batch number and expiry date linked with a named patient. The current billing software program at the practice did not have these features. Using this practice as a case study, an EMR system was implemented (O'Mahony, 2009: 346). Lessons learned and suggestions after EMR implementation included a physician's ability to manipulate computer as being vital, technical and infrastructural support should be readily available, transition to a computer-based system should incorporate the user(s) to allow for smooth and uninterrupted work (O'Mahony, 2009: 347).

In agreement with O'Mahony's (2009) research, electronic record system is the future of record management. Though O'Mahony (2009) suggests computer literacy and technical support, his research addresses a vital component in technology adoption, which is the users' input in EPR design. In designing, adopting and the use of technology in health, clinicians must be part of its every developmental phase so as maximise its use in service delivery. O'Mahonys' (2009) research proposes and suggests an electronic system as a solution to paper-based record problems but falls short of

identifying the attributes that will facilitate technology use by a clinician. Technological benefits such as its ability to store large volumes of data, improve billing, track and control medical stock are all important but EPR use is much more than all these. The issue of sharing patient information inter and intra-health facilities was not mentioned in O'Mahonys' (2009) research as this is a core characteristic of EPR and so a gap identified for the current study.

2.4.1.3.7. Case seven (Cilliers and Flowerday)

In the case of Cilliers and Flowerday (2013), they investigated user acceptance as a factor for the poor uptake of telemedicine in the Eastern Cape Department of Health. While telemedicine is not an entirely electronic record system because of limitations such as its inability to processing data, it is a HIS. The authors used the Unified Theory of the Use and Acceptance of Technology (UTUAT) theory employing a quantitative survey approach. This approach involved developing a questionnaire to make use of existing literature and distributed to various clinics around the province where telemedicine has been implemented. The results showed majority of health care workers believed in the value and benefit of HIS to improve the effectiveness and efficiency of the healthcare system. The researchers identified barriers to the effective implementation of a HIS to include a lack of knowledge and awareness regarding the telemedicine system. This in turn means that the user is apprehensive when using the system thus contributing to less frequent usage. In conclusion, Cilliers and Flowerday (2013: 4) acknowledged that information systems can help to increase the effectiveness of the healthcare system because the acceptance of telemedicine in the Eastern Cape Department of Health is positive. Though they advised that, in order to integrate it into standard work practices, more must be done with regards to the promotion and education of telemedicine.

Cilliers and Flowerday (2013) study is one of the few SA studies with a theoretical framework where the UTUAT model proposed by Venkatesh was used. The authors' research was on telemedicine, future study is shifting focus to EPR because it has a wider scope of functionality such as storage and retrieval.

2.4.1.3.8. Case eight (Smit and de la Harpe)

Finally, Smit and de la Harpe (2008) in their research compared paper and computer-based information system in pharmacy operation. The authors focussed on electronic systems used by pharmacies as they argue that paper-based systems are cumbersome, inaccurate, limited, time consuming, error-prone, difficult to access and distribute, incomplete, unreadable, insecure to

unauthorised uses and users and do not live up to the full potential of an automated, centralised system (Smit and de la Harpe, 2008: 119). A qualitative approach involving literature and interview with a pharmacist was used (Smit and de la Harpe, 2008: 124). The study sought to investigate if electronic information systems have any benefit over paper-based systems. It noted that the medical industry was slow to adopt technology as compared to industries like finance and engineering (Smit and de la Harpe, 2008: 126). The authors proposed a computer-based system owing to the vast benefits over paper-based systems. Computer benefits according to Smit and de la Harpe (2008: 127) will include central data maintenance, non-existing duplicate information, improved information accuracy as well as storage capacity over a long period.

Smit and de la Harpe (2008) reiterated what other SA researchers have said such as the many benefits of an electronic record over paper-based records. So in designing and adopting an electronic system, care must be taken not to exclude the clinicians (users) in its design. Clinician's attributes are important so that the full potential of adopting and using an electronic can be achieved. Smit and de la Harpe (2008) research proposes EPR unlike the current study which addresses post-adoption and use. The gap in the research domain here is that clinician's attitudes and use behaviour are already impacting the system.

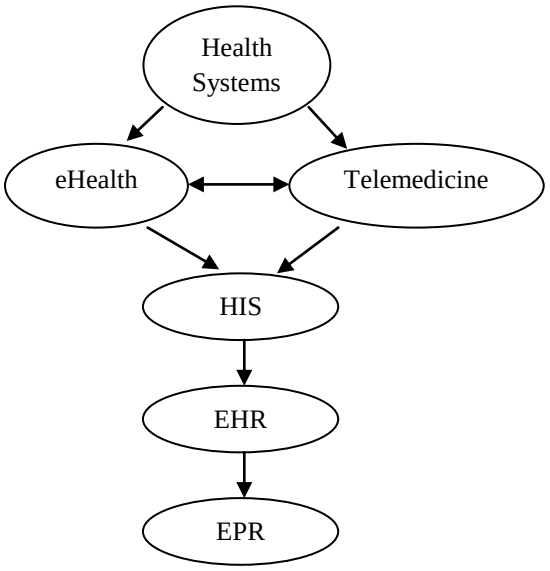
The electronic systems mentioned above are numerous so a need to classify them is important to avoid confusion.

2.4.1.4. Classification diagram of electronic systems

The terms e-health, telemedicine, health system, HIS, EHR and EPR were all mentioned above and while these terms sound different, they are inter-related. The classification diagram below attempts to show their relationships. Health systems encompass ehealth which is synonymous to telemedicine. Telemedicine is mostly applied in rural settings because of its effectiveness but can be used in urban settings. Mobile health (or mhealth) is a type of telemedicine that uses cell phones. Telemedicine is a HIS with the capability to store, process, retrieve, report and share information for health service delivery. HIS can be an EHR which is a repository of patient information at all health facilities treated at or an EPR which is a repository of patient health information at a health facility treated at.

The above summary is diagrammatised in figure 2.1.

Figure 2. 1. Classification diagram



Collection of resources (workforce, infrastructure, technology) with a functional structure put in place having the purposes of providing healthcare services to the community

Use of telecommunications technologies for exchanging medical information over a distance and providing access to expertise that is otherwise not available at a particular location for the purpose of diagnosis, consultation, treatment and teaching

Integrated application to collect, store, process, provide, report and use health data, information and knowledge for the provision of multiple services in the healthcare domain

Repository of information regarding the health status of a subject of care in a computer processable form, stored, transmitted securely and accessible by multiple authorised users

Repository of information regarding the health status of a subject of care in a computer processable form within a health facility, stored, retrieved, transmitted securely, and accessible by multiple authorised users

Source: Developed by researcher

In using EPR, quality data is vital for storage, retrieval and share and will be discussed in the subsequent section.

2.4.1.5. Health Data Quality

Health institutions like many other organisations are drowning in data and struggling to handle vast abundance of data (Parker *et al.*, 2006: 3). The healthcare sector compose of a myriad of stakeholders, including patients, health care providers, researchers, managed care organisations, third-party payers and clinicians all of whom between them generate and collect a large amount of patient data that is not well integrated (Alshawi *et al.*, 2003: 286). Due to this data abundance, it becomes even more of an obstacle for organisations who quickly need to analyse large amounts of data from multiple sources accurately (Parker *et al.*, 2006: 3).

The problem is even exasperated when many of the patient data are stored in different formats and extracted from heterogeneous resources. The patient data could be extracted from paper files, electronic files, databases, spread sheets and many other sources. This could lead to problems when real-time integrated information is required by the health practitioner as explained by Parker *et al.* (2006: 3).

Health practitioners according to Long, Seko, Robertson and Morrison (2004) accumulate an abundance of data from their patients during consultations. Data accumulated is somewhat under-utilised. This is so because when a patient moves to another practice or hospital, accumulated data can be lost as most healthcare practitioners keep patient record at their practice or hospital that captures and stores it.

The quality of data in the health sector according to Parker *et al.* (2006: 3) is important and cannot be ignored in any way. In addition, the healthcare sector relies on data to manage and make better decisions. Dravis (2004: 29-40) identified six factors or aspects of an organisation's operation (such as a hospital) that should be considered when discussing data quality and they include:

- Context (type of data being cleansed and its purpose) – the type of data and for what purpose is important to any organisation. When large amounts of data is generated and collected by a hospital for example, it should be processed to retain only valuable information needed by its users. This allows the organisation to focus on data useful for its operation. Cleansing of data renders such data high in quality as it will contain characteristics that make it useful for organisational use. Types of data in context are customer data (names, addresses and so on.), financial data (dates, account numbers and so on.), supply chain data (quantities, descriptions and so on.) and telemetry data (height, speed and so on.) (Dravis, 2004: 30).
- Storage (where the data resides) – data destination should be accessible to an organisation when needed. Data storage must be the format acceptable for use and should be easily accessed for use at any point of need (Dravis, 2004: 30).
- Data flow (how data enters and moves through the organisation) – data movement in and out of an organisation can improve data quality as raw data collected at one point of the organisation can be processed and passed on to other users needing it. If raw data is not sent through to the correct medium and user, then such a data cannot be processed adequately and used effectively and so compromises its quality (Dravis, 2004: 31).
- Work flow (interaction and use of data between work activities) – data shared between organisational departments improves data quality as further processing of the data can be effectively done. This improves organisational operation as the more users manipulate data, the more the data quality improves (Dravis, 2004: 34-35).

- Stewardship (people responsible for managing the data) – having authorised users manipulate and manage data improves data quality as it can be collected, processed and stored efficiently using standardised procedures (Dravis, 2004: 36).
- Continuous monitoring (processes for regularly validating the data) – data stored efficiently can always be re-used and by so doing subjects data for continuous monitoring and assessment of its quality (Dravis, 2004: 37).

The quality of health data is important as the implications of data loss; inaccurate data can lead to severe operational consequences that may influence data quality which also influences life or death decisions (Parker *et al.*, 2006: 3). Other factors that may influence data quality include the flow of data in the practice by the data users responsible for the data management as incorrect data input can compromise data quality. In order to determine the quality of data, its individual characteristics known as data quality dimensions need to be examined. This is explained in more detail in the subsequent section.

2.4.1.6. Health Data Quality Dimensions

Health data can be complex and should possess certain characterises known as data quality dimension (Parker *et al.*, 2006: 7). A data quality dimension is a set of data quality attributes that represent a single aspect or theme of data quality (Gurvirender, Dhillon and Chin, 2005: 26). In their survey findings, Madnick, Lee, Wang and Zhu (2009: 23) identified four (4) data quality dimensions namely: intrinsic, accessibility, contextual and representational. Parker *et al.* (2006: 7) and Gurvirender *et al.* (2005: 28-32) elaborated further on these dimensions.

- Intrinsic data quality dimension - indicates that information has quality in its own right. It includes: accuracy (implies data is correct, flawless, precise, reliable and certified free of error), objectivity (unbiased and impartial data), believability (data can be believed or regarded as credible), reputation (data use expectations) and usefulness (information use);
- Accessibility data quality dimension - emphasises that information system must be accessible but secure. It includes: accessibility (data should be available, obtainable or retrievable when needed), access security (protecting data from unauthorised users and natural disasters) and shared understanding of data by various social groups;
- Contextual data quality dimension - Data that is provided in time and in appropriate amounts. It includes: relevancy (applicability of data to the task at hand), value-added (benefits and

advantages of using data), timeliness (age of data), completeness (data must be of sufficient breadth, depth and scope for the task at hand), amount of data and semantic integrity (measures consistency and completeness); and,

- Representational data quality dimension - Includes aspects related to the format of the information and its meaning. It includes: interpretability (data should be defined clearly and represented appropriately), ease of understanding, concise and consistent representation and syntactic (data quality).

In investigating an EPR system, data quality is vital in enhancing system use. Data quality dimension is not a guarantee since the human element in using the system cannot be avoided. This human intervention increases the likelihood for system errors. For example, data accuracy is dependent of correct data input otherwise data accuracy will be compromised.

Care should be taken when collecting, using and the re-use of data. Weiskopf and Weng (2013: 144) express concerns of the re-use of clinical data which has been limited by a number of factors, including data quality concerns and their suitability for research purposes. This concern is due to the fact that there is difference in priorities between clinical and research settings, as such clinical data are not recorded with the same care as research data (Weiner and Embi, 2009: 359). The quality of data due to differences in measurement, recording, information systems and clinical focus during collection and processing makes its dimensions variable (Weiskopf and Weng, 2013: 144). Data quality is not necessarily connected to the type of system used (paper or electronic) but more on its dimensions and the data collectors. It means the use of paper-based record to collect data can still be used without compromising data quality.

Sørensen *et al,* (2008: 39) in their study of a review of ICT systems for HIV/AIDS and anti-retroviral treatment management in South Africa discovered that paper-based systems in the form of data points collected at clinic level in South Africa (SA) were standardised thereby making paper use relevant. On the other hand, Smit and de la Harpe (2008: 127) suggest an electronic information system to reduce prescription errors found in a pharmacy unit where paper-based system was in place. These errors can have negative effects as data quality can be compromised. EPR system will require the conversion of paper-based documents into digital format.

A large repository of reviewed literature so far confirms that paper-based record system disadvantages can be resolved using EPR. These literature includes but not limited to, Awokola, Abioye-Kuteyi, Otoru, Oyegbade, Awokola, Awokola and Ezeoma (2012); Balllie, Chadwick, Mann and Brooke-Read (2012); Boonstra and Broekhuis (2010); Boyle, Solberg and Fiore (2011); Calman, Hauser, Lurio, Wu and Pichardo (2012); Cebul, Love, Jain and Hebert (2011); Chikuni and Mnjama (2010); Cresswell, Worth and Sheikh (2012); Crosson, Ohman-Strickland, Cohen, Clark and Crabtree (2012); Dal Pan and Temple (2011); De Vliegher, Paquay, Vernieuwe and Van Gansbeke (2010); Dumay and Haaker (2010); English *et al.*, (2011); Erickstad, Reed, Bhat, Roehrborn and Lotan (2011); Gardner and Jones (2012); Gilmer, O'Connor, Sperl-Hillen, Rush, Johnson, Amundson, Asche and Ekstrom (2012); Greenhalgh, Hinder, Stramer, Bratan and Russell (2010); Greenhalgh, Stramer, Bratan, Byrne, Russell and Potts (2010); Greiver, Barnsley, Glazier, Moineddin and Harvey (2011); Hartmann and Sooklal (2012); Hatton, Schmidt and Jelen (2012); Herrin, da Graca, Nicewander, Fullerton, Aponte, Stanek, Cowling, Collinsworth, Fleming and Ballard (2012); and Horning (2011); amongst the many.

For the studies by Shabbir, Ahmed, Sudhir, Scholl, Li and Liou (2010); Schleyer, Spallek and Hernandez (2007); Ayatollahi *et al*., 2009); Li and Korniewicz (2013); and Samoutis, Soteriades, Kounalakis, Zachariadou, Philalithis and Lionis (2007), EPR system is found to be used in conjunction with paper-based record systems (hybrid) because of the type and nature of the valuable data they contain rather than being used as a substitute. Paper-based records according to Ayatollahi *et al.* (2009: 200) have the advantages of stability (they do not need electricity or backing up); flexibility; portability and ease of use; as well as its compatibility with the daily tasks of healthcare professionals. It has been accepted as part of the job over a considerable period of time.

In Ayatollahi *et al's* (2009: 205) study on emergency department staff preferences, its expectations and concerns of paper-based versus computer-based records, some interviewees noted that paper-based records provided them with more in-depth information. In-depth information by an administrative staff interviewed meant personalised comments such as patient's fears, feelings, worries and histories that online hospital systems lack. Limited computers at hospitals also meant paper-based records provided quicker and easier access to patient information. A nurse interviewed in Ayatollahi's (2009) study responded that:

"….just fill the card in and walk with them round would be quicker …… it can sometimes be quicker and easier than finding a spare computer and inputting information."

This statement is an indication of many health practitioners' perception of paper use being more adequate for their kind of work task. The role that paper plays in health is undeniably relevant and should be incorporated with EPR only where possible in order to facilitate better health tasks.

In discussion, the use of paper-based system is still been used in conjunction with computer-based record systems owing to the fact that many clinicians still perceive the legacy of the old paper-based routines and structures which still exist (Lium, Tjora, and Faxvaag, 2008: 12). In South Africa, paper-based records are still widely relied on by health practitioners because the health data is created by them (Rohde *et al.*, 2008: 206). Paper systems are more modifiable and readily accessed. If calculations are required, they can be done and redone by accessing the underlying counts unlike EPR systems that are often seen as 'black boxes' producing data out of their depths (Rohde *et al.*, 2008: 206).

The acceptance of electronic health record system by healthcare practitioners (users) is important to its usefulness and success. Some prior studies in information systems and other disciplines by López-Nicolás, Molina-Castillo and Bouwman (2008); Zhou (2008); Williams, Dwivedi, Lal and Schwarz (2009); Tung, Chang and Chou (2008); Premkumar, Ramamurthy and Liu (2008); Chang and Tung (2008) identified two known models. These models are the Diffusion of Innovations (DOI) and the Technology Acceptance Model (TAM). Both models have been applied extensively to explore acceptance of information technology; although not within the health informatics domain according to Morton (2008: 5). Contrary to Mouton's (2008) assumption, the works of Alanazy (2006) in his doctoral dissertation used TAM as a foundation model to focus on the factors associated with the implementation of electronic health records in Saudi Arabia. Brown (2012) used the TAM and Theory of Planned Behaviour (TPB) in his doctoral dissertation which focused on the mandatory use of electronic health records: overcoming physician resistance.

The theories (and models) associated with health informatics are important in understanding clinician's attributes in adopting and the use of EPR and its subsequent impact on a hospital.

Theories/models will be identified, explained and a framework developed for this study. Typically many studies apply a theory or model but for this study, a combination of themes from various models will be used. Themes were adopted from TAM, DOI and the model of PC utilization is because it assumes that one model is insufficient to ascertain clinician's attributes when adopting and using EPR. No study in SA thus far has highlighted an appropriate or combination of models that best fits clinician's EPR adoption and use. The themes used includes perceived usefulness (PU), relative advantage (RA), job-fit (JF), perceived ease of use (PEOU), complexity (COM), affect or attitude towards use (AFF), facilitating condition (FC), use behaviour (USE), storage (STO), retrieval (RET) and share (SHA). These themes form a conceptual framework in explaining the structurational model used for this study.

2.5. What is not known about EPR?

As mentioned in the introductory paragraph of this chapter, so much is known about EPR within the literature. What is not known or little known about this system in the literature is its actual operation especially for information storage, retrieval and share amongst clinicians. How does EPR operate within a hospital? What attributes contribute to clinicians' adoption and use of the system? The commonly attributes associated with clinicians' acceptance and adoption of technology are derived from the DOI, TAM, UTUAT and other models applied to health. These models are generic while this study proposes a customised and workable framework in a South African health facility. These attributes are necessary to identify and understand as they directly affect clinician's attitude on how it is manipulated at work in delivering adequate healthcare service. The introduction of technology to health has legal implications as the next section highlights.

2.6. South Africa Health Act

The Constitution of the Republic of South Africa No. 108 of 1966/7, chapter 2 Bill of Rights, section 7 enshrines the rights of all people in SA and affirms the democratic values of human dignity, equality and freedom (PNC, 2006: 22). The right to protection including personal information forms part of this constitution as section 13 of the Health act attests to this as an obligation to keep. The National archives of SA act, 1996 (Act No 43 of 1996), and the Promotion of Access to Information Act, 2000 (Act No 2 of 2000) are subject to the Health Act, 2003 (Act No. 61 of 2003) and states that a person in charge of a health establishment must ensure that a health record containing information as may be

prescribed is created and maintained at that health establishment for every user of health services must safeguard such record (Republic of South Africa, 2003: 11; PNC, 2006: 22).The National Health Council is established and comprises of the Health Minister, Director Generals and Heads of Health Departments. One of its functions amongst its many functions is to develop, procure and use health technology such as EPR (Republic of South Africa, 2003: 13).

The Electronic and Communication and Transaction Act of 2002 has a significant impact on the health sector as its implication is that all departments are encouraged to implement electronic systems that are characterised by security, integrity, and authenticity. (PNC, 2006: 22-23) The PNC document goes further to say these electronic system must have elements of, "accountability, transparency and good governance", all of which are in line with the basic principles of data protection. To support the protection of data is the Promotion of Access to Information Act which gives powers to a private or public body information officer to refuse access to a record by a third party if such disclosure of personal information to the third party is not contentious. By law, every information officer has a fiduciary duty to set up control measures to prevent unauthorized access to patient records and to its storage and retrieval facility, or system, where records are kept (Republic of South Africa, 2003: 11).

Lastly section 27 of the Bill of Rights of the constitution states that everyone has a right of access to healthcare services including reproductive healthcare that the State must take reasonable legislative and other measures, within its available resources, to achieve the progressive realization of these rights (Department of Health, 2011: 16). The National Health Insurance (NHI) is expected to operate on an electronic platform (Department of Health, 2011: 44) with intent to integrate all health information systems. EPR practice can play useful roles here for example, in standardising the data format within the health systems.

2.7. Summary of chapter two

Chapter two introduces and reviews the literature that relates to health systems, ehealth, and EPR, their understanding, a review of electronic record system studies in South Africa with some case studies explained. Telemedicine, HIS and EHR, history, concepts and terminologies are all discussed. A brief mention of the SA legislation that constitutes and enforces the introduction of an EPR system is discussed.

Health practice is improving and so is technology. Electronic Patient Record (EPR) is considered to be a solution to improved patient care through the storage, retrieval and share of patient information especially to those who need it the more. EPR at some hospitals is not an absolute solution but successfully used in conjunction with paper systems (hybrid). For this study, EPR is the more appropriate term. The literature consulted points to the many names used for this term. These names share common meanings such as the introduction of technology to health. Clinicians undoubtedly understand EPR and its benefits to their work tasks even though there are still continuing debates of its adoption, acceptance and use.

Chapter three details the various themes identified and highlight the development of the conceptual framework that underlies this study.

CHAPTER THREE – CONCEPTUAL FRAMEWORK

Chapter three addresses key concepts pertaining to EPR such as, the themes, models and its terminologies. The themes are adapted from various models such as TAM, DOI, UTAUT and the model of PC utilisation which are applied to health. The study adapts the structurational model of information technology as its theoretical framework. The chapter discusses these themes in detail in order to show their relevance and usefulness in developing a technology use framework.

3.1. General information system models

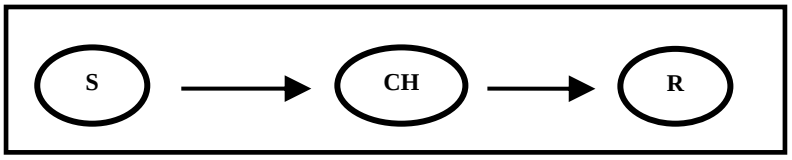
While Gregor's article is specific to the information systems discipline, information systems models vary and can be applied to different other disciplines such as psychology (Dretske 1999 psychological information flow model); communication studies (Shannon 1948 communication model, Shannon-Weaver 1949 information model of communication); and developmental studies (Heeks 1999 information chain). The information flow models discussed in this study will primarily focus on its direct application to health, hospitals, clinicians and patient records.

Models for discussion include Claude Shannon's communication model, Claude Shannon and Warren Weaver (Shannon-Weaver) information model of communication, Fred Dretske information flow model, Richard Heeks information chain and Wanda Orlikowski and Daniel Robey structurational model of information technology. A brief explanation is undertaken of each model below.

3.1.1. Claude Shannon's (1948) communication model

Claude Shannon first proposed the theory of information (Lombardi, 2005: 24) in order to solve technological problems. Shannon's model gave rise to the development of application within the technological industry such as telephones and electronics. His model was simple; a communication required a source *S*, a receiver *R* and a channel *CH*.

Figure 3. 2. Shannon communication flow



Source: Lombardi, O. (2005). Dretske, Shannon's theory and the interpretation of information, Synthese, 144, 23-39.

In Shannon's communication flow, information stops at the receiver. It is unclear if at the receiver's stage, data has been converted into information or still remains data. Be it data or information is irrelevant, what is important is whether the information flow process is complete. To use a hospital scenario as an example, a patient's file is retrieved by nurse and passed to a clinician. Clinician captures any relevant data while in consultation with patient. Clinician diagnosis patient and writes out prescription. Afterwards, information is sent to pharmacy where patient receives medication. Patient's file is subsequently returned to nurse for storage. Shannon's communication flow omits the storage and retrieval stages. It rather shows information flow between patient and clinician or clinician and pharmacy. Information storage can take place at either clinicians' or at the pharmacy, but definitely not at patients'.

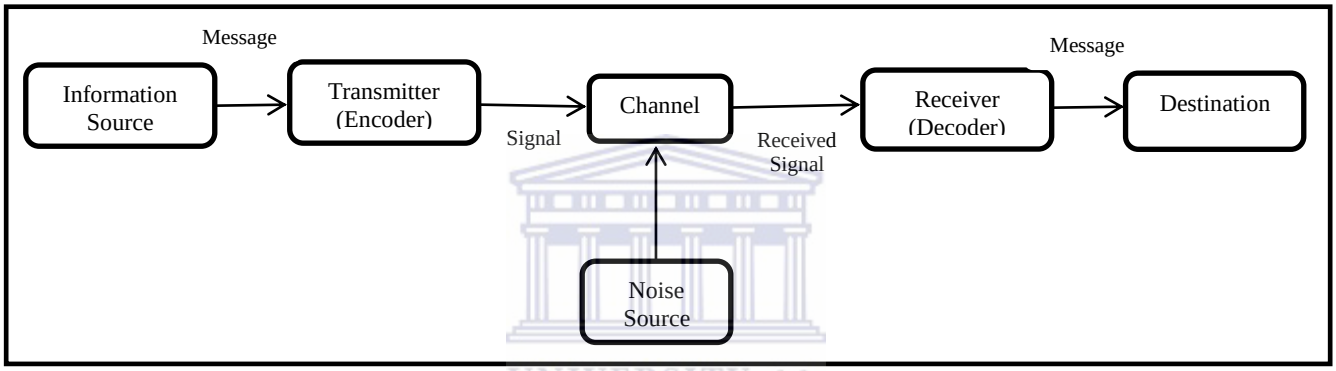
Hospital management procedure does not allow patient record to be stored with clinician nor pharmacy as the record must go back to health information assistants (record-keepers) for storage. The flow model here show that information retrieval can only take place after storage is complete. Shannon's model caters only for synchronous information flow as it makes no provision for processing, storage, retrieval and share; thus the information flow process is incomplete. Improvement to Shannon's (1948) model resulted in the Shannon-Weaver (1949) information model of communication discussed further.

3.1.2. Shannon-Weaver (1949) information model of communication

Information flows in a loop format; meaning from one point (source) to another (destination). Information flow models include a more popular one known as the Shannon-Weaver information model of communication proposed in 1949. It proposes that communication should include six elements namely: source, encoder, message, channel, decoder and receiver (Oyadonghan, 2010: 1). Source is where or whom the message originates from. A transmitter is a computer which encodes the message into signals. A channel is a communication wire to which signals are adapted for

transmission. The receiver is the computer at the other end which decodes the message from the signal. A destination is where the message reaches. Typically, when a patient speaks to a clinician, the patient is the source, the clinician is the destination, and the channel is the vacuum while the signal is the sound wave. Noise in this model is any interference of the message during communication in the sharing of information or any distraction during conversation between patient and clinician (Chandler, 1994). Since texts and images will mostly represent the data form transmitted within an EPR system, noise will mean any interference that restricts the information from reaching its destination. For example, data size or format can interfere with transmission rate.

Figure 3. 3. Shannon-Weaver information model of communication



Source: Shannon, C.E., and Weaver, W. (1949). *A Mathematical Model of Communication*, Urbana, IL: University of Illinois Press.

Explaining this model to this study, patient sends information to clinician. This information is transmitted as words during consultation. Clinician encodes the information, diagnosis the patient and tells patient what is wrong and how s/he will be treated. Information is stored as clinical notes on paper and later stored.

Shannon-Weaver information model is better explained than its previous communication flow model of 1948 as it gives a step-by-step procedure of the transformation process of a data into information. In support of this model, Chandler (1994) explains some advantages of the Shannon-Weaver model over other communication and information model to include simplicity, generality, and quantifiability. Simplicity meaning its ability to be understood when used as every step of the communication process is self-explanatory; generality meaning this model can be applied in any discipline to yield similar or same results, and quantifiable meaning each phase in this communication model can be measured. For

example, at the information source, the amount of information can be measured and at the transmitter phase, the capacity of the transmitter can also be measured to determine the capacity needed to accommodate data to allow for smooth transmission.

This model is an improvement to the Shannon communication flow but does not account for retrieval and share of patient information at a hospital for example. It renders this model insufficient for application in this study. The Fred Dretske model is another information systems model explained.

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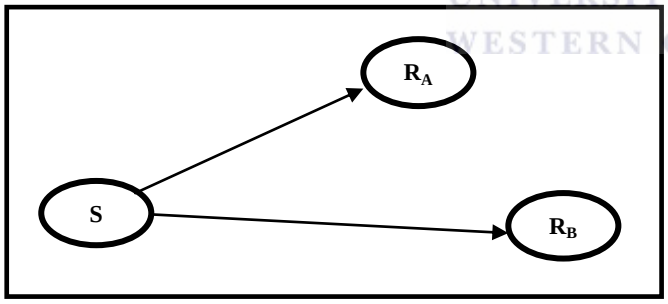
3.1.3. Fred Dretske (1999) psychological information flow model

In explaining Dretske's model, Lombardi (2005: 32) in his article, "*Dretske, Shannon's theory and the interpretation of information"* emphasises on the point of intentionality as being the reason of information becoming knowledge. Information from sender to receiver according to Dretske (1981: 38-39) does not require a channel or physical link (Lombardi, 2005: 33). In the example below, although Dretske contends that there is no physical channel between source *S* and receivers R_A and R_B, there exists an informational link between R_A and R_B.

Figure 3. 4. Dretske psychological information flow



Source: Lombardi, O. (2005). Dretske, Shannon's theory and the interpretation of information, Synthese, 144, 23-39.

One drawback of Dretske's information flow is that it lacks channel and so difficult to ascertain how information is secured before decoded. Dretske explains information as having meaning but for a receiver to understand what the sender sends (for example, a radiographers' scan result sent to a doctor); there must be a channel to transform the encoded message into information.

For a patient's record to be stored, retrieved and stored, data must be converted into information. The channel here acts as a processor and also a storage device. Using Dretske model, it is not easy to

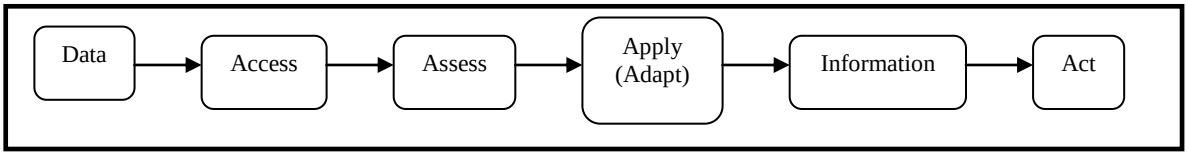
understand what stage of the information flow process stores information and at what point can this information be retrieved and distributed. This model can be assumed to be a starting point towards understanding the information flow process of patient information from one point to another. This is because it can contribute to investigating patient record storage, retrieval and share process. Fred Dreske's information flow model is incomplete and so cannot be adopted for this study.

For the purpose of this study undertaken at a health facility, Heeks information chain model is investigated as a way of understanding: (i) the type of information that an EPR system should handle, (ii) the storage and retrieval phases within the general communication cycle, and (iii) its applicability irrespective whether hospital is rural or urban situated.

3.1.4. Richard Heeks (1999) information chain

Heeks information chain model was developed based on his study in rural areas and how ICT can alleviate poverty especially small and micro-enterprises. Heeks (1999: 5-6) identified ICT as an output, a production technology, information processing technology and an information communication technology (Yang, 2001: 14). He continues by requesting that rural communities act as information recipients to turn raw data into usable information as illustrated in figure 3.4.

Figure 3. 5. Heeks information chain



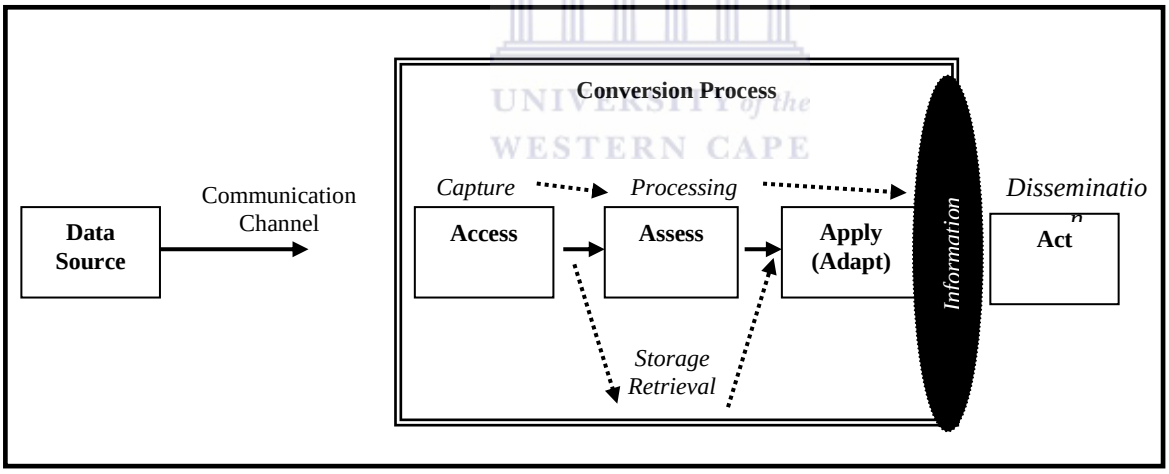
Source: Heeks, R. (1999). Information and Communication Technologies, Poverty and Development, *IDPM Development Informatics Working Paper Series, Paper No 5*. University of Manchester, UK.

The information chain model is a 4-stage process which starts with raw data, unprocessed facts and figures collected (Access), evaluated (Assess) before it becomes useful (Adapt/Apply) to an organisation for its use. At the end point, data becomes information which can contribute to development only if it meets an organisation's objective, function and practice (Act). After the acting phase, Yang (2001: 15) states that the information flow process ends. Information makes no contribution to any organisation unless an information flow within the chain operates successfully (Heeks, 2005).

In order to understand how this model can allow EPR system function properly, information must be retrieved in the same format with no alterations for clinicians' use. If information is a fundamental resource upon which information systems and information technologies can act, then it is important to identify what type of information we are referring to here. The information referred to in this study is health data of routine, survey and semi-permanent nature (Rohde *et al.*, 2008: 13). This model as it stands alone is also incomplete as it does not cater for share of patient information.

Heeks (1999) model was further aligned with Duncombe and Molla (2009) model to show how a patient's (formal) information from source follows a process of unpacking, processing (conversion) and storage. At the storage point, information flow is not complete and so must be shared amongst colleagues at other units of a hospital either at same time or at a later time. The alignment of both models will be explained to ascertain suitability for this study and where not, will be discarded. Figure 3.5 is a proposed information flow process of patient's information for storage, retrieval and share as graphically indicated.

Figure 3. 6. A systemic information flow model



Source: Combining Duncombe and Molla (2009) systemic model of enterprise IS and Heeks (1999) information chain

While the information flow indicates patient information generated, storage and retrieval, share is still missing. Every organisation as a whole must feel the impact of information flow as the information generated must be securely stored against unauthorised users, easily retrieved in the dame format stored and be able to be shared amongst authorised uses for decision making reasons. This model indicates information generation, conversion, storage and possible retrieval. The sharing of information is not well visible in the model as 'act' may be construed to mean share. This model does

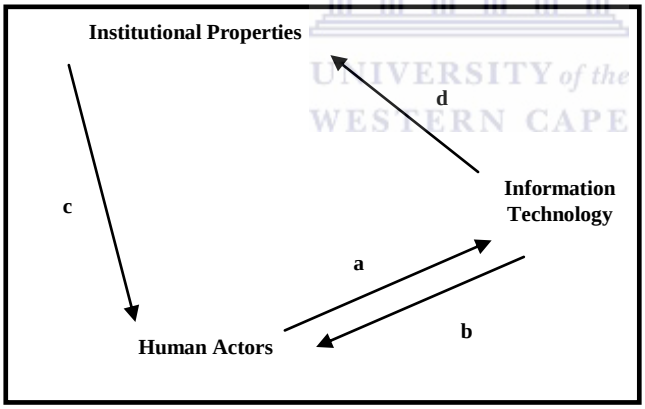
not translate ‘act’ to mean share, thus making this phase vague. In a hospital environment, to act on patient information may have many different meanings and this will result in confusion for this study. This model will not be adapted because of this confusion.

To explain the relevance of information flows within an organisation, the Orlikowski and Robey (1991) structurational model identified and discussed with relation to this study. The relationship between information technology (EPR) and its resulting effect on the structure of any organisation is discussed below.

3.1.5. Wanda Orlikowski and Daniel Robey (1991) structurational model of information technology

Orlikowski and Robey (1991: 151) labelled information technology as both an antecedent and a consequence of organisational action, perhaps in agreement with the Giddens (1976) duality of structure.

Figure 3. 7. The original Orlikowski and Robey structurational model of information technology

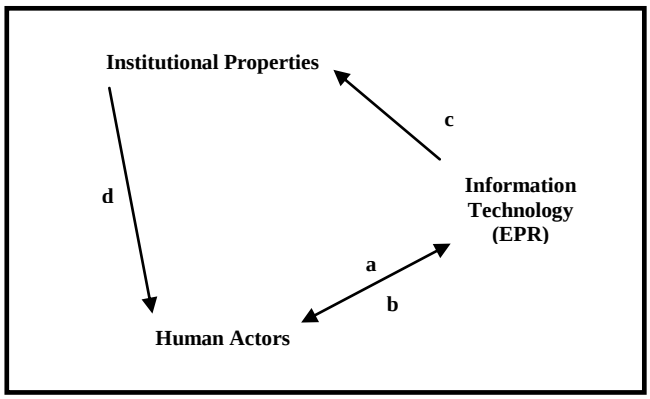


Source: Orlikowski, W.J., and Robey, D. (1991). Information technology and the structuring of organisations. *Information Systems Research*, 2 (2), 143-169.

The original structurational model depicted above recognises four influences that operates continuously and simultaneously in the interaction between technology and an organisation: (i) information technology is the outcome of human action (arrow a): (ii) information technology is the means of human action (arrow b): (iii) information technology is built and used within particular social contexts (arrow c): and (iv) interaction with information technology influences the social contexts within which it is built and used (arrow d) (Orlikowski and Robey, 1991: 152-153). With

particular reference to this research study and healthcare facility (hospital), the original structurational model is revised.

Figure 3. 8. A revised structurational model of information technology



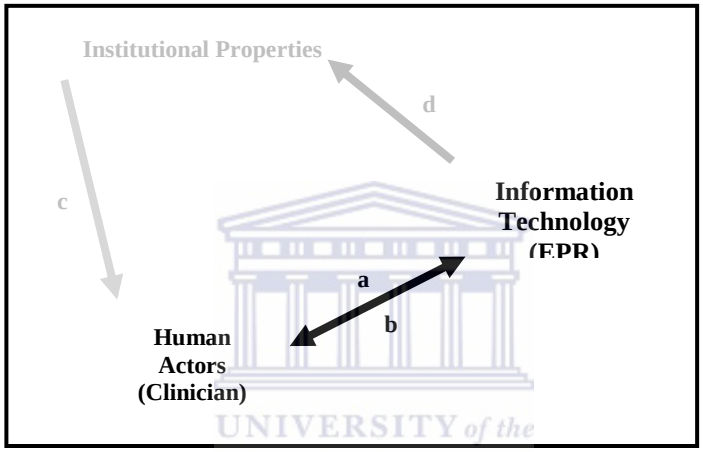
Source: Reworked by researcher.

Arrow "a" depicts EPR (the technology) as an outcome of human action (healthcare experts, developers and so on.) through design, development, appropriation and modification. EPR is the product of human action. EPR use is only possible when humans interact with it to perform tasks. Arrow "b" posits that EPR facilitates healthcare activities by quick and accurate response. This means technology (EPR) makes clinician's task faster and more accurate to meet patient's needs. It also constrains hospital activities by removing some physical elements that paper-based activities provide such as the information of patient feelings and fears. Arrow "c" is the consequence of the interaction with the EPR system by virtue of how this system influences the institutional properties by either reinforcing existing structures or deviating from its structure of signification, domination and legitimation. And lastly, the institutional properties (hospital standards, process, culture, norms, values, procedures) influence how healthcare practitioners (human actors) will use the EPR system for their routine tasks as shown by arrow "d". The institutional properties set the conditions and boundaries of interacting with the EPR system by the human actors.

With regards to a hospital, domination is organisational control over its resources, while user's rights and access to its resources represents its legitimation. It conveys meaning of its organisational structures (known as signification) by allowing humans to either reinforce these existing structures or deviate from it when using EPR. These four (4) revised relationships between technology and an

organisation occur simultaneously, but not sequentially according to Orlikowsky and Robey (1991: 154).

The structurational model even at this stage is problematic. Orlikowsky and Robey (1991) explained this model at a high level and so lacks depth and details. This depth and detail will involve the use of themes. Another problem is the themes namely human actors, IT and institutional properties; they all lack specific attributes, meanings, are broad and somewhat vague and thus need detailed explanation. The study will focus on the human actors and IT themes so as to enrich the literature on EPR and its subsequent benefits. The revised structurational model is discussed and displayed below.



Institutional propert(ies) is excluded for this study because of its characteristics. Its characteristics is such that it will require mostly secondary data from policy and procedural documents to explain its influences, that is, arrows "c" and "d". Another reason for its exclusion is because clinician's attributes can be isolated from hospital procedures and policies as these attributes are mainly internal and social.

A summary of the information system models is briefly discussed below.

3.2. Discussion of information system models

When clinicians use EPR, data is converted into information for storage, retrieval and possibly sharing. As long as data remains unused, it will remain data. But as soon as it is used, it becomes information, thus passes through a channel and completing the information flow process of reaching its destination. Clinicians behavioural attributes makes this information flow process possible. The

attributes such as perceived usefulness, relative advantage, job-fit, perceived ease of use, complexity, affect and facilitating conditions are chosen in accordance to answering the research questions. Clinician's interaction with EPR should reveal how the EPR system impacts storage, retrieval and share.

At every stage of the information flow model within an organisation, information must flow back and forth. Human action generates data within the EPR system where access, assess and its application takes place. This data is sent via a communication channel such as network cables and data is decoded and converted into meaningful use at the receivers'. After the complete conversion process, information is acted upon by humans for sharing and decision purposes. Human action represents both data source and destination. Technology represents destination.

In understanding the proposed theoretical framework using themes, the next section highlights the theme to be adapted in conceptualising the technology use framework.

3.3. Themes

Models applied to health are numerous and vary. And within health informatics, some models or theories are recognised as appropriate such as the Diffusion of Innovation (DOI) and Technology Acceptance Model (TAM). These models have been successfully applied in health studies, for example, Alanazy (2006) applied TAM in his research. The conceptual model introduced in explaining the theoretical framework contains themes that significantly explain clinician's behaviour of technology use.

Models and related themes listed here are explained in brief.

Table 3. 1 Models, themes and study relevance

Theory/Model	Concept	Themes	Relevance to EPR study
Diffusion of Innovation (DOI) by Rogers in 1995	The process that occurs as people adopt a new idea, product, practice, philosophy, and so on (Kaminski, 2011: 1)	Relative advantage, compatibility, complexity,	DOI offers a plausible explanation for why some clinical activities (e.g. EPR use) are adopted rapidly and

		trialability, observability	others experience difficulty, despite strong evidence of their potential benefits. (Sanson-Fisher, 2004: 56). Clinician's adoption behaviour is not the scope of this study as EPR already exists at the selected hospitals.
Technology Acceptance Model (TAM) by Davis in 1989	Assumes that an individual's intentions to use a technology influence usage behaviour, and perceived usefulness (PU) and perceived ease of use (PEOU) determine intentions to use	Perceived usefulness, perceived ease of use, subjective norm	TAM is a well-regarded model of technology acceptance and use and has become an important theoretical tool for health IT research as it can aid the design or purchasing process, training, implementation and other healthcare activities (Holden and Karsh, 2010: 169). TAM is a behavioural tool that cannot measure clinician's actual use of EPR for storage, retrieval and share on its own but some of its themes are adequate for this study.
Theory of Planned Behaviour (TPB) by Ajzen in 1991	Suggests that an individual's intention for actual behaviour is jointly determined by three themes: attitude toward the behaviour, subjective norms and	Attitude towards behaviour, subjective norm,	TPB is a conceptual framework for understanding human social behaviour (Kortteisto, Kaila, Komulainen,

	perceived behavioural control (Guo and Barnes, 2007: 70)	perceived behavioural control	Mäntyranta and Rissanen, 2010: 52). Behavioural studies are outside the scope of this study and so the TPB model is not adequate for this study.
Theory of Reasoned Action (TRA) by Fishbein and Ajzen in 1975	Posits that a person's behaviour is predicted by intentions, and intentions are jointly determined by the person's attitude and subjective norm concerning the behaviour (Hsu and Lu, 2007: 1644)	Attitude towards behaviour, subjective norm	TRA focus on theoretical themes concerned with individual motivational factors as determinants of the likelihood of performing a specific behaviour (Montano and Kasprzyk, 2008: 68). This is a behavioural theory which falls outside the scope of this study
Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh, Morris, Davis and Davis in 2003	Suggests that performance expectancy, effort expectancy, social influence, and facilitating conditions are determinants of behavioural intention or use behaviour; and that gender, age, experience, and voluntariness of use have moderating effects in the acceptance of IT (Wang and Shih, 2009: 159)	Performance expectancy, effort expectancy, social influence, facilitating conditions	UTAUT uses key themes to influence behavioural intention to use a technology and/or technology use (Venkatesh, Thong and Xu, 2012: 162). Some UTAUT themes are useful for this study.
Motivational Model (MM) by Davis, Bagozzi and Warshaw in 1992	Proposes that Intrinsic Motivation (IM) and Extrinsic Motivation (EM) are important in determining Behavioural Intention (BI) (Wilson and Lankton, 2004: 242).	Extrinsic motivation, intrinsic motivation	MM is an IT acceptance model used in understanding the acceptance of e-health technology (Wilson and

			Lankton, 2004: 247). Little is known of this model as its themes can be of use to this study.
Model of PC Utilisation by Thompson, Higgins and Howell in 1991	This theory implies that the utilization of a PC by a knowledge worker in an optional use environment would be influenced by the individual's feelings (affect) toward using PCs, social norms in the work place concerning PC use, habits associated with computer usage, the individual's expected consequences of using a PC, and facilitating conditions in the environment conducive to PC use (Thompson, Higgins and Howell, 1991: 126).	Job-fit, complexity, long-term consequences, affect towards use, social factors, facilitating conditions	This model concerns attitudes and actual behaviours of PC use (Thompson, Higgins and Howell, 1991: 126). This model is general and not specific to any particular system. This model comprise of some themes that are adequate for this study.

Source: Developed by researcher

The mention of these models is noteworthy as some themes contribute to developing the study's conceptual model while other does not. These themes play important roles in the flow of information as well as the degree to which patient record storage, retrieval and share is undertaken. For example, technology acceptance and the intention to use a technology in general understanding can influence the degree to which information can be protected and shared by clinicians.

There may be other models with related themes not considered to be relevant to this study but not mentioned here. These models may have direct association with information storage, retrieval, share and flow but currently, the researcher has not identified such models for discussion. The themes applied to this study include perceived usefulness, perceived ease of use, relative advantage, complexity, job-fit, affect and facilitating condition.

3.3.1. Perceived usefulness (PU)

This theme is defined in section 1.6.1 in chapter one and categorised as PU. Davis (1989: 320) introduced it to mean the extent to which people believe technology will help them perform their job better. He continues saying that a system that does not help people perform their job is likely not to be received favourably despite its careful implementation. The perceived usefulness theme is part of TAM widely used in information systems domain. The TAM proposed by Fred Davis in1986 is an adaptation of the theory of reasoned action (TRA) (Amoako-Gyampah, 2007: 1234). Perceived usefulness proposition according to Amoako-Gyampah (2007: 1235) justifies that in an organisational environment, if people expect a technology to increase their performance on the job, then their intentions to use the technology will be greater than that which can be attributed to their attitude toward the technology alone. In the current study, since EPR is already in use, improvement in clinician performance is directly influenced by attitude. The intention to use EPR is irrelevant here as there is no intent or choice to use or not to use EPR. Hospital policy and procedure mandates clinician's use. The other TAM theme is perceived ease of use which has been popularly used in the IS domain. Propositions to be tested are:

Proposition 1(a): Perceived usefulness will have a significant impact on attitude toward EPR use.

Proposition 1(b): Perceived usefulness will have a significant impact on EPR use.

3.3.2. Perceived ease of use (PEOU)

Perceived ease of use is also defined in section 1.6.1 in chapter one and coded as PEOU. In addition, PEOU according to Holden and Karsh (2010: 162-163) is limited in its definition as it does not account for the difficulty of low-effort but highly repetitive and generic tasks. Generic meaning it does not refer to specific components of usability. Perceived ease of use accounts for a more generic and repetitive task such as input of patient information by clinician. Although limited in definition, it is acceptable for this study. Perceived ease of use has also been found to be a precursor of perceived usefulness (Fagan, Neill and Wooldridge, 2008: 32). The other TAM theme is known as subjective norm. Propositions to be tested are:

Proposition 2(a): Perceived ease of use will have a significant impact on attitude toward EPR use.

Proposition 2(b): Perceived ease of use will have a significant impact on perceived usefulness.

3.3.3. Subjective norm

Subjective norm or social influence as Holden and Karsh (2010: 163) put it was defined with respect to the opinions of important others about an individual's use of health IT. Clinician's use of EPR means actual use behaviour, thus opinions of the others (such as family, friends) will not influence clinician's EPR use and so not included in this study. Opinions are subjective most especially when it is by others not directly involved in using EPR or working closely with clinicians'. These opinions will not give a true picture of EPR use and because these opinions are subjective, the benefits and challenges faced by clinicians cannot be identified and resolved. Subjective norm is excluded in this study since it measures external factors not directly influencing EPR behaviour use by clinicians.

3.3.4. Relative advantage (RA)

This theme is contained in the diffusion of innovation (DOI) model and defined in section 1.6.1 in chapter one with code RA. Relative advantage is often expressed in monetary terms. Although RA can also be expressed in social and other forms of terms (Rogers, 1995: 213), clinicians can understand RA in social terms. Within health informatics research, Sanson-Fisher (2004: 55) states that research does provide information on the relative advantage that potentially benefits patients in the case where a new clinical activity is introduced. He continues that a hospital management decision of implementing a system for example is driven not only by patient welfare but also by the interplay between the interests of the patient, the clinician and the healthcare system. This theme is accepted for this study so as to understand the degree to which clinicians perceive EPR as this translates in their extent of use. Other themes of DOI are compatibility, complexity, trialability and observability. The proposition is:

Proposition 3: Relative advantage will have a significant impact on attitude toward EPR use.

3.3.5. Compatibility

Compatibility is a measure of the degree to which an innovation such as EPR is perceived as being compatible with existing values, past experiences, and the needs of potential adopters (Sanson-Fisher,

2004: 55). In understanding compatibility, Sanson-Fisher (2004) states that EPR must address an issue that clinicians perceive to be a problem. Clinician's problems were not highlighted nor issues identified within this study. So to include this theme will mean clinician's problems must be identified and EPR assessed to ascertain its relevance in addressing these problems. Although EPR has been linked to increasing clinician's workload, this is not a problem initially identified by clinician before adoption and use thus this theme is excluded.

3.3.6. Complexity

Complexity is a measure of the degree to which an innovation is perceived as difficult to understand and use (Sanson-Fisher, 2004: 55). When an innovation (EPR) is perceived to be difficult, it should have a direct influence on adoption and use. While complexity in this context measures a perception before adoption and use, clinician's actual usage is a consequence of the degree of the complexity so this theme is included. Although the degree of the complexity of EPR can be measured through clinician's use, it is worthy of note that it does not go against what the initial understanding of complexity when using an innovation. Proposition to be tested is:

Proposition 4: Complexity will have a significant impact on attitude toward EPR use.

3.3.7. Trialability

According to Sanson-Fisher (2004: 55), trialability is the degree to which the innovation may be trialled and modified. Testing EPR before its adoption and use is costly especially when the system is expensive to install, fix and maintain. Undertaking trials of the system is highly encouraged so that its potential users (clinicians) will have the opportunity to experience the potential outcomes before its final adoption but the nature of clinician's task prevents them from doing so. An EPR system allows for different users and tasks to be performed, workshops and training to test this system is difficult as clinicians are constantly faced with the burden of workload and have limited time to attend. For this reason clinicians cannot test an innovation before implementation thus excluding this theme from this study.

3.3.8. Observability

Observability is the degree to which the results of the innovation are visible to others (Sanson-Fisher, 2004: 55). Visibility should be a characteristic of the innovation so as to stimulate peer discussion, as

clinicians and colleagues of a clinician adopting a new procedure can request information about it (Sanson-Fisher, 2004: 56). Observability of EPR will mean the system has to be purchased and installed at a hospital. In this scenario, a respected and influential clinician will have to argue for and demonstrate with EPR to show its relative advantages. Trialability will be important and this poses a challenge for the clinician arguing for EPR adoption and use. The exclusion of trialability is because it is a prerequisite for observability.

Performance expectancy, effort expectancy, social influence and facilitating conditions are themes of the Unified Theory of Acceptance and Use of Technology (UTAUT) proposed by Venkatesh, Morris, Davis and Davis (2003).

3.3.9. Performance expectancy

It is the degree to which using a technology will provide benefits to a person in performing certain activities (Venkatesh *et al.*, 2012: 169). Venkatesh *et al.* (2012) theorised performance expectancy within UTAUT to influence behavioural intention to use a technology, while behavioural intention and facilitating conditions determines technology use. Behavioural intention to use technology is excluded in this study because clinicians do not have intent to use EPR but actually using it. Performance expectancy is similar to perceived usefulness so it is substituted (with PU) for this reason to avoid duplication.

3.3.10. Effort expectancy

This is the degree of ease associated with clinicians' use of technology (Venkatesh *et al.*, 2012: 169). Effort expectancy according to Venkatesh *et al.* (2012) is also theorised within UTAUT to influence behavioural intention to use a technology. It is in contrast to its definition which presumes that effort expectancy should also have a direct influence on actual use. For this reason, confusion is caused as to whether effort expectancy is actually the same as perceived ease of use. While effort expectancy by definition will measure clinician's actual EPR use and be a more appropriate theme for this study, an argument for a direct influence on use behaviour is lacking. Effort expectancy is excluded from this study because of its similarity to PEOU to avoid confusion. Rather PEOU will be used as it has influences on both attitude and actual EPR use.

3.3.11. Social influence

Social influence as a theme of UTAUT is the extent to which clinicians perceive that important others (e.g., family and friends) believe they should use a particular technology (Venkatesh *et al.*, 2012: 169). Social influence within the context of a hospital is external with no direct influence on either attitude or clinician's use behaviour. For example, a family's perception of technology use by a clinician will not affect clinician's use of EPR as clinician's are trained to exclude personal feelings (especially from family and friends) when performing their tasks. Colleagues and friends are not understood to mean the same in a hospital context within this study.

3.3.12. Facilitating conditions (FC)

And lastly, within UTAUT, facilitating conditions refer to clinicians' perceptions of the resources and support available to perform behaviour (Venkatesh *et al.,* 2012: 169). Facilitating condition is coded as FC and an example is EPR technical support. It has a direct influence on clinician's EPR use behaviour. Technical support for EPR is an important element in understanding clinician's use behaviour as it can facilitate the degree of use, attitude towards use, the quality and frequency of use. The proposition tested is:

> **Proposition 5: There will be a positive relationship between facilitating conditions and attitude towards EPR use.**

3.3.13. Intrinsic motivation

The Motivational Model (MM) proposed by Davis, Bagozzi and Warshaw in 1992 (Wilson and Lankton, 2004: 247) is a technology acceptance model. It consists of both the intrinsic and extrinsic motivation. The intrinsic motivation theme refers to doing an activity for its own sake: the activity itself is interesting, engaging, or in some way satisfying (Lee, Cheung and Chen, 2005: 1097). Intrinsic motivation is internal as it relates to a process that gives behaviour its energy and direction (Lee *et al.*, 2005: 1096). Clinicians are understood to have a resistance to technology in studies conducted by Lapointe and Rivard (2006), Bhattacherjee and Hikmet (2007), Yarbrough and Smith (2007), Cohn, Berma, Chaiken, Green, Green, Morrison and Scherger (2009) amongst the many other studies. Clinician's intrinsic motivation should be a behaviour evoked from the feeling of pleasure, joy, and the fun of using EPR. This theme does not fit well with the study as it is a more internalised behaviour resulting from an activity undertaken which will be difficult to measure.

3.3.14. Extrinsic motivation

Extrinsic motivation according to Lee *et al.*, (2005: 1097) pertains to behaviour in response to something apart from its own sake, such as reward or recognition or the dictates of other people. For a simpler understanding, extrinsic motivation is doing something because it leads to separable outcome (Fagan *et al.*, 2008: 31). Lee *et al.* (2005) continues that perceived usefulness (PU) within TAM is an example of extrinsic motivation. In analysing this theme, it will be excluded on the basis that PU is an example and so may lead to duplication if included.

Another IS model is the model of PC utilisation comprising of job-fit, complexity, long-term consequences, affect towards use, social factors, facilitating conditions themes. Complexity and facilitating conditions have already been discussed under the DOI and UTAUT models.

3.3.15. Job fit (JF)

The job fit theme is contained in the model of PC utilisation model and defined in section 1.6.1 in chapter one with code JF. It measures the extent to which an individual believes that using a PC (or technology) can enhance the performance of his or her job (e.g., obtaining better information for decision making or reducing the time required for completing important job tasks) (Thompson *et al.*, 1991: 129). Clinician's job has traditionally being paper-based and manual so technology has been perceived to increase their workload and complex. Traditional paper system has its advantages and also disadvantages and so does technology so clinician's perception of technology use is important for this study. The job fit theme relates directly to clinician's degree of adoption and use and so included. The proposition to be tested is:

> **Proposition 6: There will be a positive relationship between perceived job fit and attitude towards EPR use.**

3.3.16. Long-term consequences

These are outcomes that have a pay-off in the future, such as increasing the flexibility to change jobs or increasing the opportunities for more meaningful work (Thompson *et al.*, 1991: 129). Clinician's nature of work is such that technology is a support mechanism rather than a substitute. Technology (such as EPR) may create a futuristic opportunity especially with clinicians' mobility. With the introduction of NHI, clinicians will be more mobile between urban and rural hospitals. Technology

use at this stage may not have a long-term pay-off considering its limited availability (especially at rural hospitals), attitude challenges especially where paper-based system is still considered suitable and effective by its users. The theme is excluded for these reasons.

3.3.17. Attitude/Affect (ATT)

Affect towards use (or attitude) is a theme within the model of PC utilisation model and defined in section 1.6.1 in chapter one with code ATT. Attitudes are feelings of joy, pleasure, pain or dislike associated with an act. Clinician's attitude towards technology (or EPR) could be positive or negative and the resulting act will impact their rate and frequency of adoption and use. Attitude in this study is included in this study because it has a direct relationship with clinician's EPR use behaviour. The relationship theme is proposed as:

> **Proposition 7: Attitude towards EPR use will have a significant impact on actual EPR use.**

3.3.18. Social factors

The last theme within the model of PC utilisation is social factors. These are clinician's internalisation of the reference groups' subjective culture, and specific interpersonal agreements that they have made with others, in specific social situations (Thompson *et al*., 1991: 126). These social factors include norms, roles, and values which clinicians' have developed both within and outside their work environments. Social factors are mainly internal factors that will impact a clinician's work behaviour to adopt or use technology. In a hospital case, these social factors are subjective and inconsistent as it varies from one clinician to another. This theme is excluded because of the difficulty in determining which social factor applies to this study while excluding the rest factors.

3.3.19. Use behaviour (USE)

The other theme applicable to this study is use behaviour. This is the degree at which a clinician is able to manipulate technology to perform a work task, in this case, for storage, retrieval and share. It is denoted as USE. Clinician's use behaviour will have a direct influence on the quality, frequency and degree on EPR use for performing many other work tasks apart from storage, retrieval and share. If use behaviour is negatively influenced by attitude, it is highly likely that the quality, frequency and

degree of EPR use will be low. The use behaviour theme is included in this study so as to demonstrate the impact of EPR use by clinicians. Information storage, retrieval and share will be determined to a large extent on the degree of clinician's behaviour to use EPR. One key characteristics of ERP is to make available patient record within and beyond a hospital. The quality of the patient's record is also determined by an appropriate storage and retrieval function. For example, if a clinician's perception to use EPR is influenced by its usefulness, then his or her attitude is likely to be positive towards using EPR for storage, retrieval or share. The propositions to be tested here are:

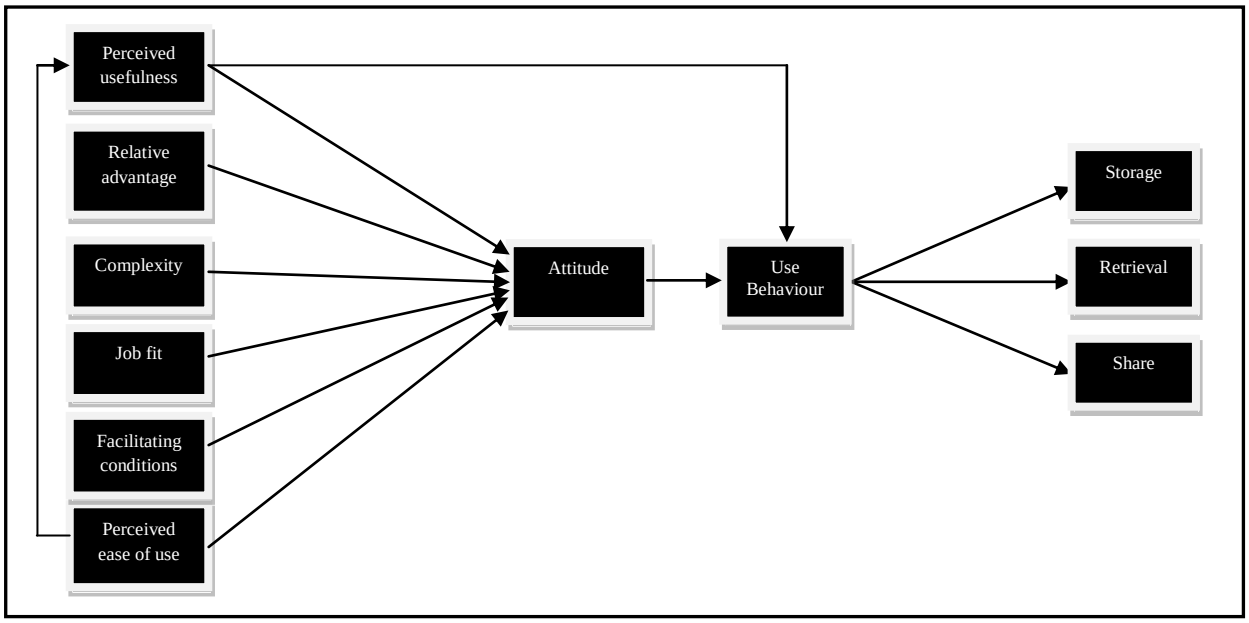
Proposition 8(a): System use will have a significant impact on information storage.
Proposition 8(b): System use will have a significant impact on information retrieval.
Proposition 8(c): System use will have a significant impact on information sharing.

3.4. Summary of chapter three

Chapter three introduces and reviews the many information system theories and models that relates to the adoption and use of technology in health such as the Diffusion of Innovation (DOI) theory, Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), model of PC utilisation amongst many others as well as discusses other information models (theories) such as Fred Dretske information flow model, Claude Shannon's communication model, Claude Shannon and Warren Weaver (Shannon-Weaver) information model of communication, Richard Heeks information chain and Orlikowski and Robey structurational model of information technology.

The conceptual framework proposed is to be known as the technology use framework. It constitutes specific themes associated with a clinician's attribute that will influence the EPR system and its subsequent impact on clinician's work. The choice of themes is based on a primary factor: that is, each theme's relevance to the current study. The seven (7) themes were adopted from the TAM, DOI, UTAUT and the model of PC utilisation.

Figure 3. 9. Proposed technology use conceptual framework



Themes contained in the information system theories were discussed with reason(s) for inclusion and exclusion given. The themes included in this study were perceived usefulness [PU], relative advantage [RA], job fit [JF], perceived ease of use [PEOU], complexity [COM], attitude [ATT], facilitating condition [FC], and use behaviour [USE]. Additional themes identified are storage [STO], retrieval [RET] and share [SHA]. These themes result in proposition formulation and will be tested and explained in chapter 5.

The Orlikowski and Robey structurational model of information technology still remains the adopted model that underpins this study. The themes were formulated to explain human action influence on EPR system and its impact on patient record storage, retrieval and share.

Chapter four introduces the method appropriate for this study, research design, data collection tools, sampling and pilot study conducted. These are all presented in the next chapter.

CHAPTER FOUR – METHODOLOGY

Chapter four is an illustration of research methods, research designs, sampling strategies and data analysis.

4.1. Introduction

The study adopts a phenomenological philosophy which attempts to understand people's perceptions, perspectives and understandings of a particular situation (or phenomenon) (Ruxwana, 2010: 115). Clinicians' perception, perspectives and understandings of EPR is the focus of this study and their understanding of its use is important to improving it. Two research designs are used, survey and case study. This does not make the study a mixed method but rather a mono-method as the method applied meets the study's objectives. A quantitative method was applied as a pilot survey study while the qualitative case study forms the main study.

The quantitative pilot study is first explained below and the qualitative case study is explained thereafter in this chapter.

4.2. Quantitative research method

A methodology according to Ruxwana (2010: 114) is an organised way, comprising sequences, procedures and systems, to manage and execute a research process. A quantitative research method is structured, rational, measured and broad (Ruxwana, 2010: 114). A quantitative pilot study was conducted first by administering a survey questionnaire developed for clinicians. The process of the questionnaire development, choice of participants and data analysis is explained further.

The pilot study has an objective to pre-test the quantitative survey questions and apportion changes where necessary. The questions will be tested for ambiguity, clearness, clarity and understanding. Also the pilot study results will be analysed to ascertain difficulties in administering the instruments used. It is important to pre-test the questions so that clinicians will provide useful responses (known as data) that will underlie the study. All changes suggested after the pre-test will be implemented before questions are adapted for interview in qualitative study.

The quantitative survey research design will be discussed first.

4.2.1. Survey

Naicker (2010: 155) qualifies a survey research to be mostly quantitative in nature and seeks to provide an overview of the phenomenon being studied by using a sample. Collis and Hussey (2009: 63) describe a survey as a positivistic methodology whereby a sample of subjects is drawn from a population and studied to make inferences about the population. A survey is a systematic method for gathering information from (a sample of) entities for the purposes of constructing quantitative descriptors of the attributes of the larger population of which the entities are members (Groves, Fowler Jr, Couper, Lepkowski, Singer and Tourangeau, 2009: 2). Surveys generally have the characteristics of (Groves *et al*, 2009: 3):

1. Gathering information primarily by asking people questions
2. Collecting information by interviewing people and recording their answers or by having them read or hear questions and record their answers.
3. Collecting information from only a subset of the population to be described - a sample rather than from all members.

Survey data is collected by administering questionnaires that allow for statistical analysis. The data collected are analysed using descriptive and inferential statistics, focusing on factor analysis, correlations, comparison of means, and regression analysis (Field, 2005; Sekaran and Bougie 2010; Saunders, Lewis and Thornhill, 2003). Survey design seeks to identify principles about the design, collection, processing and analysis of surveys that are linked to the cost and quality of survey estimates (Groves *et al.*, 2009: 30). This according to Groves *et al* (2009) means that survey focuses on improving quality within cost constraints, or, rather reducing costs for some fixed level of quality.

Survey design has some advantages such as, its ability to obtain a large amount of information from a large population. Survey studies can reach a large number of respondents to participate in the study. Flexibility is another advantage as well as its ability that allows for the asking of questions on many variables simultaneously, thus saving on time (Sekaran and Bougie, 2010; Saunders *et al.*, 2003). Sekaran and Bougie (2010) argue that survey also have some disadvantages such as the questionnaire completion by respondents is always voluntary. Respondents do not always respond promptly or

complete the survey instrument correctly as well as surveys need to be managed carefully to ensure a good response rate (Naicker, 2010: 155).

Since survey design involves asking questions, attention should be given to formulating the actual questions that go into the questionnaire. Leeuw, Hox, and Dillman (2008) in their handbook on survey methodology suggest that before questions are formulated, researchers must first decide which concepts they wish to measure. That means defining what they intend to measure by naming the concept, describing its properties and scope and defining important subdomains of its meaning. In addition, when a final survey question posed to a respondent fails to ask about what is essential for the research question, this is known as a specification error. In designing survey questions, Leeuw *et al* (2008) advices on developing a well-defined a set of research objectives. These objectives are then translated into research questions and for each research question; one or more survey questions can be formulated depending on the goal of the study.

The use of different research design approaches and techniques in the same study is known as triangulation. Although this study is not a mixed method research study, triangulation of different design is employed. This is aimed at discovering the same phenomenon (Collis and Hussey, 2009: 74). There are four types of triangulation according to Easterby-Smith, Thorpe and Lowe (1991):

- **Data triangulation:** data is collected at different times or from different sources in the study of the phenomenon.
- **Investigator triangulation:** different researchers independently collect data on the same phenomenon and compare results
- **Methodological triangulation:** both qualitative and quantitative methods of data collection are used
- **Triangulation of theories:** where a theory is taken from one discipline (e.g. engineering) and used to explain a phenomenon in another discipline (e.g. management)

Data triangulation was used in this study from different sources, that is, different clinicians.

A presentation of the pilot study will be explained in subsequent sections.

4.3. Pilot study

In Naicker's (2010: 168) study, he stated that conducting a pilot study minimises the risk of capturing incorrect data, as well as detecting weaknesses in the design and measuring instrument. He continues that, a pilot study should draw subjects from the target population and simulate the procedures and protocols designed for data collection.

Further to this, a pilot study (Naicker, 2010: 169) has some objectives such as to:

- Determine how long the questionnaire took to complete;
- The clarity of the instructions;
- Which, if any, questions are unclear or ambiguous;
- Which, if any, questions the respondent was uneasy about answering;
- Whether, in their opinion, there were any major topic omissions;
- Whether the layout was clear and attractive; and
- Whether there were any other comments?

In addition, Leon, Davis and Kraemer (2011: 2) adds that a pilot study is necessary to evaluate the feasibility of participants recruitment, randomisation, assessment procedures, new methods, and/or implementation of the novel intervention but not used for hypothesis testing. Upon the pre-test of the research instrument, the researcher should be able to make all adjustments and corrections to the instrument for further administration on a larger sample.

The purpose of a pilot study is further discussed.

4.3.1. Purpose of pilot study

A pilot study is conducted to minimise the risk of capturing incorrect data, as well as detecting weaknesses in the data collection instrument (Naicker, 2010: 168). In addition, Naicker states that the pilot study should draw subjects from the target population (clinicians) and simulate the procedures and protocols designed for data collection (Saunders *et al.*, 2003; Sekaran, 2003). The pilot study is quantitatively conducted and analysed with its questions adapted for the qualitative main study. The choice of a case study as a research design is to cover a contextual condition that is pertinent to the phenomenon of this study (Yin, 2003: 13).

The pilot study is of a survey nature. Furthermore, Naicker (2010: 169) lists the purposes of using a pilot study survey as determining:

- How long the questionnaire took to complete;
- The clarity of the instructions;
- Which, if any, questions are unclear or ambiguous;
- Which, if any, questions the respondent was uneasy about answering;
- Whether, in their opinion, there were any major topic omissions;
- Whether the layout was clear and attractive; and
- Whether there were any other comments?

The other research design used in this study is the survey design. This design is for the pilot study and is explained further.

4.3.2. Hospital selection

In conducting the pilot study, two hospitals were chosen in the Tygerberg district of the Western Cape Province in South Africa. There are four (4) hospitals situated in the Cape Town metropole region. Of the 4 hospitals, one hospital represents a 25% selection rate which is more than 10% of the total hospital number expected in order to meet the minimum representation target.

Mitchells Plain hospital is one of the Cape Town hospitals situated in the Northern suburbs of the Cape Town region and accounts for some clinician population. Tygerberg hospital is also situated in the Northern suburbs with an estimated clinician number of about 550 clinicians as claimed by the medical manger. This number was mentioned during a consultative discussion between the researcher and the hospital medical manager. The choice of Mitchells Plain and Tygerberg hospitals is because of location which gives the researcher access advantage by way of distance. Of the total estimated 550 clinicians at both hospitals, the minimum sample size to be drawn from the total sample size can be calculated using the formula advocated by Cochran in 1977, and expressed mathematically as:

$$SS = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where:

SS = Sample size (550)
Z = Z value (e.g. 1.96 for 95% confidence level)
p = percentage picking a choice, expressed as decimal (0.5 used for sample size needed)
c = confidence interval (margin of error), expressed as decimal (e.g., .05 = ±5)

Using the formal stated above, sample size for the pilot study should be 227 clinicians. The Z value to be used is 1.96 for a 95% confidence interval (or 5% margin of error). A 50% percentage of the sample of the 227 is appropriate as the researcher wants to determine the general level of accuracy for the selected sample chosen. Also a 95% confidence interval means the researcher is 5% of obtaining the exact answer. A confidence level means the researcher is 95% certain that the sample accurately represents the general clinical population of the two hospitals sampled.

A detailed explanation of how the questionnaire was assessed before its final adoption is presented in the next section.

4.3.3. Questionnaire

A survey questionnaire is a favoured tool of many researchers engaged in research, and it can often be inexpensive to administer, very little training is needed to develop them; and they can be easily and quickly analysed once completed. It is an effective way of collecting large amounts of data in a structured and manageable form; it can be very detailed covering many subjects or issues, simple and can focus on one important area (Wilkinson and Birmingham, 2003: 7-8).

A questionnaire is a list of carefully structured questions, chosen after considerable testing, with a view to eliciting reliable responses from a chosen sample (Collis and Hussey, 2009: 161). In real terms, questionnaires can be difficult to design and analyse. This is because questions posed can be

misleading or ambiguous. It may need to be targeted at specific, difficult to reach groups; and can create hours, days or weeks of work in analysis.

Wilkinson and Birmingham (2003: 10) in their book titled, "*Using Research Instruments: A Guide for Researchers"*, identified three broad types of questionnaire namely: the mail survey, group-administered questionnaire, and the household drop-off survey.

1. **The mail survey (by post) -** is considered to be the most common questionnaire type. This is so because it is addressed to respondents and delivered by mail, and has the advantage of being an efficient way of collecting large amounts of data. The mail survey is impersonal with a disadvantage to suffer from low response rates.

2. **The group-administered questionnaire (group distribution) -** is a useful instrument for collecting data from a sample of respondents who can naturally be brought together for the research purpose. Response rates can be higher than those for mail surveys, as groups can be assembled specifically for the purpose of assisting with the research. Respondents feel personally involved with the research work by being handed the questionnaire by a member of the research team.

3. **The household drop-off survey (individual distribution) -** is a hybrid of the mail and the group-administered survey. Using this approach, the researcher delivers the questionnaire by hand to a member of an identified household for collection at some later date. Among the advantages of this approach are that the drop-off and subsequent collection affords the opportunity for those completing the instrument to clarify questions posed with the researcher.

4. **Telephone** – this type of questionnaire use can be a valuable method to employ as it reduces the cost associated with face-to-face interviews, but still allows some aspects of personal contact. Collis and Hussey (2009: 163) states that a relatively long questionnaire can be used and it can be helpful with sensitive and complex questions. But there is an inherit problem that results from this method can be biased towards people who have a telephone or are willing to answer questions in this way.

5. **Face-to-face** – this can involve presenting the questionnaire in the street, at home or at the office or any other convenient place for the interviewee. Though expensive and time consuming especially when interview is conducted at a location which is the choice of the interviewee, it has the advantage of higher responses rates and collecting comprehensive data (Collis and Hussey, 2009: 163).

Another type of questionnaire commonly used today is the web-based questionnaire. It is designed to be completed online, via the internet. It is inexpensive to produce and, if carefully developed and designed, can be automatically coded upon receipt using specially designed analysis tool. It also has an advantage to produce a higher response rate than the paper-based questionnaire (Wilkinson and Birmingham, 2003: 19). In addition, questionnaires in general according to Wilkinson and Birmingham (2003: 39) have additional benefits such as:

- Its ability to collect a vast amount of data with minimal effort.
- If designed well, a questionnaire can allow relationships between data to be identified. It is particularly useful for showing relationships with data that are easily quantifiable.
- It protects the respondent's anonymity as it can be distributed and returned confidentially and without the respondent ever being identified.
- It can be used time and time again to measure differences between groups of people. It is a reliable data gathering tool.
- If coded appropriately, it can enable analysis to be conducted quickly and with low error rates.
- When compared to other research instruments (such as unstructured interviews), using a questionnaire, the researcher retains control over the research, directing how the topic is approached and guiding the respondents to discuss the issues selected.

In contrast, some additional disadvantages may include:

- Ease of production and distribution can result in the collection of too much data than can be effectively used.
- Questionnaires are everywhere, competing for respondents' time. Lack of adequate time to complete the instrument may result in the return of superficial data.

- Lack of personal contact (if the questionnaire is mailed) may mean result in low response rates, necessitating the expense of follow-up letters, telephone calls and other means of 'chasing' the respondent.

Each questionnaire irrespective of its type or format is comprised of a number of different approaches to asking questions. Questions take different formats such as: closed questions, multiple-choice or ranking questions, and open-ended questions (Wilkinson and Birmingham, 2003: 10).

1. **Closed questions** – closed questions are questions to which all possible answers are provided. The most often-used is the dichotomous question requiring a "yes" or "no" response. For example, *"do you have a computer at your office?*" is a dichotomous question. The respondent either has (responding *"yes"*) or does not have (responding *"no"*) a computer at his or her office.

2. **Multiple-choice questions** – these are questions which provide a number of predefined responses. This allows the researcher to hold some control over the responses given. However, the construction and piloting of multiple-choice questions usually require careful thought to ensure that all or most responses possible are covered. An example of a multiple-choice question would be: "*which of the following are important skills for using an EPR system? (Please tick all that apply)"*

- ☐ Basic computer literacy skills
- ☐ Numeracy skills
- ☐ Analytical skills
- ☐ Programming skills
- ☐ Business analysis skills

3. **Open-ended questions** - open-ended questions impose none of the restrictions of closed and multiple-choice questions. They allow for the recording of any response to a question provided by the respondent. The answers to open-ended questions are in no way predetermined. This approach has a disadvantage to make analysis difficult. Each response must be recorded and analysed or coded to reveal the meaning of the response. An example of an open-ended question would be: *"what do you use EPR for?"*

Another question format discussed in Wilkinson and Birmingham's book (2003: 12) is the Likert-scale question. This type of question requires the respondent to indicate answers according to a predefined list or scale, usually ranging from a very positive answer to a very negative answer. It measures attitudes to set statements put by the questionnaire. The respondent is provided with a scale of possible responses (usually five) to the question. The question range from the attitude measure *"strongly agree"* to the exact opposite measure of *"strongly disagree".* The questionnaire asks respondents to tick one area on the rating scale. An example of a Likert-scale question would be, "*EPR helps to share patient information".*

- ☐ Strongly agree
- ☐ Agree
- ☐ Unsure
- ☐ Disagree
- ☐ Strongly disagree

For the pilot study, a group-administered questionnaire involving a combination of closed and open-ended questions of a Likert-scale nature was used. The reasons for this is to control time spent answering the questionnaire and gather as much information from respondents as possible. Due to the nature of the study topic, a combination of different types of question has an advantage of comparing different sample group responses to identify uniformity or differences in meanings. It also allows for a wider understanding of how an EPR system is understood by multiple users based on its functionality. It is aimed at answering the research questions of the study. It may also lead to confusion to the researcher as each question format has its individual unique purpose and interpretation.

Questionnaires are administered to all clinicians who participate in the pilot study. The choice of clinicians is because they are EPR primary users. This study will be conducted at a hospital of which time is a luxury. Clinicians are always busy and so may not have time to partake in the study whole-heartedly, thus an advantage of using a stratified random sampling technique for the pilot study.

4.3.4. Stratified random sampling for quantitative research

Wilkinson and Birmingham (2003: 19) highlighted the difficulty in determining an appropriate sample group or size that is representative of the population in which the researcher is interested in. Wilkinson

and Birmingham's (2003) explanation of stratified sampling is establishing a population (e.g. clinicians) and taking from within that population a sample that represents the whole. For example, if 50 per cent of the clinician populations use EPR, then 50 per cent of the clinician sampled is representative enough for the study. In this way, the sample becomes representative of the hospital clinician population.

In order words, stratified sampling occurs when the researcher divides the population into subgroups (or strata) such that each unit belongs to a single stratum (e.g., medicine, surgical sciences, anaesthesiology and critical care, obstetrics and gynaecology, paediatrics and child health, and psychiatry) and then selects a clinician from each strata (Teddlie and Yu, 2007: 79). Stratified sampling is a type of probability sampling based on underlying theoretical distributions of observations, or sampling distributions, the best known of which is the normal curve according to Teddlie and Yu (2007: 79).

For the pilot study, stratified random sampling is appropriate as the researcher is interested in drawing a random sample that should be representative of the population on some characteristic of interest (e.g., clinician type). The researcher categorised the clinician population according to their respective professions e.g., nursing, pharmacy, dentistry (strata). He then independently selects a random sample from the stratums necessary for the study.

As a probability sampling technique, stratified random sampling is also known as scientific, quantitative sampling designed to generate a sample that will address research questions. It will also seek a form of generalisability (external validity), representative, large enough to establish representativeness, focuses on the breadth of information generated by the sampling units, focuses on numeric data but narrative data can also be generated (Teddlie and Yu, 2007: 84).

4.3.5. Preliminary questionnaire assessment

The questionnaire is sent to an expert panel consisting of seven (7) professors and researchers in South Africa, Germany and the United States of America. The expert panel consists of researchers in the field of health informatics or those currently working within this discipline. The rationale for this exercise is to allow for questionnaire content and scale validity testing. Naicker's (2010: 171) study highlights content, criterion and scale validity. In this pilot exercise, content and scale validity are examined as both involve the examination of the extent to which the measure assesses the various

aspects of the concept through ratings by expert judges or other means. In addition, content validity according to Naicker (2010: 171) is an assessment made by experts in the field of health informatics to determine whether the questionnaire includes all the relevant questions and that nothing important has been excluded to meet the purpose of the study. These expert panels are excluded from the final study in order to provide their unbiased opinions, recommendations and criticisms of the questionnaire in a fair and professional manner. The questionnaire contains different types of questions and explained more in the next section.

4.3.6. Questionnaire description

The initial questionnaire had seven (7) sections namely A, B, C, D, E, F, and G. Section H is reserved for commentaries and suggestions. Each section is explained in brief.

4.3.6.1. Section A: Biographical information

This section contains demographics such as age, gender, work experience, race, educational level and disability. Clinician is defined at the bottom of this section to improve understanding for the participants. Work experience means the total work experience that a clinician has spent at that particular health facility in the study.

4.3.6.2. Section B: Ability to use computer

This section contains two questions namely the ability to use a computer and the level of ability. A yes or no answer option is provided for the first question and a 5-point Likert point scale was used for the second question. The 5-point Likert scale contains ‘very good’, ‘good’, ‘fair’, ‘not good’, and ‘poor’ as possible answers. Each scale is assigned a weight in number with very good assigned ‘5’ and poor assigned ‘1’.

4.3.6.3. Section C: Availability of the computers at hospital

Section C is about the availability of the computers at clinician’s workplace at the hospital and contains three (3) questions with both a ‘yes’ or ‘no’ answer for question 1 and 2. Question 3 contains a ‘never’, ‘rarely’, ‘monthly’, ‘weekly’, and ‘daily’ answer options.

4.3.6.4. Section D: Use of PC for clinical tasks in the hospitals

Section D contains twenty-three (23) questions about a clinician’s use of personal computer (PC) for clinical tasks at the hospital. A 5-point Likert scale containing answer options of ‘never/almost never’,

'seldom', 'about half of the time', 'most of the time', and 'always/almost always'. A 24th question allows for additional clinical task to be specified if it is not listed amongst the 23 questions in the questionnaire. The name of the computer system at work was requested in a space in the form.

4.3.6.5. Section E: Choices or reasons to use EPR at work

The themes identified in the model that underpins this study are contained in this section with a heading of participants' choices or reasons to use EPR at work. A question of how many years (or months) of experience a participant has using an EPR system is asked. Themes contained in this section include perceived usefulness, relative advantage, job-fit, perceived ease of use, complexity, affect and facilitating conditions. Each theme accounts for multiple items with a 5-point Likert scales of 'strongly agree', 'somewhat agree', 'neither agree nor disagree', 'somewhat disagree', and 'disagree'. Each scale is assigned a weighted number for analysis purpose, for example, strongly agree is assigned a weight of 5 and strongly disagree is assigned a weight of 1.

4.3.6.6. Section F: Satisfaction of the EPR functions

Section F contains added themes to the study namely storage, retrieval and share. Each theme in this section contains multiple items with similar scale measure ranging from 'strongly agree' to 'strongly disagree'. Each scale is also assigned a weight identical to section E.

4.3.6.7. Section G: Global assessment of the EPR

This section contains questions about the global assessment of the EPR installed in participants' department. There are four (4) questions in total with each having a 5-point Likert scale. Question 1 has a scale of 'strongly disagree', 'disagree', 'neutral', 'agree' and 'strongly agree'. Question 2 and 3 have a scale consisting of 'non-existent', 'poor', 'fair', 'good' and 'excellent'. Question 4 has 'significantly decreased', 'decreased', 'no change', 'increased', and 'significantly increased'. Each scale has a weight ranging from 1 to 5.

4.3.6.8. Section H: Commentaries

For section H, an additional question asking if the researcher can do a one-to-one follow-up interview is asked. This question is added to the questionnaire so as to probe prospective participant through interviewing on some sections as it has the benefit of enriching the data. Interview has the advantage of providing in-depth information about EPR as well as clinician's attributes and use behaviour.

4.3.7. Final questionnaire

The final questionnaire comprises of seven (7) sections as in the initial questionnaire with section H reserved for commentaries and suggestions. Additions and minor changes were made in the final version of the questionnaire to include;

1. Section A categories were replaced with the alternative to type the required information in the blank space by the respondent. For example, age of respondents required a specific age typed in rather than choose a category as specified in the initial questionnaire. This allows for better data analysis.
2. A statistician was involved in the final questionnaire design to assess the type of analysis to be conducted after pilot data is collected. A statistician is necessary in the questionnaire design as it aids better design and understanding of data types as well as for analysis purposes.
3. The initial questionnaire was sent to seven (7) subject experts for assessment and review. Three (3) subject experts responded to the invitation and made recommendations for inclusion and slight changes to the structure of the questionnaire. The researcher implemented each reviewer's recommendation and change.
4. For validation purposes, each section of the final questionnaire was an adaptation from prior studies. Section F is the only section not adapted from any prior studies and thus the expert panel validated the section through their comments and reviews.
5. In section H, additional question is included. This question is designed to solicit additional response to any section of the questionnaire that was unclear or ambiguous but using an interview method to collect data.
6. A subject expert responded to the online version of the questionnaire and recommended no change. An online version was developed to compare speed of responses, accuracy and understanding against hard copy method. This comparison is also to best assess which method is better suited for the different clinician types for example, medical doctors may prefer hard copy as opposed to surgeons.
7. An initial questionnaire sample was piloted to final-year nursing students at a public university in the Western Cape to ascertain the relevance of hard copy administration as opposed to online method. This pilot sample was a failure as all the students indicated that they do not have access to a hospital electronic record system and so could not complete the questionnaire.

4.3.8. Final questionnaire assessment

The final questionnaire is accepted as the research questionnaire for piloting by both the researcher and the hospital medical manager. Online and hard copy questionnaires are the adopted format as agreed by both researcher and hospital medical manager. All pilot participants who accept to participate are asked to choose their preferred format. If a participant chose hard copy for example, the researcher physically hand-delivered it to that participant. If a participant chose online then the researcher emailed the survey link. The pilot sample on nursing student used hard copy and it proved that hard copy is better suited and faster to complete for participants much closer to the researcher. It took the nursing students an average between 15-20minutes to complete the questionnaire. The pilot sample is to ascertain understanding of the questions, time taken to complete questionnaire and questionnaire format preferred.

A further exercise to test the questionnaire is applied. It is administered by the researcher to final-year nursing students at a South African university since these students are mandated to undertake a part of their degree programme practice at a public hospital. All nursing students indicated that they are not allowed to touch or manipulate the electronic patient record system. This exercise is conducted because after completion of their degree programme, these students undertake internship and community services at hospitals as a requirement for completing their degree. This exercise has an objective to give the researcher a snapshot of a hospital environment and health practitioners' perception of technology but it was unsuccessful.

The entire pilot study process is detailed below.

4.4. Pilot study procedure

An initial meeting was held with a DoH manager responsible for the implementation of the health technology (EPR) at the various Western Cape Province hospitals namely, Khayelitsha, Mitchells Plain, George, Karl Bremer and Tygerberg hospitals. This meeting was aimed at identifying the research hospitals for the study. Also the identifiable hospitals must have a functioning health information system used by clinicians for their daily tasks. The meeting was held on the 11th of March 2015 for 1hour. A synopsis of the current health information systems at the various hospitals was discussed; its functionalities as well as future implementations and upgrades were highlighted by the manager.

Many hospitals were identified where EPR systems are installed and currently in operation. Of these hospitals, Mitchells Plain Hospital (MPH) and Tygerberg hospital (TBH) were selected for access. A brief summary of the research hospital sites for the study is explained next.

4.5. Hospitals descriptions

4.5.1. Site A – Mitchells Plain district hospital (MPH)

The choice of Mitchells Plain Hospital (MPH) is based on the premise that it consists of a substantial population of clinicians of diverse specialties. The hospital accounts for a large representation of health practitioners. The MPH is located in the Northern suburbs which is accessible to the researcher. The MPH is a district hospital and under the authority and control of the national department of health. Clinician population is substantial as the researcher consulted with the CEO of the hospital regarding the number of clinicians on fulltime basis. A substantial number of clinicians at MPH are estimated at over 50.

At the Mitchells Plain district hospital (site A), a formal presentation is made to the hospital executives on the 31st of March 2015 at 2pm. The presentation also included a presentation of the sample questionnaire for observation and comments. The hospital executives agreed verbally to answer the questionnaire and make commentaries but insisted on an online version as opposed to hard copy. The administration of hard copies was proposed to be used with the nurses. Further to this presentation, the online survey questionnaire link was forwarded to the CEO for distribution to the clinicians and the response rate was one (1). A formal appointment was initiated with the nursing manager to explain the purpose of the research and seek approval for administering hard copies to the nurses and after many phone calls by the researcher and re-scheduling by the nursing secretary, the meeting never took place. Reasons given by the nursing manager's office hospital included manager's unavailability, illness and time constraint.

4.5.2. Site B – Tygerberg hospital (TBH)

Tygerberg Hospital is a tertiary hospital located in Parow, Cape Town, South Africa. The hospital was officially opened in 1976 and is the largest hospital in the Western Cape and the second largest hospital in South Africa. It acts as a teaching hospital in conjunction with a University. It was designed to accommodate 1,899 beds, but presently has 1,384 active beds, including the 319 beds for

the Tygerberg Children's Hospital. More than 66,772 are admitted and more than 326,000 outpatients visit the hospital annually. Tygerberg hospital is the second research setting because of its size and having medical personnel (clinicians) comprising of about 550 (Western Cape Government, 2015). It consists of a wider variety of clinician types and when included, it will help improve the sample size of the study. It is also situated in the Northern suburbs and accessible to the researcher.

The researcher approached Tygerberg hospital (site B) with a presentation of the study on the 11th of May 2015 at 9am by the researcher to the TBH hospital management of which a sample questionnaire was also presented. Some concerns were raised about the questions in the questionnaire by the medical manager and upon agreement; a formal approval was to be obtained from the hospital management to pilot the questionnaire first. Twenty (20) clinicians were to be allocated for the pilot study according to the TBH clinical manager. At a later stage, no clinician was allocated to participate in the pilot study and reasons included unavailability and the difficulty in sourcing voluntary participants.

4.5.3. Additional site – University of the Western Cape (UWC)

A further presentation of the study is undertaken at the UWC School of dentistry on request of the dean. The presentation was undertaken on the 8th of June 2015 at 2pm. The presentation was to inform the academic clinicians (dentist) of the researcher's study and its impact on their clinical work. The UWC school of dentistry is housed at the Tygerberg hospital premises and operates a functioning dental department to the hospital. Clinicians are situated at this school, fulltime and interns inclusive. This presentation is to seek support from the school management for its clinicians to participate in the pilot study by scrutinising the survey questionnaire. Naicker (2010: 169) advises that scrutinising the questionnaire procedure was to determine whether any of the respondents had difficulties in interpreting or answering the questions – whether the instructions were clearly understood, and to take note of any criticisms and comments made by the respondents.

4.6. Selection of participants

Clinicians contacted and finally selected for the study had to meet certain criteria. In determining who qualifies as a clinician for this study, the criteria met were;

1. a clinician must have obtained a medical or health sciences degree (NQF level 7 tertiary qualification);

2. be registered with a health professional council or body as required by the profession. Registration with a professional council or body is mandatory for practising clinicians and exceptions are only made for student health practitioners who currently are undertaking community service and/or internship as a requirement for full registration. These category of student clinicians are included if they use ECM at hospitals;
3. clinician must be a practising health practitioner, meaning the clinician is currently employed either full time, part time, on contract, or internship.
4. clinician must have access and using ECM at the hospital
5. clinician must be associated with a public hospital, in this case MPH or TBH.

All other hospital personnel who do not meet these criteria are excluded from this study entirely. They can consist of office administrators and support staffs. Nurses were also excluded as they do not use the hospitals' EPR. An appropriate sample size is determined when data saturation is reached and this is determined by the researcher.

The success or failure of the pilot study still requires ethical considerations before its commencement and so the researcher obtained written permission from all relevant authorities in charge of the two hospitals from the Western Cape health department and his university.

This is discussed below.

4.7. Ethical consideration

The researcher applied and obtained ethics clearance from his affiliated University. The ethics clearance was approved in January 2014 (appendix A). A further application was made to the Western Cape Department of Health which manages MPH while a direct application was made to Tygerberg hospital for approval to access it. A letter of permission was obtained from the DoH to access MPH in April 2015 (appendix B). Subsequently a presentation was undertaken to MPH management (excluding nursing manager) in March 2015 by the researcher as a procedure to secure research approval. Further appointment was made in May 2015 with the nursing manager at MPH to present and seek approval of research as well as administer questionnaires to nurses. Tygerberg hospital application was made in March 2015. Although research concerns were expressed by the Tygerberg

medical manager, all documentations were submitted and approval granted on the 13th of July 2015 (appendix C).

Another research application is made to the researcher's University registrar to pilot the survey questionnaire to academics of the schools of dentistry, nursing and pharmacy. Permission was granted on the 18th of May 2015 (appendix D). The reasons for including academics of these schools were because some are also clinicians registered with their respective professional associations and bodies and also practising health practitioners. The final questionnaire is contained in appendix E

The quantitative data analysis technique is presented below.

4.8. Quantitative data analysis

Analysis of the quantitative pilot study data requires the use of the Statistical Package for Social Sciences (SPSS) version 23.0 for windows to describe and make inferences about corresponding population properties. The choice of SPSS is because it has the ability to perform correlational analysis, multiple regression and Analysis of Variance (ANOVA) in order to find associations between the dependent and independent variables (Naicker, 2010: 15).

A presentation of the responses obtained from the pilot study is explained in detail below.it starts with the reliability and then the validity test of the questionnaire.

4.9. Reliability of the questionnaire

According to Sekaran and Bougie (2010), reliability is the consistency in obtaining the same result when measurements are repeated over and over again. In other words, reliability should be a measurement of instrument accuracy in determining whether any differences have arisen out of confusion. The pre-testing of the questionnaire and the fact that the questions in the questionnaire were from previously validated research, increases the reliability of the questionnaire. Special care was taken to re-test the questionnaire where items had been re-worded or changed. One method to test for reliability is to administer the questionnaire at two different points in time to determine whether there are any significant differences. For this study, administering the questionnaire at multiple points cannot be undertaken because of time limitation and problems associated with the availability of a substantial amount of participants.

A reliability test of this nature is appropriate to test the consistency of the items associated with a theme. The questionnaire is administered to clinicians at an academic institution, two hospitals in Western Cape and a clinician at a KZN hospital respectively. Another method to test for reliability is to address the issue of internal reliability. This is normally done to measure how well a group of questions correlates with a concept or theme (Hussey and Hussey, 1997; Sekaran, 2003; de Vaus, 2007). Cronbach's alpha was used to test for inter-item consistency. According to de Vaus (2007: 21),

> *"... of the internal consistency measures, Cronbach's alpha is the most widely used and is the most suitable".*

De Vaus maintains that Cronbach alpha examines how a group of variables is related to other groups of variables. The scholar continues saying, reliabilities in the 0.8 range is good and those in the 0.7 range is still acceptable. The closer the reliability coefficient to 1.0, the more reliable the items are consistent.

Sections D, E and F items were involved in the reliability testing as they contained items to test the propositions presented and answer the research questions at a later stage. Sections A, B, C, G and H contains information on demographics, ability to use a computer, availability of the computers, global assessment of EPR and participants additional opinions and suggestions. These are not necessary for pre-testing.

Reliability statistics (section E and F)

Cronbach's Alpha	Cronbach's Alpha based on standardised items	N. of Items
0.850	0.866	39

The reliability test for 9 themes namely, perceived usefulness, relative advantage, job-fit, perceived ease of use, complexity, affect, facilitating conditions, storage, retrieval and share was computed. Cronbach alpha using SPSS version 23 was used to measure the internal consistency of the measuring questionnaire. There were 39 items from the 9 themes with a Cronbach alpha score of 0.850 obtained. This implies that the items that were meant to measure the same underlying concept were answered in

a consistent way (de Vaus, 2007). A 0.850 score is closer to 1, so the reliability range is good. It is noteworthy that the theme called affect obtained a Cronbach alpha score of 0.692 when analysed individually but was still included because it has three (3) items unlike other themes with four (4) items. It is highly likely that if a fourth item is added, its score will improve.

Reliability statistics (section D)

Cronbach's Alpha	Cronbach's Alpha based on standardised items	N. of Items
0.925	0.913	23

Subsequently, section D had one theme (USE) with a Cronbach alpha score of 0.925 implying that the items measure the same underlying concept were answered in a consistent way.

4.10. Validity of questionnaire

Hussey and Hussey (1997) define validity as the extent to which the findings of the research truthfully represent the phenomenon being studied. Sekaran and Bougie (2010) strongly advise that researchers should be sure that they are measuring the concept they set out to measure and not something else.

In Onwuegbuzie and Leech's (2007: 234) research work, internal validity was replaced with internal credibility and defined as 'the truth-value, applicability, consistency, neutrality, dependability, and/or credibility of interpretations and conclusions within the underlying setting or group'. On the other hand, external credibility refers to, 'the degree that the findings of a study can be generalized across different populations of persons, settings, contexts, and times. In addition, external credibility pertains to the confirmability and transferability of findings and conclusions. Sekaran (2003) state that there are many validity tests that can be used to test the validity of the measures such as face, content, construct and criterion-related validity. Each is discussed below.

4.10.1. Content validity

Content validity involves examining the extent to which the measure assesses the various aspects of the concept through ratings by expert judges or other means (de Vaus, 2007; Sekaran, 2003). Content validity is an assessment made by experts in that particular field of study to determine whether the questionnaire includes all the relevant questions and that nothing important has been excluded to meet the purpose of the study. On the other hand, face validity is a basic index of content validity, which

indicates items that "do on the face of it look like they measure the concept" (Sekaran, 2003: 206). Face and content validity was met by administering it to subject experts in the field of health informatics. Sections 4.3.2 and 4.3.4 explains face and content validity process and the adoption of a final questionnaire.

4.10.2. Criterion validity

The choice of scales has an influence on scale reliability (Sekaran and Bougie, 2010). Moreover, the authors state that this should be evenly balanced. Nunnally (1978: 521) on the other hand states:

> *"... as the number of scale steps is increased from 2 up through 20, the increase in reliability is very rapid at first. It tends to level off at about 7, and after about 11 steps, there is little gain in reliability from increasing the number of steps".*

Naicker (2010: 172) advises that a five-point Likert scale is appropriate and this was used especially for the items measurements. Items are grouped under an associated theme and each item comprised of a 5-point Likert scale measurement. It is scaled from 'strongly agree', 'somewhat agree', 'neither agree nor disagree', 'somewhat disagree', and finally 'disagree'. Strongly agree is weighted a 5 and strongly disagree a 1.

The results from the pilot study process are explained in the next section.

4.11. Results from pilot study

The online survey questionnaire is sent to 74 academics at the school of dentistry which hosts more academics because of the merger of all dentistry faculties/departments of all universities in the Western Cape Province into one school hosted at UWC. In a similar vein, 28 academics at the school of nursing received the survey link while 18 received the survey link at the school of pharmacy. The survey questionnaire was further sent to MPH after being granted permission to access it by the department of health. The online survey questionnaire was further sent to another clinician at a KwaZulu Natal district hospital in SA while twenty (20) hard copy questionnaires were given to clinicians (nurses) at TBH.

Of the 120 academics from the three schools at UWC who received the survey questionnaire link, 18 responded. In addition, of the 14 that responded, 6 academics completed the survey questionnaire. A clinician at MPH out of 16 contacted and one from a KwaZulu Natal district hospital contacted completed the questionnaire. Of the 20 clinicians at TBH who responded to the pilot questionnaire, four (4) completed the online questionnaire. The table below is a summarised display of clinicians' participation in the pilot study in section 4.11.

Table 4. 1 Summary of pilot study participation

Organisation	Total questionnaire administered (hard copy/online)	Acknowledged receipt	Completed questionnaire returned
TBH	20	20	4
MPH	16	2	1
UWC-Nursing	28	7	2
UWC-Dentistry	74	7	4
UWC-Pharmacy	18	4	0
KZN	1	1	1
Total	**157**	**41**	**12**

Source: Email correspondences with all hospital and schools' secretaries

All clinicians (from all samples) who responded to the pilot study invitation were 41 out of a total of 157. This amounts to 26.11%. Those who completed the online survey questionnaire by answering all questions were 12 out of the 41. The remaining 29 did not complete the questionnaire.

The low response rate of clinicians at the academic university (UWC) can be attributed to the following reasons:

- the timing of conducting the pilot study. The timing of the pilot study participation was undertaken during the university (UWC) examination period. It meant academics were either preparing exam questions, invigilating or marking scripts and so have limited or no time to participate in the survey pilot study.

- condition for participating. The condition is such that the participant must be a practising clinician other than being an academic. This criterion limited the number of participants as observed in some responses. Many clinicians who could not complete the questionnaire indicated that they did not have access to an electronic computer system at the hospital where they practiced or there was no EPR system available at all.
- some respondents are no longer practising clinicians but only fulltime lecturers.

The low response rate of clinicians at both TBH and MDH are because:

- some TBH clinicians (nurses especially) do not have access to the hospital's electronic system
- other clinicians were heavily burdened with work so either could not participate or forgot to complete the questionnaire
- at MDH, there was no absolute reason for clinicians' non-response to the study even though they responded positively to the presentation and verbally agreed to an online survey rather than the use of hard copy. Numerous attempts (28/04/2015 to 23/11/2015) were undertaken by the researcher to convince the MPH clinicians to participate but to no avail. An example of an attempt was that the researcher contacted the medical manager on a weekly basis and solicited his cooperation to remind the clinicians via email. This strategy failed to yield any additional participation.

Faced with a low response rate, there is no agreed sample size for a pilot study as Leon *et al.* (2011) argued. The authors say a pilot study is not a hypothesis testing study, thus no inferential statistics tests should be proposed in the study protocol. For this reason, it does not provide p-values or make provisions for power analyses. With this claim, the pilot study results will be accepted for analyses.

All twelve (12) completed questionnaires out of a 157 total clinicians contacted amounted to a 7.64% response rate. All completed questionnaires were analysed for question clarity, ambiguity, incorrectness, and understanding using respondents' feedback. No complaints were indicated with regards question ambiguity, incorrectness and understanding.

Slight changes are made to some worded items such as in section D where the words hospital computer replaced the word PC. This was to eliminate the confusion between a work computer and personal computer such as a laptop. Other changes were made to the covering letter to make it read in

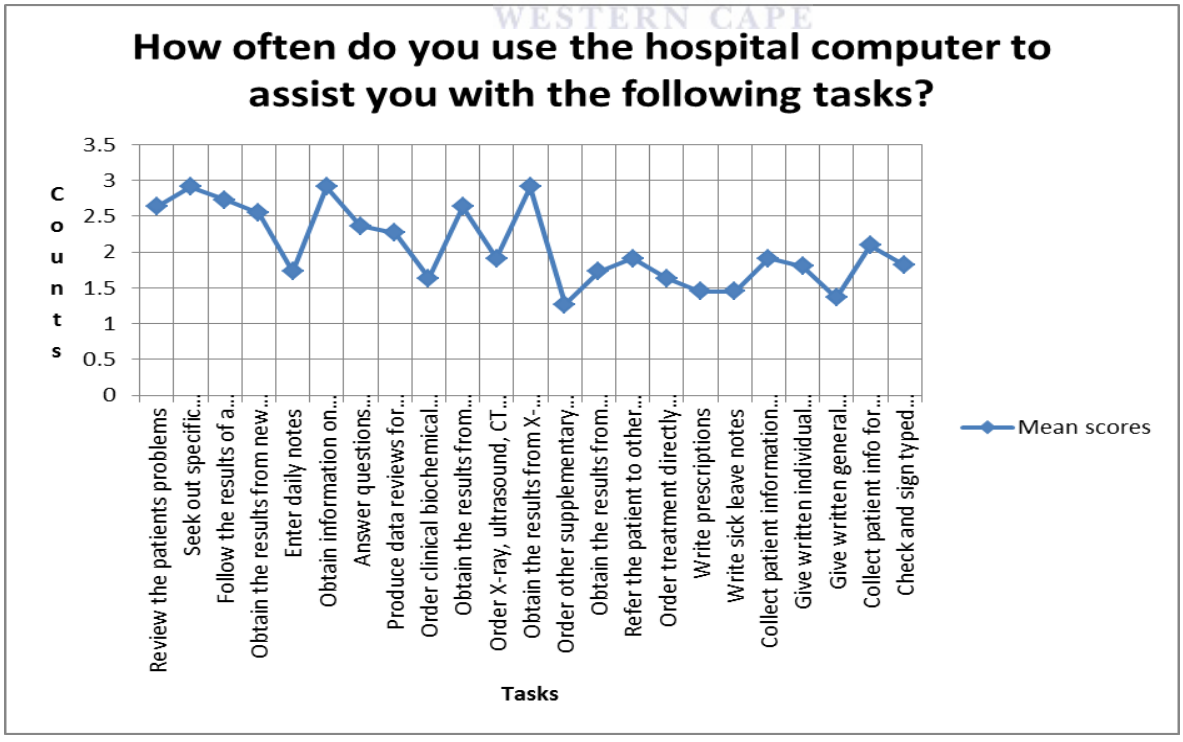
a more submissive manner. Section F contained new themes which clinicians answered with no complaints.

The next section is a detailed explanation of what the data obtained means to the study. The data analysis of the pilot study is important as it will have an implication on the larger qualitative study.

4.12. Analysis of the pilot study results

The mean age of respondent was slightly over 40 comprising of 7 males (58.3%) and 5 females (41.6%). Occupation ranged from lecturer, doctor, pharmacist, orthodontist to gynaecologist working at a hospital. Highest and lowest qualifications were from a Doctorate degree to Bachelor with all races inclusive. Whites participated more at a rate of 50% (6 out of 12), Coloureds accounted for 16.6% (2 out of 12), Blacks were 16.6% (2 out of 12) and Indians were 8.3% (1 out of 12). One participant did not indicate race. All respondents had the ability to use a computer with a 'very good' computer skills rate of 100%. Section D asks, 'how often do you use the hospital computer to assist you with the following tasks' of which a list of 23 clinical tasks were given. Figure 4.1 is a summary of the responses and some explanations given.

Figure 4.1. Section D - How often do you use the hospital computer to assist you with the following clinical tasks?



The mean scores of respondents indicate they sometimes use the hospital computer for clinical tasks but more especially for reviewing patients problems, seek out specific information from patients records, follow results of a particular tests, obtain results from new tests or investigations, obtain information on investigation or treatment procedures and obtain the results from clinical biochemical laboratory analyses, obtaining X-ray, ultrasound, and CT investigation results.

Respondents further indicated that they hardly use the hospital computer for capturing patient health information whether daily notes, order laboratory analysis, X-ray, ultrasound, and CT investigation results, medications, supplementary investigations, write prescriptions, sick notes, reports or make referrals. It is reasonable to conclude that the hospital computer is mainly used for retrieval purposes as clinicians can neither capture nor share patient information.

In understanding clinicians' attitude towards EPR use at work, a summary of their mean responses per question is highlighted below.

Figure 4.2. Section E – Perceived usefulness

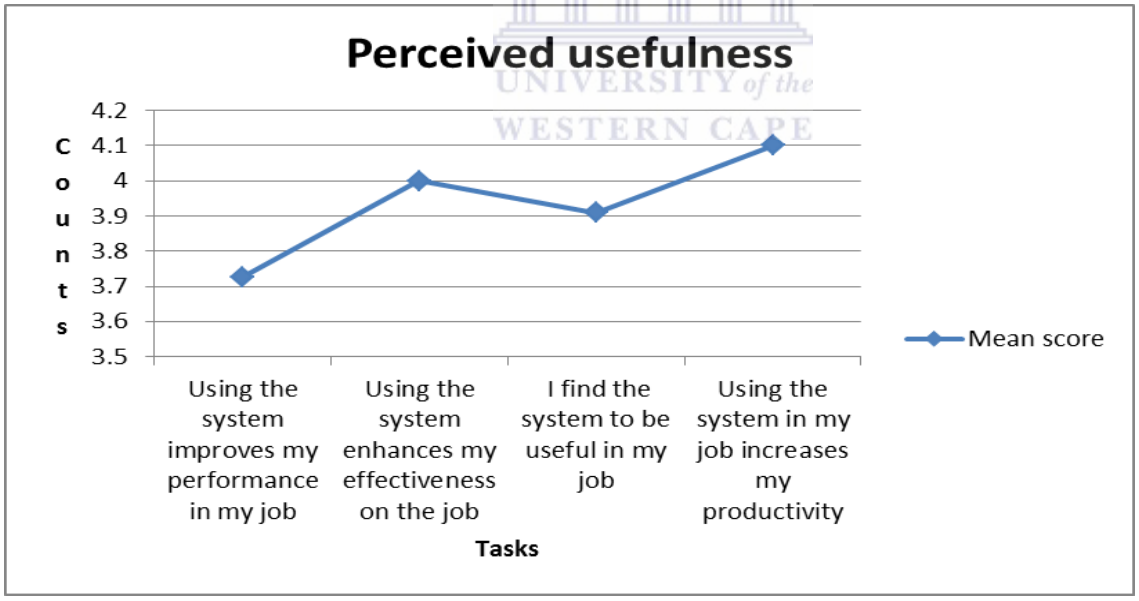
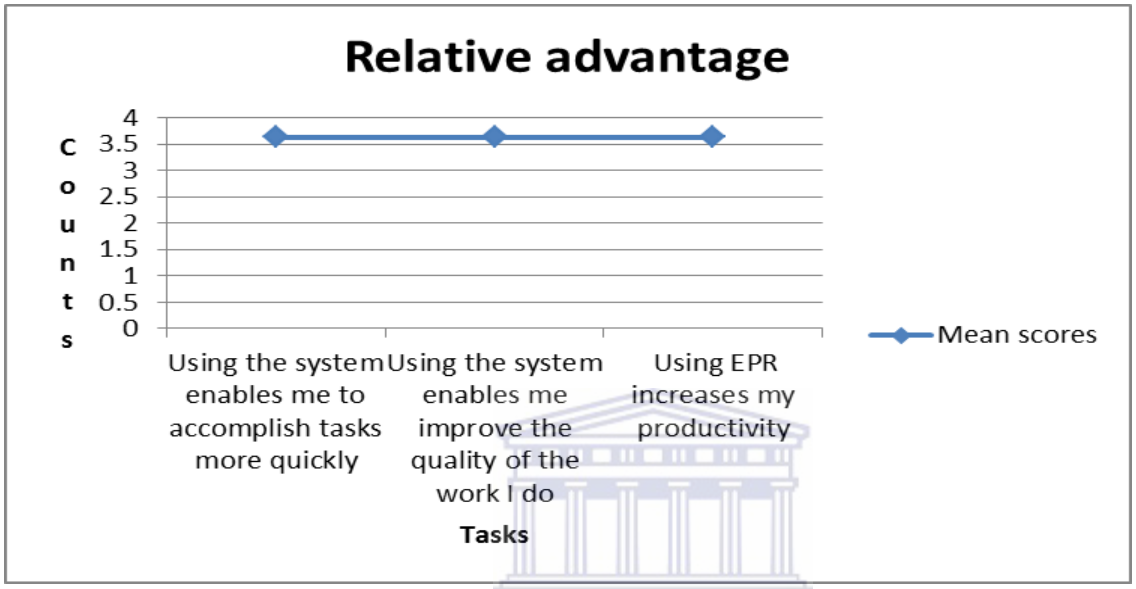


Figure 4.2 is a summary of respondents' perception of EPR usefulness at the workplace. Although most clinicians did indicate in figure 4.1 that they seldom used the hospital record system to capture and share information more especially, their perception of EPR usefulness in performing their work still remains positive.

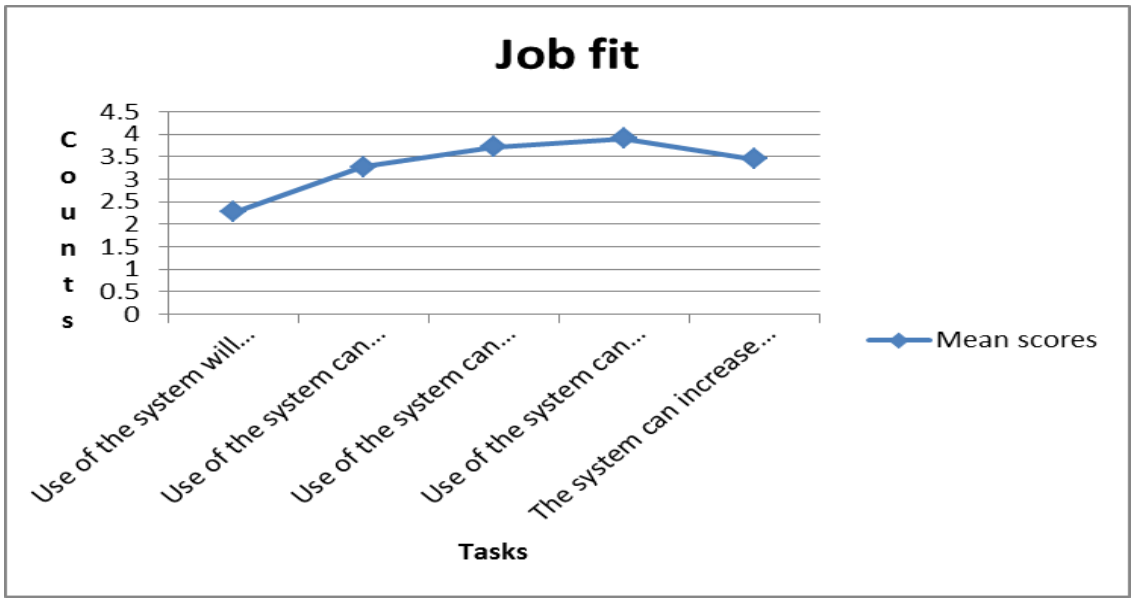
Not all clinicians are overwhelmingly positive that using EPR will improve their work performance as this can be attributed to their experience in accessing the system. But there was an overall agreement using the mean scores that EPR was perceived to enhance job effectiveness, useful and increase work productivity.

Figure 4.3. Section E – Relative advantage



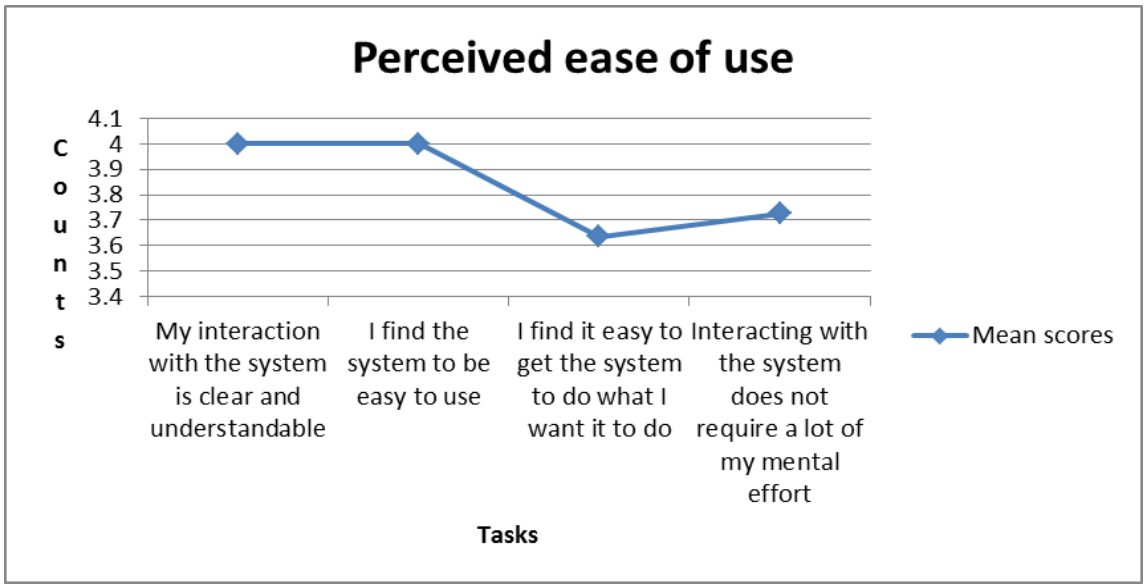
For relative advantage, clinicians on average somewhat agreed that using EPR is advantageous by improving the quality of their work, accomplishing tasks quickly and it increased productivity. It is an indication that EPR had advantage over the use of paper system or other legacy system used in the past.

Figure 4.4. Section E – Job fit



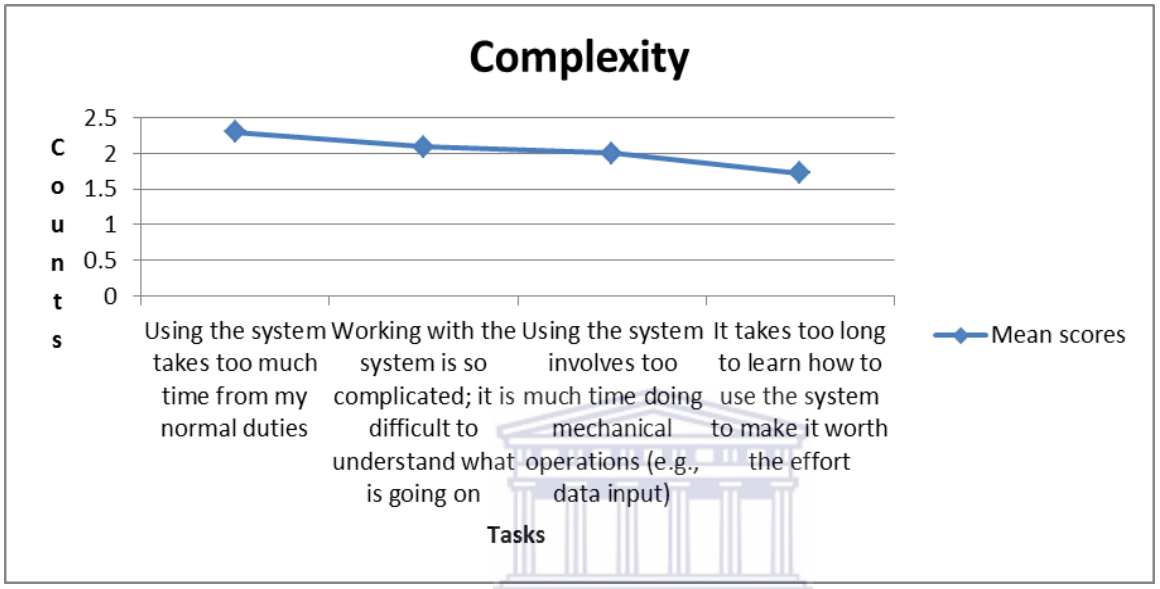
In figure 4.4, clinicians on average agreed on EPR having an impact on their work. Although they somewhat agreed that EPR will not decrease their work time, it will subsequently increase work quality and output, work effectiveness and output quantity. Their agreement is based on the assumption that existing paper systems still play a role as complementary to EPR even though EPR is of daily use.

Figure 4.5. Section E – Perceived ease of use



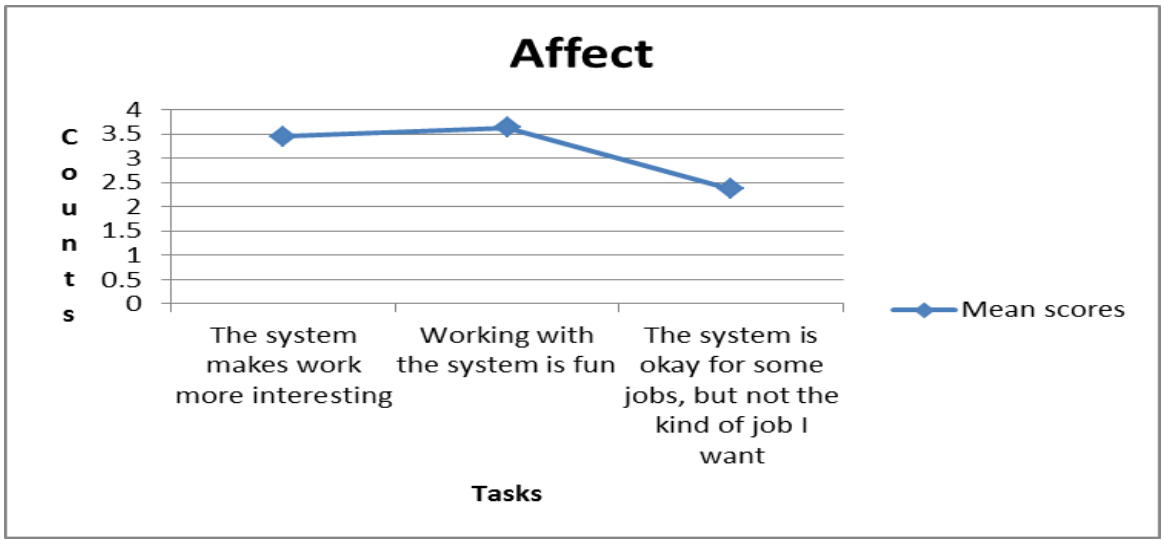
With regards to figure 4.5, on average clinicians agreed that EPR is easy to use although they were somewhat indecisive in agreeing that EPR is easy to manipulate in doing what they want. This indecisiveness can be undertsood since clinicians were not involved in its design and development and thus would find the system difficult to customise to perform individual tasks.

Figure 4.6. Section E – Complexity



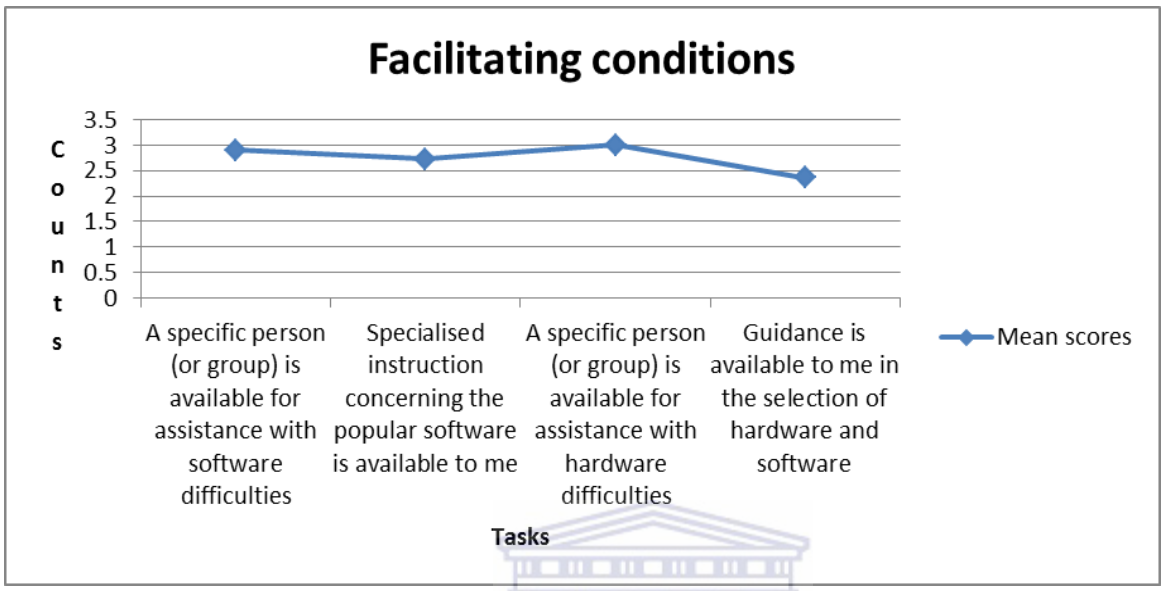
Clinicians on average disagreed that EPR is complex. And in particular, they indicated that EPR requires too much time to learn to make it worth their effort. This can be a result of their high ability to use a computer which has a mean score of 4.55 out of 5 with 5 being 'very good'.

Figure 4.7. Section E - Affect



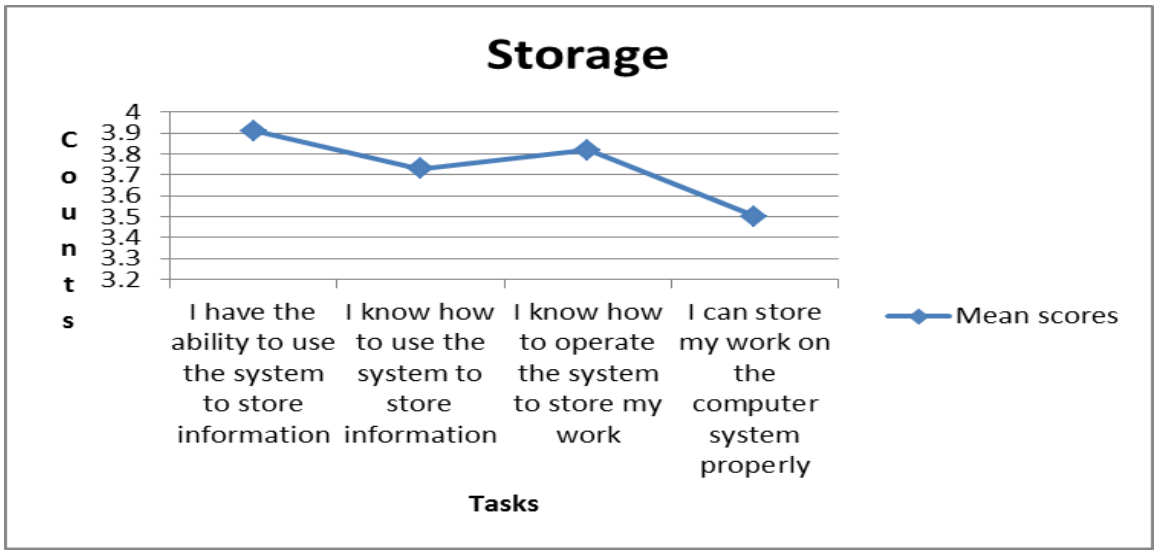
Clinicians' attitude (affect) of EPR indicates willingness and a positive feeling to use. Figure 4.7 on average indicates clinicians' agree EPR is a good system to use for their individual work tasks.

Figure 4.8. Section E – Facilitating conditions



Facilitating conditions means system support to users. Figure 4.8 indicates that clinicians moderately agree on average that EPR support is available to them during difficulties. Their moderate responses can be attributed to the fact that they have computer soft skills only which can be acquired during training but no hard skills such as hardware repair, installation or maintenance.

Figure 4.9. Section F – Storage



Clinicians' responses for all questions on average indicated that they had the ability to use EPR to store information. Clinicians' ability to use EPR (question F1a) indicates technical competence to use the system which is acquired through training. Clinicians' ability to use EPR (question F1b) indicates their capability to actually use the system in the correct way without technical assistance. Subsequently, clinicians' ability to operate EPR (question F1c) indicates their capability to perform all tasks associated with using the system e.g. switch EPR on, capture, retrieve, share information Figure 4.9 indicates that clinicians' had a mean score above average in agreeing that EPR can be used to store information.

Figure 4.10. Section F – Retrieval

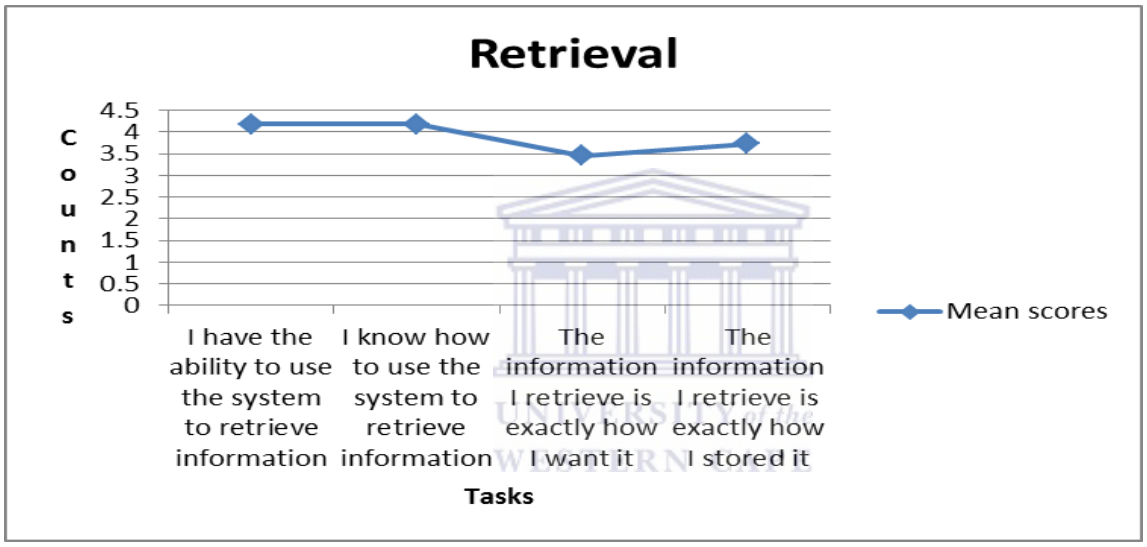
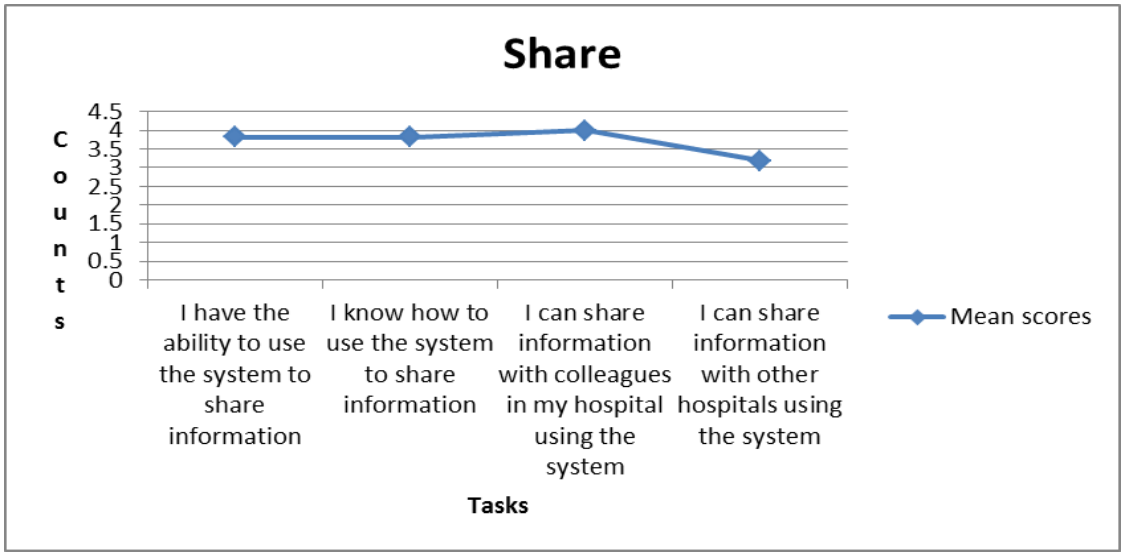


Figure 4.10 is on information retrieval and clinicians' did agree that they could retrieve information from EPR. But they were indecisive on the format of information retrieved, this is because of their inability to store information in the format they prefer.

Figure 4.11. Section F – Share



On average, sharing information using EPR by clinicians was indecisive. And the only agreement that EPR can be used to share information was amongst colleagues of the same hospital. This is possible because EPR allows for multiple users at the same time thus clinicians can view patient information from multiple screens at different locations of the hospital.

Figure 4.12. Section G – Global assessment of EPR at workplace

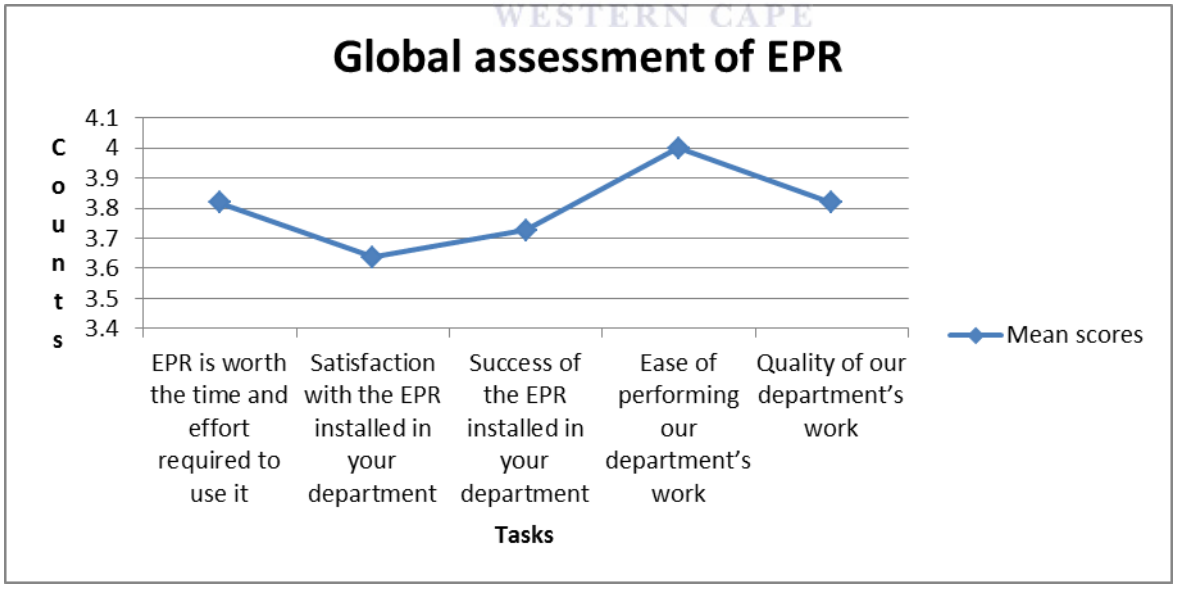


Figure 4.12 is an overall assessment of clinicians' assessment of EPR use at work. On average, clinicians' were indecisive of EPR satisfaction, success in enhancing their work tasks, worthwhile as well as improving their work quality. They agreed on EPR ease of use. This assessment is an

indication that EPR at hospital needs further investigation to ascertain its usefulness (if any) in improving clinicians' work tasks.

4.13. Limitations of the pilot study

The low response rate meant the exclusion of some analysis that could have been undertaken such as cross-tabulations, chi-squared analyses of independence, bi and multi-variate analysis, regression and factor analysis. The low response rate confirms the views of Pillay (2008: 262) that it is increasingly difficult to achieve desirable response rates in surveys involving clinicians. Although the sample size was small, it was deemed relevant as pilot studies sample sizes are typically based on the pragmatics of recruitment and the necessities for examining feasibility (Leon *et al*, 2011: 3).

A small sample size limited the pilot study to better understand clinicians' perceptions of ERP at workplace based on identified themes, but this study is in agreement with Leon *et al's* (2011: 6) conclusions that pilot studies are a necessary first step in exploring novel interventions and novel applications of interventions. A pilot study results basically informs feasibility, which in turn, is instructive in that it points to modifications needed in the planning and design of a larger efficacy study.

Qualitative research design using interview protocol was not included in the pilot study as interview questions will be adopted directly from the validated and reliable pilot study quantitative questionnaire. Qualitative research is now introduced and explained in detail highlighting all the different aspects such as design, data collection techniques and data analysis.

4.14. Qualitative research method

This is a multi-method approach to the study of social interactions in natural settings. Ruxwana (2010: 14) continues that it includes elicitation and analysis of empirical data from various sources such as first-person accounts, life histories, visual records, semi structured and open-ended interviews, informal and formal observations, biographical, and auto-biographical materials. The purpose of the qualitative research is to understand and examine clinicians' attributes that affect their attitude towards EPR use. The qualitative research design involves a case study of EPR and explained below.

4.14.1 Research Design

Research can be defined as a careful and systematic process of inquiry to find out answers to a problem of interest (Peh and Low, 2013: 133). Continuing, Peh and Low (2013) categorised research designs into six different types namely case studies, surveys, experiments, correlational research, causal-comparative research and historical research. The study uses a qualitative case study research design of EPR. The case study design is further explained in more detail in the next section.

4.14.1.1. Case Study

Creswell (2007) defines a case study as an issue explored through one or more cases within a bounded system. Case study design according to Yin (2003) should be used when: (a) the focus of the study is to answer "how" and "why" questions; (b) you cannot manipulate the behaviour of those involved in the study; (c) you want to cover contextual conditions because you believe they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context.

In determining a case study research design, the selection of a specific type of case study design guided by the overall study purpose (Baxter and Jack, 2008: 547) is applied by the researcher. Case study research design has five components that are especially important according to Yin (2003: 21-27) namely:

1. Study questions – the form in which the question takes, for example "who", "what", "where", "how" and "why". These forms provide an important clue as to the relevant research strategy to be used. One of the study question takes a "how" format.
2. Study propositions – each proposition should direct attention to something that should be examined within the scope of the study. This study investigates clinicians' cognitive attributes towards using EPR. It also examines information storage, retrieval and sharing of patient information using an EPR system at a hospital.
3. Unit of analysis – it relates to the fundamental problem of defining what the case is for example, the case might be an individual, organisation, events, programs, decisions or group. For this study, the unit of analysis is clinician.
4. Linking data to propositions – this is where several pieces of information from the same case may be related to some theoretical proposition for example, using a pattern matching technique.

5. Criteria for interpreting a study's findings – setting a precise criteria for interpreting findings is difficult but it is hoped that the different patterns are sufficiently contrasting enough so as to allow the findings to be interpreted in terms of comparing at least two rival propositions.

The various types of case study accordingly (Yin, 2003) include:

1. Explanatory - used if you were seeking to answer a question that sought to explain the presumed causal links in real-life interventions that is too complex for the survey or experimental strategies. Explanatory case study aims to indicate causality between variables or events (Babbie and Mouton, 2001: 81)
2. Exploratory - used to explore those situations in which the intervention being evaluated has no clear, single set of outcomes. This approach is typical when a researcher examines a new interest or subject of study that is relatively new (Babbie and Mouton, 2001: 79-80). It involves in-depth interviews, analysis of case studies and the use of informants since it usually leads to insight and comprehension rather than the collection of detailed, accurate and replicable data.
3. Descriptive - used to describe an intervention or phenomenon, situation, event and the real-life context in which it occurred. It includes conceptual analysis (the typologies and taxonomies), historical analysis (narrative descriptions), retrospective reconstruction of small numbers of cases (case studies), and the use of multivariate descriptive statistics (contingency tables, correlations, regression, analysis) (Babbie and Mouton, 2001: 81).
4. Multiple-case studies - enables the researcher to explore differences within and between cases. The goal is to replicate findings across cases as comparisons will be drawn.
5. Intrinsic - suggests that researchers who have a genuine interest in the case should use this approach when the intent is to better understand the case with a purpose of interest based on its particularity and ordinariness (Stake, 1995). In a simpler form, this type of case study was used because of its uniqueness and inherent interest, importance, or likely insights, without regard to its applicability to other situations (Yin, 2011: 310).
6. Instrumental - used to accomplish something other than understanding a particular situation (case is of secondary interest) as it provides an in-depth insight into an issue or helps to refine a theory (Stake, 1995). In a simpler form, this type of case study is conducted because of its potential applicability to other like-situations (Yin, 2011: 310).

7. Collective – case studies similar in nature and description to multiple case studies.

A descriptive case study research design approach of a constructivist paradigm (Baxter and Jack, 2008: 545) was used. Constructivists claim that truth is relative and that it is dependent on one's perspective with an advantage being the close collaboration between the researcher and the participant, while enabling participants to tell their stories (Crabtree and Miller, 1999). And through these stories, the participants are able to describe their views of reality and this enables the researcher to better understand the participants' actions (Lather, 1992; Robottom and Hart, 1993).

This descriptive case study research has a characteristic of using multiple data sources, a strategy that enhances data credibility (Yin, 2003). It also describes the causes of events, processes or relationships within a setting (Denscombe, 2005: 38), Examples of data sources include, but not limited to documentation, archival records, interviews, physical artefacts, direct observations, and participant-observation (Baxter and Jack, 2008: 554). Using multiple data sources has more advantages where the investigator can collect and integrate quantitative survey data, which facilitates reaching a holistic understanding of the phenomenon being studied. Data from these multiple sources in case study can then be converged in the analysis process rather than handled individually. Each data source is considered one piece of the "puzzle," with each piece contributing to the researcher's understanding of the whole phenomenon. This convergence thus adds strength to the findings as the various strands of data braided together in order to promote a greater understanding of the entire case (Baxter and Jack, 2008: 554).

The case study design involved the use of interview to collect data from clinicians and this will be discussed in more detail in the next section.

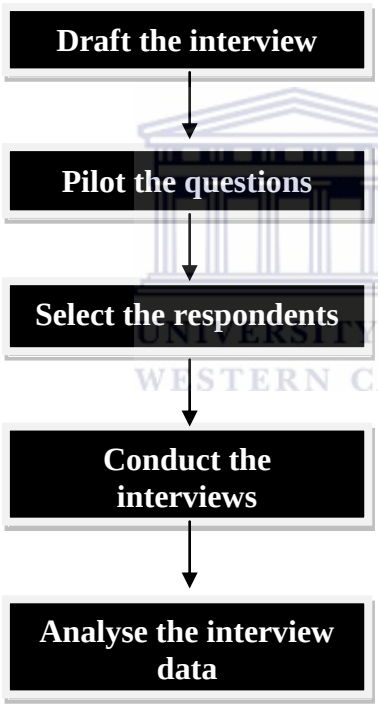
4.14.1.2. Interview

Interviews as a research instrument was used as a way of obtaining detailed information about the study topic, that is, Electronic Patient Record (EPR) system, information storage, retrieval and sharing amongst clinicians. Often interviews are used where other research instruments seem inappropriate according to Wilkinson and Birmingham, (2003: 43). Interviews were conducted on clinicians. An interview is aimed at answering all the research questions of the study.

Interviews have a disadvantage of being more resource-intensive as it requires the researcher to probe and elicit information from the respondents on a one-to-one basis. It also has the disadvantage of time as interviews can typically last longer than an hour and can produce vast amounts of data. Though its resulting advantage is the fact that it can give the researcher more of an insight into the meaning and significance of what is happening (Wilkinson and Birmingham, 2003: 44). It is also less structured than other research instruments such as questionnaire.

Conducting an interview in this study involved the following procedures as prescribed by Wilkinson and Birmingham (2003):

Figure 4. 13 Interview procedure



Source: Wilkinson, D., and Birmingham, P. (2003). *Using research instruments: A guide for researchers*. Routledge.

4.14.1.2.1. Draft the interview

This involves indicating the questions the researcher would ask. The number, type and format of the questions is informed by the level of structure to be imposed in the interview. Semi-structured interviews are used because it has the advantage of giving the researcher control over the order of predetermined questions asked. Semi-structured interview also has an element of predictability and provides an easier framework for analysis (Wilkinson and Birmingham, 2003: 45). In contrast,

unstructured interview has a disadvantage of the researcher losing control to the interviewee during the interview process. In semi-structured interview, it has predefined areas of discussion as the format and ordering of the questions are informed by the on-going responses of the interviewee to the questions posed.

4.14.1.2.2. Pilot the questions

A quantitative pilot study is already conducted to validate and relevance of research questions. No pilot study of interview questions is conducted. Pilot study identifies and corrects imperfections to the questions. Piloting (or testing out) is undertaken quantitatively with a select few clinicians at a public hospital in Cape Town in order to establish clarity of what EPR means to clinicians and its usefulness in patient information storage, retrieval and sharing. Piloting helps to eliminate ambiguous questions as well as generate useful feedback on the structure and flow of intended interview (Wilkinson and Birmingham, 2003: 45).

4.14.1.2.3. Select the respondents

Interviews typically take longer to plan, conduct and analyse, so care is taken to select clinicians' sample group. Face-to-face interviews are the most expensive form of interview. This is so as the researcher has to arrange a venue to hold the interview as well as make arrangements of how to get to that venue, typically at the interviewee place (Wilkinson and Birmingham, 2003: 55). Interviews are conducted at the hospital. Face-to-face has an advantage of being more exploratory, in-depth and personal. Selecting respondents required a considerable amount of time to set up and twice as much time to transcribe. Researcher involved clinicians that are available to participate. The representation requires the use of purposive sampling technique because rich data is expected to be got from these participants based on their positions within the hospital. Other sampling technique employed included snowball sampling to solicit more participation.

4.14.1.2.4. Conduct the interview

Less formal interview process where the researcher will sit alongside interviewee was used so as to allow both parties to feel at ease during the interview process. An audio recorder device (Dictaphone) was used with permission from the interviewee. An introduction of the researcher began the interview process outlining the purpose of the interview and its intended format and structure. The researcher indicates how the interview data will be used and whether anonymity will be preserved. A consent

form is issued to interviewee for signing as an indication of interviewee's agreeing to participate in the interview process.

Open-ended questions were used to encourage the interviewee to provide more information. Cues such as nodding the head to indicate understanding and interest to the interviewee's response and adopting an attentive posture by sitting straight, maintaining eye contact, restating the interviewee's response and drawing a conclusion with the interviewee to clarify thoughts and correct inaccuracies are many ways to enhance interviews (Wilkinson and Birmingham, 2003: 53-54).

4.14.1.2.5. Analyse the interview data

Analysing interview data involved drawing together the data collected and structuring them. This according to Wilkinson and Birmingham (2003: 63) would be grouping the responses to each question from all interviewees to make comparison between respondents easy. Themes, issues and concerns are identified and quantified using this approach. When analysing a large number of interview transcripts, it will be necessary to utilise the functions of computer-based tools such as ATLAS ti version 7. The small sample size meant the researcher used the traditional analysis method of coding and categorising data according to themes. The ATLAS ti software was discarded.

4.14.2 Trustworthiness in qualitative research

In a qualitative study, Bowen (2005: 215) expressed a concern of trustworthiness and suggests four factors to be considered in establishing the trustworthiness of findings from a qualitative research: credibility, transferability, dependability, and confirmability. Credibility according to Bowen (2005) is the confidence a researcher has in the truth of the findings, and can be established by various methods. In this study, the use of interviews and documentation all form the various methods of establishing credibility. Transferability in essence is the extent to which other researchers can apply the findings of this study to their own or to other settings and groups. Dependability refers to the stability of the findings over time and confirmability is the internal coherence of the data in relation to the findings, interpretations, and recommendations.

An analysis of the qualitative results is introduced and discussed in the next section.

4.14.3. Qualitative data analysis procedures

Data analysis in a case study design depends on the type of case study used. Yin (2003) describes five procedures for case study data analysis namely pattern matching, explanation building, time-series analysis, logic models, and cross-case synthesis. In contrast, Stake (1995) only describes categorical aggregation and direct interpretation as types of case study analysis procedure.

4.14.3.1 Pattern matching

This is a deductive based qualitative and analytical procedure involving predicting a pattern of outcomes based on theoretical propositions to explain what you expect to find (Saunders, Lewis and Thornhill, 2009: 500). In the use of this approach, a researcher needs to develop a conceptual or analytical framework utilising existing theory and subsequently test the adequacy of that framework as a means to explain its findings. Yin (2003: 116) sums it up stating that if the patterns coincide, the results can help a case study strengthen its internal validity.

1.14.3.2. Explanation building

A deductive based qualitative and analytical procedure which involves an attempt to build an explanation while collecting data and analysing them, rather than testing a predicted explanation as set out in pattern matching (Saunders *et al*, 2009: 500). Yin (2003) recognises that explanation building is similar to grounded theory but different in that, it is designed to test theoretical propositions, though in an iterative manner, rather than to generate theory inductively. According to Saunders *et al* (2009: 501), it sets out the following stages in explanation building:

a. Devise a theoretically based proposition which a researcher will then seek to test.
b. Undertake data collection through an initial case study in order to be able to compare the findings from this in relation to this theoretically based proposition.
c. Amend the theoretically based proposition in the light of the findings from the initial case study where necessary.
d. Undertake a further round of data collection in order to compare the findings from this in relation to the revised proposition.
e. Further amend the revised proposition in the light of the findings from the second case study where necessary.
f. Undertake further iterations of this process until a satisfactory explanation is derived.

Explanation building does have its own peculiar problems. It is more difficult than pattern matching since it occurs in narrative forms which are not precise. Another problem is that it demands much analytic insight as a researcher can easily drift away from the original topic of interest (Yin, 2003: 122). The use of a case study protocol is a way of solving one of its many potential problems as well as a constant reference to the original purpose of the inquiry (Yin, 2003: 122).

4.14.3.3. Time-series analysis

It may involve one single dependent or independent variable in which the more precise and intricate the pattern is, the better conclusions that can be drawn from the case. It may also involve multiple cases where different time-series patterns are proposed for different cases (Yin, 2003: 126-127). In a complex time-series event, as an example, data collection problems are more, although this can lead to a more elaborate trend that helps to strengthen the analysis. Time-series analysis looks at relevant "how" and "why" questions and the relationships of events over time (Yin, 2003: 127).

An essential feature when using time-series analysis is to identify the specific indicator(s) to be traced over time, as well as the specific time intervals to be covered and the presumed temporal relationships among multiple events, prior to collecting the actual data (Yin, 2003: 127).

4.14.3.4. Logic models

It stipulates a complex chain of events over time as these events are staged in repeated cause-effect-cause-effect patterns whereby a dependent variable (event) at an earlier stage becomes the independent variable (causal event) at the next stage (Yin, 2003: 127). A logic model was used as an analytic technique as it consists of matching empirically observed events to theoretically predicted events (Yin, 2003: 127). Logic model is similar to pattern matching with a difference being that its stages follow a sequence unlike pattern matching which does not. There are various types of logic model according to Yin (2003: 128) with the differences being the unit of analysis relevant to each individual case.

4.14.3.5. Cross-case synthesis

This technique applies only to multiple cases unlike the previous four which can be applied to both single and multiple cases. Cross-case synthesis can be applied whether the individual case study have previously been conducted as an independent research or as a predesigned part of the same study (Yin, 2003: 133-134). Notwithstanding, the technique treats each individual case study as an independent

case study, that is, combining findings across a series of individual studies. When a large amount of cases are available for analysis, quantitative technique can be used.

A descriptive case study better suits the current study so as to understand EPR within a SA hospital context as well as its functionalities especially for storage, retrieval and share. Clinicians' perception and performance expectations are stories in describing EPR adoption and use. An electronic record system (EPR) is in use at hospitals in SA but understood differently by clinician's and hospital management in the literature reviewed. The case study used here affords the researcher an opportunity to better understand how clinician's perceive EPR, how they interact with it and its impact on their work. Descriptive case study will address the research questions in order to meet the study's objectives. Interview is employed in collecting data from clinicians. A pattern matching data analysis procedure was used for this case study because the researcher has developed a conceptual framework utilising themes from existing models as well as proposed propositions to explain the data.

This research would rather follow the interview process of; pilot the questionnaire, adopt interview questions from questionnaire, select the respondents, conduct the interview and analyse the interview data. The technique employed in selecting the respondents is explained in the next section as sampling.

4.14.4. Purposive sampling for qualitative research

In purposive sampling, the most important guiding principle by Koerber and McMichael (2008: 464) is maximum variation; that is, researchers should seek to include people who represent the widest variety of perspectives possible within the range specified by their purpose, that is, clinicians. These participants have certain traits and characteristics such as being the EPR primary users. Other characteristics include their work impact on patient wellbeing using EPR as well as delivering public health service. Purposive sampling is suitable to sample clinicians.

The choice of purposive sampling is because the nature of the research includes a case study approach. Case study requires in-depth probing to gather information of everything related to EPR technology at the hospital. Purposive sampling implies that the researcher has some degree of choice in selecting the research sample and the purpose guiding this choice is subject to the fact that health issues are sensitive, so clinicians will serve the purpose of furnishing information describing the EPR system and their expectations of what it should do.

The sample population is also described in the next section.

4.14.5. Population Sample

A sample is made up of some of the members of a population. Population may refer to a body of people or to any other collection of items under consideration for research purposes (Collis and Hussey, 2009: 144). In order to select a good sample from the population, it should be:

- chosen at random, that is, every member of the population mush have a chance of being selected
- large enough to satisfy the needs of the investigation being undertaken
- unbiased

The population sample is clinicians and a sample is taken from this population. The unit of analysis is another topic discussed in this study below.

4.14.6. Unit of analysis

The meaning of the word "unit" according to Graneheim and Lundman (2004: 106) is the collection of words or statements that relate to the same central meaning. It has been referred to as a content unit or coding unit, an idea unit, a textual unit, a keyword and phrase, a unit of analysis, and a theme. In addition, Graneheim and Lundman (2004) consider a unit to mean word(s), sentence(s) or paragraph(s) containing aspects related to each other through their content and context. The unit of analysis for this study is clinician.

A description of the various qualitative data analysis techniques is discussed with an appropriate choice chosen for this study.

4.14.7. Qualitative data analysis techniques

General appreciations of the different types of strategies are identified by Thorne (2000: 68) to include; constant comparative analysis, phenomenological approaches, ethnographic research methods, narrative and discourse analysis.

4.14.7.1. Constant comparative strategy

It involves taking one piece of data (one interview, one statement, one theme) and comparing it with all others that may be similar or different in order to develop conceptualisations of the possible relations between various pieces of data. (Thorne, 2000: 69). This analysing technique is better suited for grounded theory because this design is specifically used to study those human phenomena for which the researcher assumes that fundamental social processes explain something of human behaviour and experience, such as stages of grieving or processes of recovery (Thorne, 2000: 69). Unfortunately it is not suited for this study as comparisons are not made nor are social processes the phenomenon under investigation.

4.14.7.2. Phenomenological approaches

These are analytic methods employed in studies that explicitly avoid cross comparisons and instead orient the researcher toward the depth and detail that can be appreciated only through an exhaustive, systematic, and reflective study of experiences as are lived (Thorne, 2000: 69). Added to this, this approach allows the researcher to immerse oneself in data, engaging with data reflectively, and generating a rich description that will enlighten a reader as to the deeper essential structures underlying a particular human experience.

4.14.7.3. Ethnographic research methods

It uses an iterative process in which cultural ideas that arise during active involvement "in the field" are transformed, translated, or represented in a written document. It involves sifting and sorting through pieces of data to detect and interpret thematic categorisations, search for inconsistencies and contradictions, and generate conclusions about what is happening and why (Thorne, 2000: 69). This approach is not suited for this study because it mainly involves self-reflection and story-telling of one's lived experiences unlike this study which explains a phenomenon based on others experiences.

4.14.7.4. Narrative analysis and discourse analysis

They both rely heavily on speech (interview) as the most relevant data form. For example, narrative analysis is a strategy that recognises the extent to which the stories we tell provide insights about our lived experiences. In contrast, discourse analysis according to Thorne (2000: 69) recognises speech not as a direct representation of human experience, but as an explicit linguistic tool shaped by numerous social or ideological influences. Thorne (2000) continues stating that discourse analysis

draw heavily upon theories developed in such fields as socio-linguistics and cognitive psychology as it tries to understand what is represented by the various ways in which people communicate ideas.

This study uses a phenomenological philosophy which claims that truth is relative as experienced by clinicians. The understanding of EPR by clinicians is paramount to this study. Narrative content analysis technique of a pattern matching procedure was used. Themes are identified in the literature, coded and classified with the purpose of understanding the contextual use of the words or content themes or patterns. This is also known as summative content analysis (Hsieh and Shannon, 2005: 1278).

A summary of chapter four is discussed here taking into account the methodology adopted, research designs, sampling and data analysis procedures and technique chosen.

4.15. Summary of chapter four

Clinicians' use of EPR examining patient information storage, retrieval and sharing is to understand their perceptions towards its use. Also the current hospital record process is investigated. This study will involve the use of a single case study of descriptive nature involving interviews as a qualitative instrument in order to answer all the research questions. In addition to case study, a pilot study of quantitative nature is required as it will involve the use of survey questionnaire to test the question's validity and reliability. These questions were then adapted as interview questions for the qualitative main study.

It is not a mixed method research but a mono-method approach involving multiple research designs of survey and case study. This is so because the pilot study is to validate and test the reliability of the questions to be used in the main qualitative study. A qualitative method approach of this nature will use data triangulation to collect data which tends to have the characteristics of a mixed method research. Mixed methods have the advantage to deflect attention away from theoretical work that is often specific to particular disciplines and thus, encourages thinking 'outside the box'. It also has the ability to speak two languages - the technical language of research and the language which makes research results simple to communicate and its messages easy to understand.

The unit of analysis is clinician. Clinician's perception, attributes influences their attitude which is essential in understanding the degree to which they adopt and use EPR. Their attitude may be positive or negative and this will translate into the degree to which they use EPR for storage, retrieval and share. The EPR records all patient information such as biographical, medication, radiographic, visitations, treatments and consultations between a patient and hospital staff. It allows for patient information to be stored, retrieved and shared amongst authorised hospital users at a hospital.

Case study analysis is a deductive-based qualitative and analytical procedure which involves an attempt to understand a pattern while collecting and analysing data. It is designed for the researcher to utilise in developing and understanding a conceptual framework. Interviews of face-to-face nature of clinicians are used. Purposive sampling technique was used in this qualitative approach because of the nature of a research questions requiring in-depth information of EPR, and users. Narrative analysis technique is use because of its suitability for data analysis of case study interviews.

A quantitative pilot survey study using stratified random sampling technique to have a representative of clinicians' population was used. A group-administered questionnaire involving a combination of closed-ended questions of a Likert-scale format are used so as to control the time to be spent by respondents answering the questions. The choice of a descriptive survey over an analytical survey is to identify and count the frequencies of a specific population, either at one point in time or at various times for comparison (Collis and Hussey, 2009: 64). Data analysis requiring the use of the Statistical Package for Social Sciences (SPSS) version 17.0 for windows to make inferences of survey questionnaire data was used.

Chapter five is a detailed presentation, analysis and interpretation of the qualitative interview data. A measurement scale is developed in analysing the data and discussed thereafter.

CHAPTER FIVE – ANALYSIS AND FINDINGS

The chapter five introduced here presents the results extrapolated from the data qualitatively. The analysis (interpretation) and findings chapter has the objective of, first to present the findings, then analyse (or interpret) it to derive meanings in relation to the research study questions and meet the study objectives. Relationships (if any) between themes in understanding the conceptual framework proposed with appropriate findings is also presented.

5.1. Introduction

A quantitative method using a survey questionnaire was applied to the study to test the questionnaire instrument to ascertain its relevance, correctness and reliability of the items and sub-items. This was undertaken in chapter 4 above. The initial pilot study produced low response from clinicians, thus the choice of using qualitative (interview) method to generate the major data for this study. Although a pilot study does not have an objective of testing theory, a model or framework, its main objective of validating the questionnaire instrument is achieved as the questions contained in the survey is clear, understanding and unambiguous. The survey questionnaire is found to be valid and reliable as the qualitative interview questions were directly adapted from it.

A qualitative method using a case study is a common method in information systems discipline because it is concerned with the meaning, and not the frequency of a phenomena being investigated (Jacono, Brown and Holtham, 2011: 58). Jacono *et al*. (2011) continues that the rationale for conducting qualitative analysis is that, given the human capacity to talk, the object of understanding a phenomenon from the point of view of the actors are largely lost when textual data are quantified. In other words, a qualitative method using case study was used to revise and extend an existing theory from practice, before moving onto the testing stage.

In retrospect, the research questions are listed here as a reminder for understanding the entire research study. The research questions for the study are:

1. To what extent does cognitive attributes influence clinician's attitude to use EPR?

This question identifies the various research themes, their linkages to each other as well as how each influences the attitude theme.

2. To what extent does clinician's attitude influence clinician's EPR use behaviour?

The research theme attitude is assumed to influence the use behaviour theme, thus the relevance of this research question.

3. To what extent does clinician's use behaviour impact information storage, retrieval and share purposes?

At this point the research themes storage, retrieval and share are investigated to ascertain use behaviour influence on them. This adds a new dimension to the IS body of knowledge by bringing to fore what EPR was used for and how it was used.

4. How is EPR currently functioning in the storage, retrieval and sharing of patient's record?

This question explains clinicians' use of EPR at current.

The next section will now discuss the interview process to include how the sample size, sampling, and coding is made.

5.2. Interview process

Face-to-face contact was made with the Tygerberg hospital (TBH) management requesting clinicians to participate in the interview in July 2015. Referrals were made by the hospital management to the medical school which hosts active clinicians and hospital registrars that use the hospital's electronic record system. The electronic patient record (EPR) system being used at Tygerberg hospital is called enterprise content management (ECM).

Further interview requests was made to all the heads of department (HODs) of the 5 core departments namely: medicine, surgery, anaesthesiology and critical care, obstetrics and gynaecology, paediatrics and child health. The psychiatry department was further added to expand the variety of clinicians' sample. Most interviews were conducted at each clinician's office, with one at the staff canteen.

The themes used in the interview were identified from the literature in chapter 3 and included here; perceived usefulness, relative advantage, perceived ease of use, job-fit, complexity, facilitating conditions, affect and use behaviour. The themes storage, retrieval and share are added to the study to

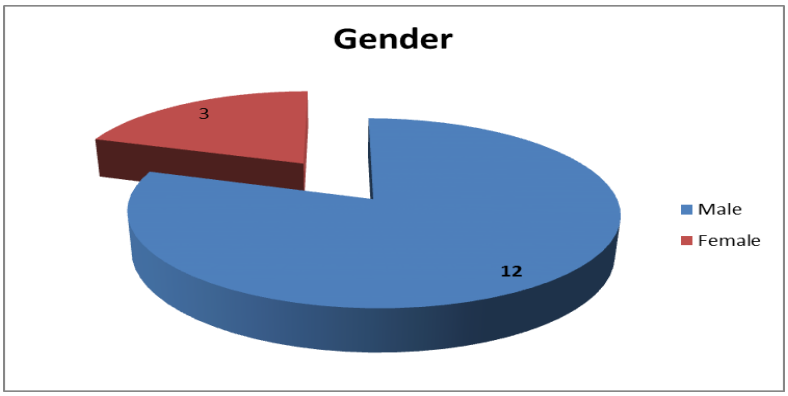
explain in detail the technology use framework specific to Tygerberg hospital. An explanation of how the sample size is found is contained in the next section.

5.3. Sample size

Ninety-nine (99) clinicians from the 5 core medical departments were contacted via their emails for interviews. One physiotherapist who also uses ECM was contacted making the total clinicians sample 100. Fifteen (15) clinicians were interviewed (see Table 5.1, p. 135) on the ECM system used at Tygerberg hospital. Each interview lasted between 20-30mins depending on the length of discussion and clinician's time availability. A consent form was issued to each clinician for signage. The consent form contained clinicians' participation guidelines (see appendix G). All clinicians interviewed read and understood that their participation is voluntary and no financial benefit will accrue from participating.

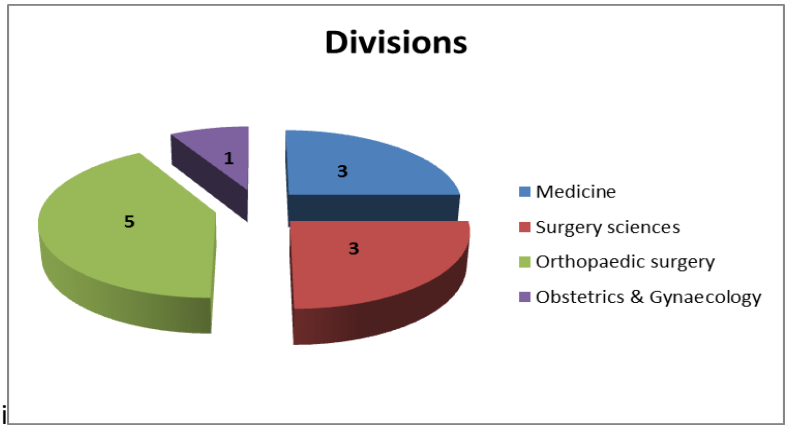
The demographics of the clinicians did not indicate any impact on their attitudes or behaviour using ECM. This was discovered in the pilot study thus not taken into consideration in the qualitative interview. Notwithstanding the gender of clinicians is shown here in Figure 5.1.

Figure 5. 1 Gender



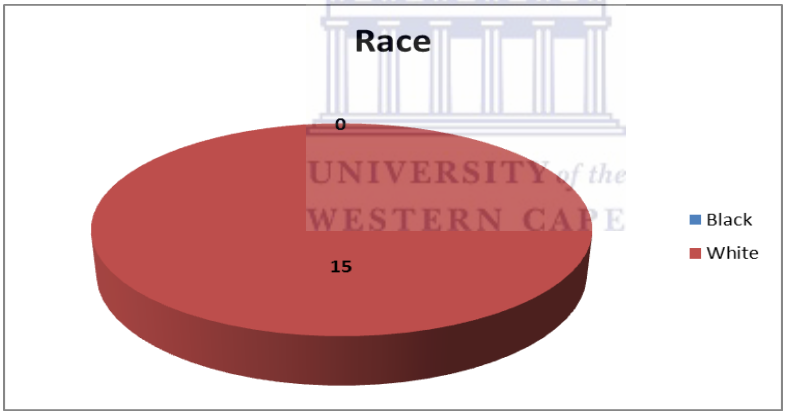
There were 3 female clinicians and 12 male clinicians interviewed. All female clinicians were in the orthopaedic division while their male counterparts were from different divisions as shown in Figure 5.2.

Figure 5. 2 Male clinicians' specialisations



Race did not impact the study in any way. Race was classified into Black and White. Black represents Africans, Coloureds and Indians in this study. Race is highlighted in Figure 5.3 below

Figure 5. 3 Race



All 15 clinicians who availed themselves to be interviewed for this study were Whites. Clinician's years of using ECM, work experience(s), qualification(s) and ages were not asked nor taken into consideration. A reason being that the pilot study results indicated that the amount of time using ECM, work experiences, qualifications obtained and ages did not impact ECM use. All clinicians had a University medical degree which is a minimum requirement to be in practice and a criterion for participation in the study. A University medical degree (MB, ChB) is a University medical bachelor degree comprising of a six (6) year training followed by two years of internship and thereafter a year of community service. Three (3) interviewees were professors of which two (2) were HODs in their respective divisions.

Table 5. 2 Divisions and number of interviews

Divisions	Contacted	Responded	Declined	Interviewed
Medicine	3	3	0	3
Surgery sciences	35	5	1	3
Orthopaedic surgery	31	5	1	8
Anaesthesiology and Critical care	2	0	0	0
Obstetrics and Gynaecology	1	1	0	1
Paediatrics and Child health	25	2	0	0
Psychiatry	2	2	0	0
Physiotherapist	1	1	1	0

One hundred (100) clinicians were contacted, 19 responded to the invitation to participate, 3 declined while 15 were eventually interviewed. The email invitations were repeatedly sent to clinicians over a period of 7months (August 2015 to February 2016).

5.4. Sampling

Purposive sampling is proposed for clinicians (chapter 4) to be interviewed qualitatively while stratified sampling is proposed for the pilot study in chapter 4. The purposive sampling technique allows the researcher to choose respondents from a wide variety of clinicians. For this reason, a respondent was contacted from each department for an interview. Snowball sampling was later introduced as complementary to purposive sampling because it offered a way to overcome many of the selection challenges associated with reaching difficult to-reach clinicians to partake in the research (Sadler, Lee, Lim and Fullerton, 2010).

Snowball sampling according to Sadler *et al.* (2010: 370) has the advantages to shorten the time and diminish the cost required to assemble a participant group of sufficient size and diversity to be representative of the specific target group. It also enables the researcher to identify study participants

where there are multiple unique eligibility requirements; each study participant's eligibility criteria involves characteristics that are unique (e.g. participants must have a tertiary degree, be a practicing clinician and must be using the ECM system). The snowball sampling strategy finds an individual (the "source", also referred to as the "seed") who has the desired characteristics and uses the person's professional networks to recruit similar participants in a multistage process (Sadler *et al.*, 2010: 370). In addition, Sadler *et al.* (2010: 371) continues that some disadvantages would include its non-probability nature; that is selection of participants is not random. This exposes the sample to bias while another disadvantage is its tendency to generate a sample that is unbalanced in selected clinical characteristics. For example there were more orthopaedic surgeons sampled than general practitioners (GP) or paediatricians.

Snowballing is advantageous and more reliable and serves to counter against the problem of small sample size. The difficulty of accessing clinicians at their work space contributes to the problem of small sample size and the lessons learnt from the pilot study were motivators for inclusion of this sampling strategy. The section below will discuss the data credibility and dependability of the qualitative study.

5.5. Credibility and Dependability of qualitative data

Credibility and dependability in qualitative research is synonymous with validity and reliability in quantitative research as highlighted by Golafshani (2003: 601). To ascertain the credibility and dependability of the qualitative research method, trustworthiness was used as a measuring scale. In addition, a demonstration of credibility should be sufficient to establish the dependability of the qualitative data and process through examination of raw data, data reduction products, and process notes according to Golafshani (2003: 601).

In understanding credibility and dependability in qualitative study, Golafshani (2003: 601-602) says;

> *"since there can be no validity without reliability, a demonstration of the former [validity] is sufficient to establish the latter [reliability;]".*

Thus a demonstration of the credibility of the qualitative study inquiry is sufficient to establish its dependability.

Suffice to the above statement, the trustworthiness as a measurement scale was applied to establish credibility and dependability of this study. Krefting (1991: 215) lists truth-value, applicability, consistency and neutrality as four (4) trustworthiness criteria (Guba's model) applicable to assessing the research. Each of the four criteria will now be discussed below.

5.5.1. Truth-value

Truth-value (also termed credibility) asks whether the researcher has established confidence in the truth of the findings for the subjects or informants and the context in which the study was undertaken (Krefting, 1991: 215). The author concurs that truth value establishes how confident the researcher is with the truth of the findings based on the research design, informants, and context. In this study, truth-value was obtained from the discovery of clinicians' experiences as they are lived and perceived. The researcher is confident of the value of the evidence presented by clinicians as ECM issues warranted their participation in the study. The ECM issues frustrate clinicians and the independence of the researcher allowed them to freely participate.

5.5.2. Applicability

This refers to the degree to which the findings can be applied to other contexts and settings or with other groups; it is the ability to generalise from the findings to larger populations (Krefting, 1991: 216). Applicability is also termed transferability. The data collected and presented in this study has the characteristics of generalisation since clinicians in public hospitals in the Western Cape Province where ECM is installed are homogenous and their work procedure and work settings are similar. Though the research sample size is small, the frustrations expressed by clinicians interviewed can be generalised across other clinician groupings exposed to ECM at different hospitals.

5.5.3. Consistency

Consistency (also termed dependability) is whether the findings would be consistent if the inquiry is replicated with the same subjects or in a similar context (Krefting, 1991: 216). The findings in this study will be consistent if same study is replicated as ECM operates in the same way (including issues identified) at every hospital where it is installed. Clinician's workload is similar and so work schedule

(i.e. low clinician-patient ratio, long hours) are similar across public hospitals, thus findings will be consistent.

5.5.4. Neutrality

Neutrality refers to the degree to which the findings are a function solely of the participants and conditions of the research and not of other biases, motivations, and perspectives (Krefting, 1991: 216-217). The researcher was free of bias by decreasing the distance between him and the research participants, for example shorter contact sessions during interviews. The independence of the research allowed for fairness in questioning and judgement, neutrality. This is because the researcher has no affiliation with both the clinicians and their employer.

The four (4) criteria adopted from Guba's model indicate that the trustworthiness of the qualitative data, method and analysis process are all credible and dependable. It means the data is sufficiently credible and dependable enough to meet the study's objectives. Credibility and dependability of the data is further tested using the techniques mentioned below. These include triangulation, disconfirming the evidence and a thick, rich data description. Since the aim of the study was to explore clinicians cognitive attributes towards ECM use, probing for deeper understanding (Golafshani, 2003: 603-604) was undertaken. Each of the test technique is mentioned in the next section below.

5.6. Credibility and dependability testing

Since the aim of the study was to explore clinicians cognitive attributes towards ECM use, probing for deeper understanding (Golafshani, 2003: 603-604) is undertaken using the three (3) tests.

5.6.1. Triangulation

Triangulation in general is a strategy (test) for improving the credibility and dependability of this qualitative research or evaluation of findings according to Golafshani (2003: 603). In his view, the methods chosen in triangulation depend on the criterion of the research. The criterion of the study understands clinicians' cognitive attributes in using ECM. Additionally the clinicians must currently be using ECM for their work task. A public hospital with diverse clinical specialists is also a criterion.

In establishing triangulation, convergence among multiple and different sources of information (different clinicians) to inform themes or categories in the study is conducted. A popular practice according to Creswell and Miller (2000: 126-127) is for qualitative inquirers to provide corroborating evidence collected through multiple methods, such as observations, interviews, and documents to locate major and minor themes. Themes were identified in the literature and interview data from multiple sources was used as evidence(s) in converging data under each theme. Additional sub-questions were asked in the same format during each interview session. The narrative account is reliable as the researcher applied this converging process by relying on multiple forms of evidence (from multiple and diverse participants) rather than a single source or data point in the study. Data triangulation involved the use of different data sources, that is, clinicians of different specialties such as orthopaedics, gynaecologist, cardiologists and general medical practitioners. Tygerberg clinicians are similar but very different. Their similarities involve education and training to become clinicians. Their differences are that, each specialises in a specific function. For example, a cardiologist treats heart-related issues and so cannot be tasked to undertake a function involving hand injury as it is the function of an orthopaedic surgeon. Within orthopaedic for example, there are different specialisations e.g. hand, head, leg and so on. For these reasons, data triangulation was the more appropriate strategy (test) for improving the credibility and dependability of this qualitative research as the data sources are different and obtained at different times of the study. Triangulation was also used to enhance the study's generalisability and transferability. It also strengthens the study's usefulness for other hospital settings accordingly (de Vos, Strydom, Fouche and Delport, 2007: 346). Themes identified in the theoretical literature are included to corroborate interview data. The other test used is disconfirming the evidence which will now be discussed below.

5.6.2. Disconfirming the evidence

Creswell and Miller (2000: 127) argue that this process involves investigators first establishing the preliminary themes or categories in a study and then search through the data for evidence that is consistent with the theme or disconfirms the theme. Themes are identified from the theoretical literature (chapter 2) and the data was examined to confirm or disconfirm the evidence.

Each interview quote is categorised under an identified theme. Each clinician is asked a question directly related to understanding each theme. Additional sub-question(s) is sometimes asked to get clarity on a theme and elicit deeper understanding. Every theme has a proposition(s) proposed which is then applied in the disconfirming or confirming using the evidences (interview quotes) presented.

Disconfirming or confirming the evidence will further provide support of the narrative accounts' credibility because reality, according to constructivists like Creswell and Miller, is multiple and complex. The evidences were either confirmed or disconfirmed in relation to a theme based on its analysis. The third test is a thick, rich data description which will be discussed below.

5.6.3. A thick, rich data description

Thick, rich description is a test used to describe the setting, participants, and the themes of a qualitative study in rich detail (Creswell and Miller, 2000: 128). Thick, rich descriptions are deep, dense and detailed accounts with a purpose to create authenticity. Respondents' statements should produce for the readers the feeling that they have experienced, or could experience the events being described in the study by the researcher (Creswell and Miller, 2000: 129). Description of the setting (Tygerberg hospital), clinicians' experiences and each explanation is detailed in chapter 4. Description of the themes was made in chapter 3 and they are perceived usefulness, perceived ease or use, relative advantage, job-fit, complexity, facilitating conditions, affect, use, storage, retrieval and share.

Based on the contents of above, the researcher now presents a discussion of the empirical findings below.

5.7. Presentation and interpretation of findings

Clinicians interviewed were asked about their general understanding of what an electronic record system is, how they accessed it at the hospital, its name(s), and what they currently use it for. Another question was included that asks clinicians what the ECM they use at work is. Some examples were introduced to facilitate more responses with regards to what they use ECM for. For example, clinicians' were asked if they used ECM for the review of patients problems, check and sign typed dictations, collect patient information for discharge reports, enter daily notes, write prescriptions and sick leave notes. The interview questions that were used during the data collections is found in Appendix F.

Additional questions asked included providing an explanation of ECM use with regards its usefulness to their work, relative advantage, job fit, ease of use, complexity, affect, facilitating conditions. For each of these, clinicians' opinions and views were sought. In addition, clinicians' were asked to describe ECM use (if any) for storing, retrieving and sharing of patient information. General questions

regarding ECM were asked, for example clinicians were asked about their general satisfaction with ECM and asked to rate it from 1 to 10 (1 being lowest and 10 being highest). Permission was sought for a follow-up interview by researcher if and when necessary.

All interview questions were adapted from the survey questionnaire with few additions such as, explain more, give example, describe and so on. These changes were mainly of the language and tenses. The coding of the data will now be presented in the next section.

5.8. Coding

Coding is how you define what the data you are analysing are all about, says Gibbs (2007: 38). In order words, it is a way of indexing or categorising text in order to establish a framework of thematic ideas about it. All interviews were tape-recorded using a digital recorder, transcribed verbatim and coded under individual themes. Digital recorder has the advantage of playback to listen to interview recording when researcher is not clear of words pronounced or understanding a quote. It has the disadvantage of unnerving participants as indicated by de Vos *et al.* (2007: 298). In this study, all participants were comfortable with the recording of the interviews. Interviewee identities were coded as follows:

Table 5. 3 Interviewee identification and dates of contact

Interviewees ID	Department/Division	Date of interview	Place of interview
GT	Obstetrics/Gynaecology	14/09/2015 at 10am	Office
RM	Medicine	14/09/2015 at 2pm	Office
SH	Abdominal surgery	23/09/2015 at 11am	Office
TG	Medicine	29/09/2015 at11am	Office
AP	Cardiology	30/09/2015 at 9.15am	Office
JL	Abdominal surgery	30/09/2015 at 2pm	Medical school canteen
ZK	Trauma surgery	01/10/2015 at 12pm	General staff office

JR	Orthopaedic surgery	21/10/2015 at 1pm	General staff office
SP	Orthopaedic surgery	21/10/2015 at 2pm	General staff office
EB	Orthopaedic surgery	21/10/2015 at 2.30pm	General staff office
NT	Orthopaedic surgery	29/10/2015 at 10am	General staff office
IR	Orthopaedic surgery	29/10.2015 at 11am	General staff office
DH	Orthopaedic surgery	29/10/2015 at 12pm	General staff office
MT	Orthopaedic surgery	29/10/2015 at 12.30pm	General staff office
JT	Orthopaedic surgery	10/11/2015 at 1pm	General staff office

Each clinician interviewed is coded using their first name and surname. For example, John Smith is coded JS. This is in accordance with the ethical commitment by researcher to hide the true identity of each interviewee. The researcher signed a declaration with all clinicians interviewed to uphold point 4 of the declaration form which clearly states that, *"your answers will be totally anonymous and your identity will never be revealed under any circumstance"*. All identities are coded for anonymity.

Key words were used for identifying statements and grouped under each individual theme. Each theme was identified and explained in detail in chapter 3, from p. 71. These are perceived usefulness [PU], relative advantage [RA], job fit [JF], perceived ease of use [PEOU], complexity [COM], attitude [ATT], facilitating condition [FC], and use behaviour [USE], storage [STO], retrieval [RET] and share [SHA].

Table 5. 4 Codes used for themes

Themes	Codes	Key words
Perceived Usefulness	PU	Useful, important, necessary
Relative Advantage	RA	Advantageous, better than
Job Fit	JF	Fits into work, fits job
Perceived Ease Of Use	PEOU	Easy to use, not difficult, easy
Complexity	COM	Complex, difficult
Affect	AFF	Interesting, fun
Facilitating Conditions	FC	Support, help, assistance
Storage	STO	Store, input
Retrieval	RET	Retrieve, recover
Share	SHA	Share, distribute
Use behaviour	USE	Use, make use

Each key word was used to identify and categorise statements under each theme. Analysis of the data is presented in the next section and results are explained.

5.9. Analysis of qualitative data

Narrative content analysis was used in the analysis of the interview transcripts. It involves a systematic classification process of coding and identifying themes or patterns as explained by Hsieh and Shannon (2005: 1278). The study is a qualitative approach that uses the interview procedure to collect data.

5.9.1. Case study of electronic patient record

The electronic record system at Tygerberg hospital (TBH) is known as enterprise content management (ECM) system. Clinicians at TBH generally understand an EPR system as an electronic system that contains patients' health information in a digital format and can be accessed electronically via an access point using a username and password and integrated with other hospital systems.

Clinicians were individually asked:

Question 1: In your own words, what do you understand by electronic patient record

Their verbatim expressions are captured here:

> *"basically an electronic system….that you will enter most of the information of patients, the clinical notes electronically and that then you will be able to of course to record it"* (GT)

> *"it's patient details, clinical and laboratory, and other details which have been captured electronically and available electronically and can be accessed electronically and can be submitted electronically"* (RM)

> *"well basically it's a way of archiving whatever gets y'know, gets written up about a patient, results, investigations or reports of a patient. Everything y'know……..degree gets put in as an electronic input into the system and that then functions as a way of retrieving information about the patient for future reference"* (SH)

> *"….it's an electronic record keeping system which accessible via a password which I think helps abit with confidentiality and it's an easy way to track your patients care and to see what's happen in the previous years as everything's scanned in"* (TG)

> *"that all the records at the hospital and in my mind preferably also the prescribing, everything that's paper based at the moment gets placed on an electronic system that is still restricted access, so it's still patient confidentiality, it's still kind of respected but that everyone has or all the involved party, the treating doctor, the sister have access to it, to go and see the notes there"* (JL)

> *"….its, basically the integration of all the medical information except for radiology of patients into a bigger system, easily accessible to everyone to be complete and to make seeing patients more effectively, faster than before…"* (ZK)

> *".....should be a easily completable, easily so the templated system, it should be easy to fill in, it should be easy to access and it should be accessible from*

everywhere…… I should be able to access it on the internet outside…….. I should be able to access it for various reasons whenever I need to, for research purposes, for things like that and it needs to be current, in order words it needs to be updated, real-time…..: (SP)

Discussions on question one

The researcher is of the view that clinicians at Tygerberg hospital do understand what an ideal EPR system is. An EPR does not have a single definition and its understanding differ at hospitals and amongst clinicians and researchers. A general view and understanding of what clinicians at TBH perceive an electronic system to be is necessary in identifying its characteristics. An electronic system must be electronic (interviewees GT, TG, JL). It must contain all patient medical information (interviewees GT, RM, SH, TG, JL, ZK). It must be able to capture information electronically (interviewees GT, RM, SH, SP). Secure access is necessary (interviewees RM, TG, JL, ZK, SP). Storage is possible (interviewees GT, RM, SH, JL). Retrieval should take place (interviewees RM, SH, TG, JL, SP). Sharing information can be undertaken (interviewees RM, JL, ZK). It also needs to be able to process information for management use (interviewee SP).

From the individual statements above, an electronic patient record system is understood to be an electronic system with the capability to store, retrieve and share patient information (Mostert-Phipps *et al*., 2013), securely accessible and be able to process information for use in operational and decision purposes (Abdullah, 2007: 7-8) by its authorised users.

An electronic record system (termed EMR) within a SA context and understood by a researcher such as Weeks (2013: 138) is a system that represents a departure from traditional paper record keeping in that, it includes patient demographics, medical histories, and all records of patient treatment stored in a computerised format. Weeks (2013) understanding is within the context of what clinicians' understand EPR to be. Other researchers such as Mostert-Phipps *et al*. (2012: 328) indicate that electronic record system (which they term EHR) is a longitudinal collection of health information about an individual that has been aggregated from various data sources. Their understanding surpasses Weeks (2013) because it encapsulates all medical information, past, present and future from all health facilities visited by a patient. Clinicians' understandings of EPR are intertwined with the understanding of this

study's researcher and also in-line with this study's EPR working definition (chapter 2, section 2.4.1.2) which is,

> *"a repository of information regarding the health status of a subject of care in a computer processable form within a health facility, stored, retrieved and transmitted securely, and accessible by multiple authorised users".*

The researcher in this study argues that this repository in the case of ECM should also include laboratory and radiology results. Blood tests results for example, involve laboratory experiments which a clinician can use to diagnose and treat a patient. X-ray results are gotten from radiology scan which contain information that can also be used for diagnosis and treatment. Authorised access to ECM by nurses (as JL suggests) is indecisive as nurses do not diagnose and treat patients. This does not compromise their role as healthcare practitioners. Tygerberg hospital has about 2,500 permanent, contract and temporary nurses so security of patient information will be compromised if nurses were to have access to ECM containing such information. Also the fact that nurses are not trained to diagnose and treat patient is a reason to exclude them from gaining access to ECM.

A further question was asked to clinicians:

Question 2: What is the name of the system you currently use at work?

They all said ECM but most do not know what ECM stood for. It stands for enterprise content management. Some clinicians understand ECM to be:

> *".....a patient record that's digital and that is y'know kept up to date so every time you see a patient we make digital notes set on a central server and then obviously everybody can access it real time as soon as its up…….the ability to edit it y'know over time so longitudinally we can edit those notes and change it as the patient's condition changes……"* (AP)

"……..so what they have here its they, all the old notes, they basically scan into the system so you can just get old information from it" (EB)

"……basically the written notes and you digitise them afterwards and they are available on the computer as records instead of microfilm or paper" (JR)

Discussions on question two

In Weeks (2013: 143) investigation, he found that the Western Cape Department of Health first deployed the ECM system at the Forensic Pathology Services, as well as within the oncology unit at Tygerberg Hospital. It is called the enterprise content management system which was subsequently rolled-out at the Khayelitsha district (KDH) and Mitchells Plain (MPH) hospitals.

The study researcher is of the opinion that ECM should be a real-time repository of medical notes containing continuous health information of a subject care in a computer or digitised form within a health facility, stored, retrieved and shared securely and accessible by multiple authorised users. The system in its current form lacks the capabilities to process information real-time and is non-integrated.

The ECM system in particular and the other individual systems at Tygerberg hospital (TBH) currently have the characteristics of access using individual unique username and password as RM describes it;

"…….you're given a username and password and that gets you into the patients file"

A unique username and password is a standard procedure and process required to gain access to ECM. Every clinician is assigned a unique username and password and this is typically allocated by the ECM system administrator.

Clinicians were further asked:

Question 3: Do you have access to EPR? How? E.g. using password, username?

They described their access saying:

> *"username, password and then you have access points in outpatients….."* (GT)
>
> *"we have standard usernames but we've now moved away from that. We now have personalised usernames"* (GT)
>
> *"username and a password so you open up any of the hospitals desktop computers and there's an icon that you can click for ECM, put in your personal number or your password and then you have access to the system"* (SH)
>
> *"…….username and password so we know who's made the notes and it gives you a sort of a record or history or timeline's of who's changed, who's made notes when……the patient has been seen"* (AP)
>
> *"we have a username and a password that we type in. it's on all the computers, I can't think of one that it's not on, it's on all the computers, username and password and then we're on the system"* (JL)
>
> *"….there's a username and password……it changes every 3months so then you really have to re-activate it in some other way…."* (ZK)
>
> *"yes, so username and password expires frequently……"* (SP)
>
> "*….you actually access via the intranet and you access it via a password……."* (JT)

Discussions on question three

Access to ECM is restricted to authorised users only, clinicians. This is synonymous with all electronic systems holding sensitive information such as a patient medical history. Protecting patient data is at the heart of electronic records systems. Security of any electronic system is paramount to its success. Adesina *et al.* (2011: 4) in their research, noted that, data security requires three (3) basic elements namely; data confidentiality, data integrity and system availability. In their view, hospitals must process all confidential data so that it is not disclosed to those to whom it should not be, whether the disclosure is accidental or malicious. Secondly, protecting the integrity of data means ensuring that

the recorded information is correct and is not in any way corrupted. And lastly, electronic systems should be available to users whenever the need arises because they enhance information sharing by clinicians (Adesina *et al.*, 2011: 5).

The use of unique (personalised as GT claims) username and passwords is a simple way to safeguard patient data from unauthorised persons gaining access. These access codes may not be sufficient enough to protect patient's data as they need to be frequently changed or continuously strengthened. Analysing clinicians' comments, the study researcher agrees that access codes were designed with good intention to safeguard and protect patient data but the frequency of change is not in sync with clinicians' expectations and is a source of concern. Also the different hospital systems each require its own unique individual access thus making clinicians have multiple access codes for each system and a reason to mix access codes or forget some of them.

For example, the frequency at which the passwords change for accessing ECM is quick (3months according to ZK). A clinician can easily forget his/her password coupled with the fact that the same clinician needs additional passwords to access the other hospital systems. This can lead to frustration, reluctance and resistance to want to efficiently use ECM.

In a SA hospital context, Adesina *et al.*, (2011: 7) suggests that the implementation of digital watermarking should be complemented with data encryption mechanisms to improve the assurance and integrity of the data stored, retrieved or transmitted across electronic devices. These should be undertaken at the digitising phase (or transforming phase) from paper record to electronic record-keeping.

An additional question is asked which is:

Question 4: What other systems do you use at work other than ECM?

Other systems identified by the study researcher used in conjunction with ECM include DISA, PACS, iSite, Clinicom and Trackcare. The full meanings of the acronyms DISA, PACS and iSite are not available to clinicians. The PACS system for example, is for access of radiology (x-ray) results, Trackcare system is for laboratory results while the DISA was a prior system to the current ECM

system. These systems all require access codes according to clinicians because they all function differently. Each system access code is separate from ECM code as clinicians explained:

> *".....we've got a PACS system which is a system that allows us to order x-rays online....get the results of the results of the x-rays and radiology online as well so we don't have to send in requests, that is done electronically. And then the final system that we got is for patients biochemical results which are called the Trackcare system, it's come online in the past month or so, that's come online, that allows us access to patients laboratory results...."* (RM)

> *"...then there is a system, PACS system from which we access radiology reports and pictures or scanning volumes and that has a different username and password but that's more or less generic one for each division and then there's also the, obviously the lab results that we get electronically as well. So for the NHLS system there's this new thing called Trackcare and you use, have a unique per individual username and password for that which you then can get any investigation in the country if you can input the patients file number"* (SH)

> *"....other system is your laboratory system, Trackcare and we've got DISA as well so those are 2 separate systems which I can access anywhere in the hospital as well at any time also password driven....."* (TG)

> *"But accessing our radiology is a different system. And accessing our labs results is a different system"* (JL)

> *"And the Trackcare is a little bit easier than lab system because then you use your persal number....."* (ZK)

In continuation, the study researcher found out that other systems are being developed or already developed by clinicians to aid their work owing to ECM shortfalls. Some clinicians put it this way:

"it's difficult to get continuity of patient so we have also got a additional data capturing system called orthoware that we at least got a decent system to fall back on" (JT)

"……the iSite would probably be the most commonly used system here. It's that database and we've got various little databases like we got a orthoware here for orthopaedic cases" (JR)

The orthoware system is only used in the orthopaedic unit by orthopaedic surgeons. It was developed in-house by the clinicians and functions in parallel to the ECM system. This system represents orthopaedic surgeons' perception and expectations of how they want ECM to perform. Incorporating this system into ECM can be considered otherwise identification of some of its features and functionalities that can improve clinicians' work task can be adopted into ECM.

When accessing multiple systems such as ECM, PACS, Trackcare, Clinicom or orthoware, clinicians are required to also have multiple access codes, usernames or passwords for each system. Follow-up question is:

Question 5: Do you have one access code to all systems or multiple access codes? Describe

In response, clinicians explained how each of the system is accessed such as:

"all different and you have to change them, some every 3months, every 6months because we've got another electronic system for radiology, the X-rays which can also be accessed anywhere in the hospital so that's separate one so we've got X-rays, which is electronic, lab systems which is electronic and then we've got the ECM which is more the doctors notes and the summary of the patients consultations, different nursing notes et cetera" (TG)

"There are probably 3 things that we use a lot, ECM is one, then there is a system, PACS system from which we access radiology reports and pictures or scanning

volumes and that has a different username and password but that's more or less generic one for each division and then there's also the, obviously the lab results that we get electronically as well. So for the NHLS system there's this new thing called Trackcare and you use, have a unique per individual username and password for that which you then can get any investigation in the country if you can input the patients file number" (SH)

"we've got many systems, we've got ECM which is the electronic note keeping but then we have obviously a lab system but again no ordering of blood digitally. We have a PACS system for radiology, there you can order the X-ray or whatever special investigation by the, digitally so that has been, that's sort of moved up, it's not integrated so y'know it's different icon for everyone, different username, its very user unfriendly way of doing it" (AP)

"....at the moment we just changed our DISA lab, so I've got 4 that I use at the moment, I for ECM, 1 for the old lab, 1 for the new lab, and 1 for radiology" (JL)

".....same thing. For the radiology, for the path, for laboratories and then for Clinicom which is the sort of....definitely and they don't see each other" (NT)

Discussions on question five

The other electronic systems operating at the hospital have their own unique access codes. The understanding by the study researcher is that these other systems are situated at various areas of the hospital, some of which are not close to clinicians. In treating a patient, clinicians will have to use different access codes to access the different systems, walk across to different systems but still required to diagnose and treat patients in time. This increases their time and workload per patient.

Each system access code is continuously changed to restrict unauthorised access. By this, clinicians' find accessibility a cumbersome and time-consuming procedure and would prefer a system where a single access code will enable them access all the different systems. To achieve this, all the hospital's systems will have to be integrated.

In understanding clinicians' cognitive attributes and its influences on their attitudes towards ECM use, propositions were developed and mentioned in section 5.10, from p.154. This is to ascertain the relevance or non-relevance towards authenticating the conceptual framework proposed in chapter 3, Figure 3.8. The objective of these propositions is to ascertain framework-fit, show relationships between attributes and significance of the relationships. To measure the degree of significance and relationship, a scale is developed and tabulated below.

Table 5. 5 Significance, relationship and framework fit

Impact	**High**	**Moderate**	**Low**
Significance	Significant	Significant	Insignificant
Relationship	Yes	Yes	No
Framework-fit	Yes	Yes	No

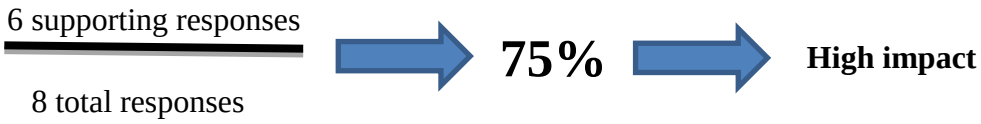
Table 5. 6 Impact determinant

Impact	**High**	**Moderate**	**Low**
Significance Relationship Framework-fit	75% or more of responses that support the proposition	50%-74% of responses that support the proposition	49% or less of responses that support the proposition

Tables 5.4 and 5.5 are measurement scales developed in explaining the impact of the relationships. For example, if 10 out of an overall 15 responses support the proposition, it will be adjudged moderately significant (or significantly moderate). Using the measuring scales above, an example is given below:

$$\frac{\text{10 supporting responses}}{\text{15 total responses}} \Rightarrow \mathbf{66\%} \Rightarrow \textbf{Moderate impact}$$

For 12 out of 15 (80%) responses that support the proposition, it results in a high impact. A third example is if the supporting responses are 7 out of 15 (47%), it results in a low impact. The total responses may vary as not all clinicians responded directly to each question posed but this will not alter the score and result presented. Another example is:



Note - There is no exception to the rule in calculating the above degree of impact but it is of note to avoid misunderstanding of the analysis especially for **complexity and attitude**. Complexity is not positively related to the adoption and use of technology. Attitude on the other hand can be positive or negative. The scales are designed to measure the degree of significance, show relationships and ascertain degree of fit for the framework. The issue of positive versus negative is of no consequence(s) as it only an expression of significance.

The measuring scales will determine the propositions level of significance, relationship and fit The next section introduces the 12 formulated propositions and each individual analysis to ascertain

5.10. Propositions

There are 12 propositions formulated in chapter 1, section 1.6.1. Each proposition will test individual themes to ascertain fitness in conceptualising the proposed framework. Clinicians' comments will indicate level of significance, relationship and fit. Each proposition is discussed below.

Proposition $1_{(a)}$: Perceived usefulness will have a significant impact on attitude toward EPR use.

For proposition $1_{(a)}$, all clinicians were asked about ECM usefulness:

Question 6: Do you find it useful in your job? Explain.

Clinicians' responded saying:

"ya I think it's useful, I think with regards to two aspects we already can report it really works well. And that is the request of the laboratory investigations and the results that you get back" (GT)

"I think we save money, we save a lot of time by in the past we have to phone the laboratory, give the file number, hang on the telephone for ages ultimately to hear the specimen hasn't arrived or something like that" (GT)

"……so if we get a patient that came from a primary care facility through a district hospital through a regional hospital ultimately to us, we have access to all the information and that's very very useful" (GT)

"I think it's a step in the right direction….." (RM)

"it's better than the paper system we had……." (JL)

"I do……" (MT)

Although ECM was perceived to be useful, there were reservations made such as:

"it is useful if it's up to date" (SH)

"very useful but it has lots of, it needs to be improved a lot still" (AP)

Discussions on question six

Not all clinicians perceived ECM useful to their job. Reasons being that usefulness is perceived in different ways by different people. Davis (1989: 320) explained PU as the extent to which people believe technology will help them perform their job better. Six (6) of the total eight (8) responses by clinicians are positively favourable towards ECM. Some clinicians perceive ECM to save money, time and a better access.

The study researcher observed from the perspectives of different clinicians that PU is determined by what it helps them do the best. The fact that ECM relieves the burden of having to walk to the record store to retrieve patients' file each time they want to review information improves their attitude to

want to use ECM more. This attitude becomes positive. ECM allows for quick access. Also the fact that after treatment, access to their clinical notes is no longer possible; ECM becomes their only source of access.

Using the measuring scale in Tables 5.4 and 5.5, for proposition $1_{(a)}$, PU is found to have a significantly high impact on clinicians' attitude towards EPR use. Proposition $1_{(a)}$ obtained a 75% (6/8) supportive response. Moon and Kim's (2001: 224) study on extending the TAM for a World-Wide-Web context concurs with the findings of this study in that, they found a significantly positive relationship between PU and ATT towards technology use. De Veer and Francke (2010: 850) in their study had an objective to obtain more insight into the usefulness of EPR as perceived by nursing staff and to clarify the determinants of nursing staff's acceptance of EPR. They also found that PU had a statistically significant individual relationship to ATT towards using EPR. Their data confirmed that nursing staff members who believed that EPR improved the quality of care, reduced the cost of care, increased the number of patients that can be cared for, or improved work circumstances showed a more positive attitude toward EPR use.

Clinicians' are positive that ECM is useful as it has the potential to meet their work needs in providing better service to patients. Clinicians' attitude towards ECM is positive thus a reason for their use since it meets their expectations and perceptions. The fact that ECM is perceived as useful by most clinicians' irrespective of its issues is an indication that ECM is acceptable.

Proposition $1_{(b)}$ assumes there is a significant relationship between PU and USE as explained in the next section. There is no single direct question asked here since clinicians were responding in detail to question 6.

Proposition $1_{(b)}$: Perceived usefulness will have a significant impact on EPR use.

In response, an additional question asked is ECM usefulness in clinicians' day-to-day tasks. Clinicians' perceived ECM usefulness as;

"it is useful" (TG)

"I find it potentially useful……. " (EB)

"I find it very useful for a number of reasons. Firstly we find that most of the pages don't get lost so it's useful in that regard, y'know in the public hospital a lot of things get lost especially if it hasn't been used for a couple of months. Secondly the patients don't come with very thick files……." (JR)

"yes…….so in terms of having access to old notes, definitely it's been very useful purely from that set" (DH)

Other clinicians' explained ECM usefulness as;

"yes and no. Frustrating atimes because you have to go through, if you open the folder and it says there are 50 notes, you have to physically go through 50 slides to get to what you're looking for but once you have it its useful" (ZK)

"no but that's because, that's just because of the time issues, nothing wrong with the program" (SP)

"no……. it doesn't help me with research, it doesn't help me with creating summaries or anything like that, it's purely a note keeping system" (NT)

"useless……. because there's no continuity, you see a patient now, you see him again in a week later for follow up, all ECM notes is not on, you can't find it, you must go there for this date, there for that date, it's a mess…." (JT)

Discussions

To perceive ECM as useful directly influences its actual use. If clinicians' PU is positive then it motivates them to use. So the more a clinicians' PU of ECM is, the more s/he will use ECM. For this proposition, there were 4.5 positive responses out of 8 which amount to 56.25%. In summary, proposition $1_{(b)}$ indicates that PU has a significantly moderate impact on EPR use.

In support of the claim above, Jian, Syed-Abdul, Sood, Lee, Hsu, Ho, Li and Wen (2012: 283) explored the factors influencing behaviour and adoption of USB-based Personal Health Records (PHR) in Taiwan. They found evidence that PU affected technology use (which they termed adoption

behaviour) positively. Subsequently, Yang and Yoo's (2004: 26) study concurs with Jian *et al's* (2012) study as they found PU has a direct influence on technology use.

The study researchers' view is that, although clinicians' perceive ECM to be useful, their actual use is somewhat moderate because of ECM teething problems. Some of these problems include ECM inability to function efficiently as it lacks continuity where information is not real-time so clinician's cannot access patient information immediately after treatment. Another reason is it lacks the capability to process information thus functioning as an archiving or note-keeping system.

Clinicians look forward to using ECM to process data for research purposes. Its inability to display information according to how clinicians want it using the search and find function is frustrating to clinicians; a reason for the use of the word "useless" by one clinician.

In understanding clinicians' perceived ease of use having an impact on their attitude toward EPR use, clinicians' were asked:

Question 7: Do you find it easy to get the system to do what you want? Example

Proposition $2_{(a)}$: Perceived ease of use will have a significant impact on attitude toward EPR use.

Comments made include;

> *"yes it's pretty easy, y'know once you've logged in……."* (RM)
>
> *"ya I think it's easy, it's very, the interface is well designed, it clearly state where you can go……."* (SH)
>
> *"Because I am techno savvy, it's very easy for me to use electronic systems and I am very open minded to it but not everybody is like that"* (TG)
>
> *"relatively easy"* (AP)
>
> *"very easy to use, yes…."* (JR)

Discussion on question seven

Having obtained 5 positive responses out of 5total responses, it amounts to 100%. This means for proposition $2_{(a)}$, it indicates that PEOU has a significantly high impact on clinicians' ATT toward ECM use. Moon and Kim's study (2001: 224) investigates PEOU and PU to be fundamental in determining the acceptance and use of various corporate information technologies and found that, there is also a significant positive relationship between PEOU and ATT toward technology use. Continuing, Porter and Donthu (2006: 1000) investigated the use of technology acceptance model (TAM) to explain how attitudes determine internet usage and found that the more that an individual perceives the internet as easy to use (PEOU), the more favourable that individual's attitude (ATT) toward use of the internet.

Clinicians according to this study's researcher have a positive attitude saying ECM is easy to use. Their positive attitude enables them to use the ECM system irrespective of its shortcomings. It is also because all clinicians are computer literate thus minimising the effort required to learn, re-learn and use ECM. This is not to exclude the fact that hospital policy and procedure mandates them to use ECM as paper notes become inaccessible after patient treatment.

Even though ATT changes quickly according to Yang and Yoo (2004: 26), continuous efforts should also be given to maintain the attitude because it is temporary, unstable, and malleable. The issues associated with ECM should be attended to by management as clinicians are already burdened with so much workload, their frustrations can only be further tested even though they still perceive ECM to be easy to use.

For proposition $2_{(b)}$, clinicians were asked similar question to proposition $2_{(a)}$ on the ease of using ECM. Additional probing question is asked as discussion progressed.

> **Proposition $2_{(b)}$: Perceived ease of use will have a significant impact on perceived usefulness.**

Comments were:

".....accessing guideline document that have been pasted into a specific folder are easy, navigating through the interface is very easy, it's very plain, it's on windows, everybody understands windows……." (SH)

"ya its user friendly……." (ZK)

".....it's not difficult, it's easy to get because you have to type in a folder and it gives you a list of PDF documents then you got to work through each PDF document which is may not be labelled correctly....." (SP)

"…….its easy interface to use yes, I know I mean I was shown how to use it once and its quite easy to know what to do with it but it's just like I told you before" (EB)

"yes, for me obviously from the point of view of just reviewing notes its fairly simple, I mean it's a simple log in, put in the folder number and everything's there ……..I think it's actually very easy even for a person who's not tech savvy to use it" (DH)

Few clinicians had complaints such as;

"no it's not easy to use. It's not simple, it's not searchable so in my mind most data paperless data capture system should be searchable, this is not, I can't, and the fact that it doesn't see the other systems makes it very cumbersome so I have to log into all different systems to get all the patient information" (NT)

"no, it's very difficult, you struggle to find the patients continuity……. it's very difficult to make sense out of. I have to literally each time I see a patient, I have to go through everything again and then try and make a summary of everything" (JT)

Discussions

The analysis produced 5 positive responses out of 7 in total. This amounts to 71.4% in the measuring scales highlighted in Tables 5.4 and 5.5. Proposition $2_{(b)}$, is supported, that is, PEOU has a

significantly moderate impact on PU. Saadé and Bahli (2005: 324) in their study on the impact of cognitive absorption on PU and PEOU of use in on-line learning using the technology acceptance model also supports this proposition. Their findings reveal that PEOU had a positive effect on PU.

The ECM system is easy, but only because clinicians are able to perform one or more tasks with it. But its ease is limited as other important functions such as search-ability and processing makes it difficult. But it is noteworthy to mention that the ease to learn, understand and use ECM is a direct reason why clinicians still find it useful. Typically people generally perceive a system to be useful if they can easily manipulate it. This is no different in clinicians' case as their ability to use ECM for a task is a precursor to perceiving it as useful. It even becomes more useful when a clinician gets better in manipulating ECM for a task. This motivates the clinician to improve on the skill of using ECM for that task. Practice makes perfect so the more a clinician improves on using ECM to undertake a task, the easier ECM in whole is perceived.

Proposition three (3) investigates RA and its impact on attitude to use ECM. Clinicians were asked:

Question 8a: Using it enables you improve the quality of the work over paper. How?

Question 8a was rephrased so that clinicians' would understand the question clearer. Question 8b was similarly asked:

Question 8b: Do you find ECM having any advantage over any prior system you have used in the past?

Proposition 3: Relative advantage will have a significant impact on attitude toward EPR use.

Clinicians commented:

> *"So I think there certainly are advantages, definitely there are advantages of the whole system"* (RM)

"ya I think we're moving in the right direction, yes, y'know I think it's good to go paperless because I think the chance of you losing critical documentation is much less" (SH)

"yeah, we didn't have electronic systems beforehand, it was paper based. We had to get the whole folder from records, we had to go through these whole folder like this, which was unorganised try and look for the results. So this is the first electronic system we actually have patients' notes" (TG)

"yes it's much better than the previous system, much better……..its instant, its real time, it's not handwriting-dependent and we can track what people do so no its much better than the previous system" (AP)

"I would say yes, difficult handwritings, well they're scan in so that isn't really take that away, I think there's an advantage yes……" (ZK)

"the big advantage with ECM is the fact that notes are gone where any paper based system especially in this age a lot of times the patient would have to open a temporary file because the old file is missing again" (EB)

"definitely" (JR)

"yes" (JL)

"well its better than having a file that gets missing….. (NT)

"yes I think so……..some pages are faded y'know as paper will do that sort of thing whereas at least once somethings being captured in the ECM…….so I definitely think from that point of view it is an advantage…….also, there's never a question of we cannot find the folder or y'know because it's an electronic system, it's always there. Once it's there is always there so that I, definitely think that's an advantage" (DH)

To some clinicians, ECM does not necessarily have an advantage:

"….the previous system we had a scanned system so they put in unto microfilm, we had microfilm readers. So if a folder got too big it was eventually microfilmed the whole folder so you would get, so the folders weren't too big so it was a paper based system and they microfilmed them which is ECM is doing exactly the same thing so there's absolutely no change on the old system from there….." (SP)

"……but this is now almost a step back I think because they implemented this scanning system and I think they should have rather gone for the proper paperless system which has got dedicated forms that are searchable and easy to fill in" (NT)

"no I don't think so I mean, yes it was, it was frustrating possibly to wait for files and yes paper copies can get lost but this does not save time in the sense……. It is improving but I don't seem to think, I can't find, the current system we have now there's not much advantage" (MT)

"…….the old, even the imperfect old notes system that we literally wrote notes was much better because that continuity, you can go to your old notes and so forth" (JT)

Discussion on questions eight

Proposition 3 has 10 positive responses out of a total of 14. Using Tables 5.4 and 5.5 as measurement scales, it amounts to 71.4%. The proposition that RA has a significantly moderate impact on attitude toward ECM use is accepted. The ECM system has significant advantage over prior system(s) because of its ability to secure patient information and avoid unauthorised access. The ECM system definitely has advantages for most clinicians especially for its ability to securely store records. Patient record is priority and so its safety is considered utmost which ECM undertakes. For this reason, ECM ability to safeguard records outweighs its technical inefficiencies to most clinicians.

The paper-based system still has an advantage over ECM because it provided continuity of care in the past. The study researcher noticed amongst clinicians that, when using paper records, they are still able to access some form of patient information even in the absence of the complete medical history. For this reason, not all clinicians are convinced of ECM has full advantage over other systems (such as

paper) as its continuity of care results in longer turnaround times. Also access to paper records is straight-forward for clinicians. They walk to the record room and retrieve patient record even though it will still take them time to search for the record. For ECM, access codes restrict their immediate access as they first have to find a workable and available computer system, input their access code and then scroll through the entire patient record to find a document. When their access code is faulty, there is no backup information in any format for them to use in the meantime.

The access code itself is complicating because it is created by the system administrator and frequently changed for security reasons but this is not easily remembered especially when clinicians have many more codes to remember. As opposed to the Trackcare system, clinicians' persal number was used which is easily remembered because it is a number that does not change, more easily remembered by clinician and attached to a clinician for life irrespective of location of practice. For these reasons, some clinicians perceive ECM to be less advantageous in operation compared to some other system (and paper) used at the hospital.

In a study by Lin and Chen (2012: 537-538), they investigated perception, attitude and adoption of cloud computing and also found RA to have a significant impact on ATT to use technology on a personal level rather than on an organisational level. This is because their ability to access and also the convenience to use technology is considered important and relevant. At an organisational level, RA had no significance on ATT since research participants were not aware of organisation's service level agreement (SLA) regarding products and services with third parties. Personally having technology was advantageous to the research participants because of its ability to process information much faster and a larger storage capacity.

Proposition four (4) investigates complexity and its impact on attitude to use ECM. Clinicians are asked:

Question 9: Is it difficult to understand the system and how it works? Explain?

Proposition 4: Complexity will have a significant impact on attitude toward EPR use.

The ECM system is perceived as not complex to understand and use even for an ordinary computer user. Clinicians commented here:

> *"I think its very fool proof y'know for the average user. There's a, you can't go and break it or delete documents that are particular"* (SH)
>
> *"very simple"* (TG)
>
> *"So in a way y'know I'd probably say it's not too complex, it's very easy"* (AP)
>
> *"no I don't think it makes the problem worse, no I think, I can understand they're trying to make it better so no no I don't think it makes it worse……"* (ZK)
>
> *"no its not complex at all, it's easy as I said, it's easy to upload……"* (SP)
>
> *"no its not complex at all. I think it's more human error that come in that makes it difficult"* (EB)
>
> *"no it isn't complex"* (JR)
>
> *"it's relatively simple at the moment because it's only the notes"* (JL)
>
> *"it's not complex but I don't find that useful"* (NT)
>
> *"no. I must say for me, I think I've got a reasonable understanding of electronics in the way programs and so on works so I found it to be, I found it to be fairly straight forward……"* (DH)

Complaints about ECM complexity are highlighted as:

> *"it is quite, it can be quite frustrating in the sense of having to read through all the different things because things are incorrectly labelled and the notes are scanned late……"* (MT)

"very…….yes, it makes a simple thing very complex" (JT)

Discussion on question nine

Complexity in this study is the degree to which ECM is perceived to be difficult to understand and use (Sanson-Fisher, 2004: 55). Lin and Chen (2012: 538) states that complexity of an innovation is not positively related to the rate of adoption and use. Using this meaning, proposition 4 did obtain a score of 83.3% from 10 negative responses out of a total of 12 and 16.7% from 2 positive responses. This means COM has a negatively significant high impact on ATT towards EPR use and so the proposition is accepted.

Clinicians perceive ECM not to be difficult to understand and use. This is because the more complex ECM is, the less its use. In this case, ECM system was found not to be complex in both use and understanding but some aspects of its features and functions were frustrating to clinicians. One frustration is the incorrect note-labelling of files which results in clinicians having to go through a patients' entire medical record while searching for a document or item. This issue results in frustration and so clinicians sometimes perceive ECM as complex.

Continuing, Lin and Chen's (2012: 538) study found COM to have a significant impact on ATT to use technology as users felt the technology (cloud computing) is difficult to code, debug and understand especially from a developers point of view. Shih and Fang (2004: 219) concurs with Lin and Cheng's findings as their study investigated internet banking in Taiwan using the decomposed theory of planned behaviour and found COM has a negative impact on ATT to adopt and use internet. Though negative, their perception of a complex innovation will impact their attitude to adopt and use that innovation. For clinicians, the more complex ECM is, the more resistant they will be towards its use. From the findings, it is clear that clinicians found ECM less complex. Their attitude is more receptive towards ECM use because they found it less complex.

Technology such as ECM is still being understood by clinicians so the tendency to experience technical and operational problems is common. Clinicians were asked:

Question 10: Are specific support staffs available for assistance with difficulties?

Proposition 5: There will be a positive relationship between facilitating conditions and attitude towards EPR use.

Some clinicians expressed their views based on their personal experience when they had issues using ECM. They said:

"I have a problem, I go to the nurse in charge, I say sister just help me, this patient had a pap-smear and she said it was done at Bishop Lavis but I can't find the …….can you please check for me whether you can find the results y'know. So I think the support sort of develops spontaneously" (GT)

"the support system is generally good, y'know we had a number, so if we had issue there's a person that was responsible, you call the number the person would come and they will sort you out……..I forgot my password and they were very helpful so I think the support system that was put in place was quite good" (RM)*"*

"ya there's a helpline number, a helpdesk that you can call and they always available and there's also, you can also email people and email is always very good y'know it's a black and white type of question that you generate to them, it's on their system and they usually respond to the emails fairly directly" (SH)

"yeah they gave me good service, it was just slow, it took 3 days, to reset the password because one has to email one person then another person and then another person" (TG)

"reasonable I know them quite well so maybe I have a better experience than other people but in all and all its probably……." (AP)

"yes, when the system came out, they were very good. They came to you at the clinic and tried to get you logged in then after a while once the passwords changed it became more difficult because they couldn't help over the phone then they want you to go and see the IT person" (ZK)

"I actually haven't contacted them. My boss today contacted support because his password didn't want to work and they fixed it for him telephonically" (EB)

"for ECM if we have a problem you log a call or you log a complaint or a problem and I must say in the beginning I used to phone them…….so then I get help quite quickly but it's been frustrating quite a few times with it not functioning well……." (JL)

"ya they're not bad, to call support is not bad. They support fairly quickly and sort things out" (NT)

"a lot of time you can't find them but they are in broad terms available but the problem is the way that they've structured ECM, they cannot help us with these problems currently" (JT)

Other clinicians were neutral in their response owing to either negative or no experience:

"no I've never used the support system……" (DH)

"no I haven't" (MT)

"So the support I find is not adequate" (JR)

Discussion on question ten

Generalised views by clinicians indicate that there is a highly positive relationship between FC and ATT towards EPR use. Of the 13 responses recorded, 10 were positive indicating a 76.9%. Clinicians are mostly of the opinion that support for ECM is adequate and available. The support mainly involved password reset. This is the common issue experienced by clinicians as it's the main reason for contacting support service. Any other issue that may arise will be technical. Facilitating conditions according to Teo (2010: 255) includes but not limited to skills training for clinicians, information or available materials for clinicians to enable them use ECM better and administrative support. The study specifically classifies FC as administrative support.

For the clinicians that have contacted the support team, their experiences were positive in many ways and they were satisfied. For a system such as ECM, technical support is very important since the system was used on a daily basis. Standby support may be necessary to enable ECM continuously

function efficiently. It indicates that if adequate support is provided then clinicians will show a positive attitude towards ECM use. The alternative will yield an opposite result.

In view of the findings above, Teo (2010: 259) examined the influence of subjective norm and facilitating conditions on the intention to use technology among pre-service teachers in an educational context and found FC had medium impact on ATT toward technology usage. Facilitating condition is also a motivator that enables clinicians' continuous use of ECM.

For proposition six (6), clinicians were asked:

Question 11a: Can the system improve the quantity of output for same amount of effort.

Additionally, a further question was asked to simplify the first question if a clinician was unclear:

Question 11b: Does the ECM fit into the kind of job you do?

Proposition 6: There will be a positive relationship between perceived job fit and attitude towards EPR use.

The ECM system seems to fit into clinician's job roles and expressed here as:

> *"…….if you use it correctly its much faster, it streamlines my work, makes it easier to access results and to get the right information"* (TG)

> *"……..I think it does as long as we have accessible computers that are not offline or something like that……."* (ZK)

> *"it helps, I'd say if it was working optimally I definitely think it's helpful"* (EB)

> *"I think so because even looking through 20 documents on a computer I think is even faster than looking through 20, 30 documents in a file……not fast tracked but it's made my life easier at the hospital"* (JR)

> *"……I think it's definitely the way to go……."* (DH)

"I must say I would rather have it" (MT)

Other clinicians were of opposing views such as:

"lots of teething problems" (JL)

"it's difficult now to say, the whole thing that's sad for me is that they've had the opportunity now to create a good paperless system and they've gone for a cheap, very cheap system that is actually very cumbersome. Because it doesn't add any value for me except the notes hopefully it's not kept in a file holder somewhere, it's now virtually kept somewhere so notes won't get missing if they are scanned" (NT)

"it fits into nothing, no. If this, if we can't improve into the proper way that ECM has to be used I'd rather go back to the old system as in yesterday" (JT)

Discussion questions eleven

Six (6) out of a total of 9 responses were positive indicating a 66.7% score. It means there is a moderately positive relationship between perceived JF and ATT towards EPR use. Some clinicians' perceive ECM to fit into the kind of job they do because it aids their daily work. For this reason their attitude using ECM remains positive. Some other clinicians do not share the same sentiments. In total, not all clinicians embrace ECM but it is safe to say they are optimistic of its importance. The fact that ECM was imposed on them without any input from them leaves them with no major alternative. Other hospital systems developed in-house are peripheral systems developed to work in conjunction with ECM but not as a replacement.

Clinicians generally know the importance of technology and positively embrace its implementation but currently ECM has not met their desired expectations optimally. With the current teething problems experienced, clinicians have not fully embraced ECM into their daily work as it seems to add to their workload in some cases rather than remove from it.

Literature showing the relationship between JF and ATT is scarce and it may be because JF is termed different. Thompson *et al.* (1994: 179) indicated that JF encompasses beliefs about how technology (a PC as example) will help with current job tasks. This can show a relationship between clinicians' positive attitude and ECM helping them with their current work task such as information review, storage, retrieval and share.

Attitude is the same as affect thus clinicians were asked:

Question 12a: Does the system make work more interesting? Explain?

Continuing, an additional question was asked:

Question 12b: Do you find ECM interesting or fun?

Attitude is a feeling and can be positive or negative. It is important in determining the degree of ECM use.

Proposition 7: Attitude towards EPR use will have a significant impact on actual EPR use.

Clinicians' expressions were overwhelming:

> *"ya I wouldn't say that I want to go and sit and play on it or explore it or see what I can do with it at the moment. At the moment its basically part of work……."* (SH)

> *"ya ya fun, interesting, I think fun isn't, its work it's not really fun for me, I have to do it, it's interesting and its useful"* (TG)

> *"no……..it's for work"* (EB)

> *"no, definitely not. It's not fun at all, its work related, its nothing fun about it"* (JR)

"no no no…… it's just for work purposes……." (JL)

"it's frustrating to use it because there's a lag on it so I see a patient or my registrar sees a patient casualty a week ago, now I have to follow the patient up a week later and I don't have any clinical information so it's very frustrating to be involved in ECM" (NT)

"no……." (DH)

"it's purely for work" (MT)

"no, how on earth would I find it fun or interesting, it's a data management program, it's boring as hell" (SP)

"no. Not at all" (JT)

Discussion on questions twelve

Clinicians' attitude towards ECM has a significantly high impact on actual ECM use. This is in-line with the study researchers' measuring scale in Tables 5.4.and 5.5. All 10 responses were negative and amounted to a100% support of ATT impacting EPR use. With the current situation at TBH, clinicians' attitude towards ECM is negative as the system is not interesting or fun in any way. They use ECM primarily for work and nothing else. For this reason, there is no willingness to explore any additional functionality or no interest to understand more about the system. Clinicians' attitude is an indication that the ECM system is not functioning well, it does not meet their expectations and goals so no extra effort or interest to maximise its use.

In view of this, Yang and Yoo's (2004: 26) study agree with the findings here that ATT has influence on USE, although positive and only in part. They identified two (2) dimensions of attitude namely cognitive and affective. Their study found that cognitive attitude has a high significant impact on USE while affective was insignificant. They proposed using the cognitive dimension as a measurement variable in future studies. Attitude in this study was used as a single dimension. In retrospect, clinicians' attitude determines their ECM use to a large extent. The comments by clinicians indicate that their negative attitude toward ECM use is high, a reason why they are reluctant to explore ECM

further, troubleshoot issues or contribute towards its improvement. No wonder the orthopaedic unit opted to develop their own system to work in parallel with ECM.

The remaining propositions highlight clinicians' perception regarding ECM use for storage, retrieval and share of patient information. Proposition $8_{(a)}$ is specific on record storage. Question asked:

Question 13: Do you know how to use the system to store information? Explain?

Proposition $8_{(a)}$: System use will have a significant impact on information storage

For proposition $8_{(a)}$, the researcher investigates ECM function for storing patient information. Clinicians' responses are:

> *"I do have colleagues that store information. So everybody that does colonoscopy or endoscopic procedures for instance have the capacity or the ability to store information on it as a user"* (SH)

> *"you can do your discharge summaries on it but I haven't been doing that because I'm a consultant so I don't discharge patients…….. you can enter the discharge summary directly unto it but I haven't used that. I, but, I don't input anything on it"* (TG)

> *"ya we store all patient information on ECM"* (AP)

> *"no. not myself but I know people in my department store all their theatre bookings list on that system, on the ECM system, I don't do it……"* (ZK)

> *"if you had done it yourself yes, you have to create a separate program, upload it to the system then it will keep it for you but there's no place in the program to do that….."* (SP)

> *"…..I've never done it but apparently there is a function like that"* (EB)

"you can upload documents on ECM, I haven't had the need to use that before but definitely you can upload I think photographs and PDFs document or whatever unto the system" (JR)

"yes. As I said we had, we have a colorectal database on there and we put our endoscopy report on there" (JL)

"I haven't but some of our registrars have, there is a way to do it but we haven't officially been informed on how it works……." (NT)

"…….I've piloted using a Word document where you can just import that from the computer itself and it's a proforma word document that you can do your note keeping on and to store it straight in there" (DH)

"I have……So then I have in some cases uploaded that PDF file into ECM but I haven't physically on ECM created a document, typed it and then saved it" (MT)

A clinician expressed a different view to his colleagues with regards record storage;

"currently, no we not, all we doing is the information is there, we making notes, that file goes down to ECM, they scan it in and hopefully it goes where it should go" (JT)

Discussion on question thirteen

The ECM has the functionality to store information directly. Most clinicians have not stored or input information into ECM directly, but they indicate that ECM has the potential to perform such a task. Storing information can be in the form of typing information on ECM and saving or modifying existing information and re-saving.

The general rule is that after diagnosis and treatment, all clinical notes are taken away for scanning into ECM. A few of the clinicians have directly typed into ECM, imported files or uploaded a file into it. Though the capability to directly store information into ECM is there, understanding how to undertake this functionality is not standardised to most clinicians.

For this study, ECM use (USE) indicates a significantly high impact on information storage (STO). This is based on 11 supporting responses out of a total of 12 responses. This amounts to a 91.6% score. Consistent use of ECM will enhance and improve clinicians' understanding and skills to use it. There is currently no literature that shows a relationship between system use and information storage.

For proposition $8_{(b),}$ question asked include:

Question 14a: Do you know how to use the system to retrieve information? Example.

Additionally, clinicians were asked:

Question 14b: Will patient information be in the same format stored with no alterations when retrieved?

Proposition $8_{(b)}$: System use will have a significant impact on information retrieval

Clinicians' responded to the questions saying:

> *"that's what I do"……"So you log in to the system, you open up the patients file and then when you've generated a word document, you can copy paste into the system"* (SH)
>
> *"absolutely for me"* (TG)
>
> *"…..it's very good"* (AP)
>
> *"yes. Sometimes I find it a lot of rubbish gets scanned in, blank papers……I can see everything, nothings been altered on it and its readable so just not well organised well yet in what you're getting but otherwise you can read everything….."* (ZK)
>
> *"ya, it must be"* (SP)

"yes it's not altered, it is a verbatim copy" (JR)

"yes. Well our colorectal logbook database is on there and I can get it out there. I can open it, it's in an excel spreadsheet and I can type in there, other doctors can put their patients in and we can all access it and see it and get the information out again" (JL)

"it's exactly the same as hand-written notes, nothing else" (NT)

"yes it's the same. I mean obviously it's a simple scan, it's a copy, a scan of a document the way we use it now so it's exactly the same" (DH)

"ya there's no alterations. You can that I found, you could even, on your, on the ECM you could create a folder and make it orthopaedics and then drag it in and, not that I've ever had to research for the stuffs but it seems to save like I want it to" (MT)

"there's no alterations but a lot of times the information's not just available because its hasn't been scanned in yet" (JT)

Discussion on questions fourteen

The clinical notes scanned into ECM are retrieved in the same format stored with no alterations. All notes scanned into ECM are an exact copy of the original. The use of ECM has a significantly high impact on the information retrieved as it is a daily routine. The more clinicians use ECM, the more information will be retrieved but the quality of information will not be affected as information captured is through scanning. Using Tables 5.4 and 5.5 measurements, all 11 responses support the proposition resulting in a score of 100%. For this, EPR use (USE) has a significantly high impact on information retrieval (RET).

At current, ECM operates similar to an information retrieval system rather than a fully functional EPR system. An information retrieval system according to Kowalski and Maybury (2002: 2) is a system that is capable of storage, retrieval, and maintenance of information. The ECM at Tygerberg hospital performs these tasks although its storage and information maintenance functions are minimal. An objective of an information retrieval system as Kowalski and Maybury (2002: 4) put it is to minimise

the overhead of a user locating needed information. Overhead they claim can be expressed as the time a user spends in all of the steps leading to reading an item containing the needed information. Clinicians overhead is high as some complained about having to go through an entire patient file searching for an item. ECM non-searchability compounds this problem.

A retrieval system cannot operate in isolation as it works hand-in-hand with storage. Without storage, retrieval is not possible. Clinicians need to optimise their ability to store information in ECM so that retrieval becomes possible. Their consistent use of ECM will enable them generate more information both for storage and retrieval. The relationship between USE and RET becomes significant and relevant. There is currently a paucity of academic literature to show a relationship between USE and RET but hopefully the evidence presented in this study will lay a foundation for future studies on this..

Proposition $8_{(c)}$ indicates that the ECM system will have a significant impact on system information sharing. Clinicians' were asked:

Question 15a: Can you share information with colleagues in the hospital using ECM? If so how?

Additional question was:

Question 15b: What about sharing information with other hospitals?

Proposition $8_{(c)}$: System use will have a significant impact on information sharing

Many clinicians are not fully conversant with ECM functions as their responses suggest:

> *"ya so they can log in, so they have password, the ECM is a central system, they have got a password they can see all my notes"* (AP)

> *"the other department can log into the systems, they can get, so you can leave a referral note in your folder and they can then log in and find referral to files in your orthopaedic file"* (SP)

"Basically everyone's notes is accessible, so it's all uploaded so you type in the patient number and I can see the occupational therapist notes……" (EB)

".....if there is historical documents and I want someone in another department, my gynaecology to access it then yes definitely they can, they access the same system and they have also access to all the records I have access to" (JR)

"well I think so in the sense of I could upload a referral letter and then label it like for your attention because you can change the file name or the folder name but then of course that person would have to log in into ECM and then find it so I think it's possible yes" (MT)

"not really though, well you can share it in terms of if you've done the report and it's been scanned in, they can log in and have a look at our report. So in a way you can share if that person is a user with a username and password on ECM then they can actually access that file number" (SH)

"……..I can share with anybody within the hospital. So if somebody in cardiology wants to have some orthopaedic information, they can just go unto the ECM and go to the orthopaedic part, yes that they can do" (JT)

Alternative responses were:

"……....not all the hospitals have ECM yet but as they get it they can, they will get access, they get access but what we do is the clinician who've referred the patient to us, we send an email back with the copy of the notes, of the digital notes of course" (AP)

"not really no. what you will need to do is if you refer a patient you will have to open up the system and either save the PDF to a memory stick or email the PDF, save it or print it out and then actually give the patient the paper copy with which to travel" (SH)

"I'm not sure if you can use it, I don't think so. I have, people have phoned me for information, I looked it up and I conveyed the message telephonically to them but I didn't email them or I didn't send electronic copy to them" (TG)

"no, I haven't done that. I haven't shared it like that no" (ZK)

"I don't think so. I've never used it, I don't think so……....." (JL)

"no, not at all" (NT)

"no. we at the moment still use the paper documentation……" (DH)

Discussions on questions fifteen

Information sharing using ECM is a functionality not fully explored and the reason for this can be attributed to the fact that clinicians do not find ECM interesting or fun. There is no real motivation to explore ECM to find out what other functions it performs so clinicians are of the opinion that ECM use will have no significant impact on information sharing. The fact that all authorised clinicians have access to ECM indicates that information sharing somewhat takes place but only through the use of access codes. Sharing of patient information takes place via emails, storing on removable drives and handing to colleagues or paper sharing.

Information sharing in this study's context refers to using ECM to communicate patient's information in part or full for diagnosis and treatment. Using the measuring scales, 7 responses supported the proposition out of a total of 14 responses amounting to a 50% score. The proposition will state thus, system use (USE) will have a moderately significant impact on information sharing (SHA). Sharing is important as ECM is implemented at various hospitals in the Western Cape Province. Most other hospitals are district hospitals and refer patients to Tygerberg. It is necessary that ECM is well integrated between these other hospitals to avoid patient paper information physically moved from one point to another. The risk of patient information on paper being moved around should have been mitigated against by the introduction of ECM. Email and other secure communication functionalities can be added to ECM (if not available yet) to enable it improve its sharing capabilities.

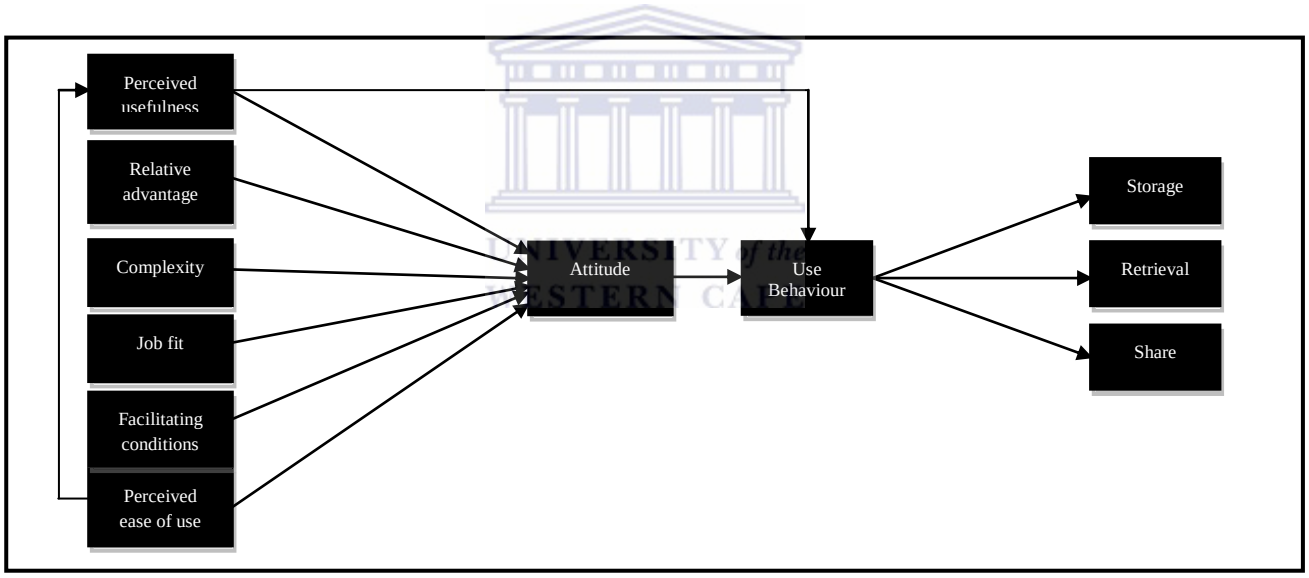
To the knowledge of the researcher, there is no available literature during the course of this research study to substantiate the proposition that USE has a significant impact on SHA.

The next section summarises the findings.

5.11. Summary of findings

Revisiting the conceptual framework proposed in chapter 3, Figure 3.8, it is imperative to summarise the findings of the data analysed and ascertain whether the conceptual framework holds merit. Using the results derived from the data collected, a summarised conclusion of the propositions is listed here. The conceptual framework is diagrammatised below and findings summarised thereafter.

Figure 5. 4 Initial technology use framework



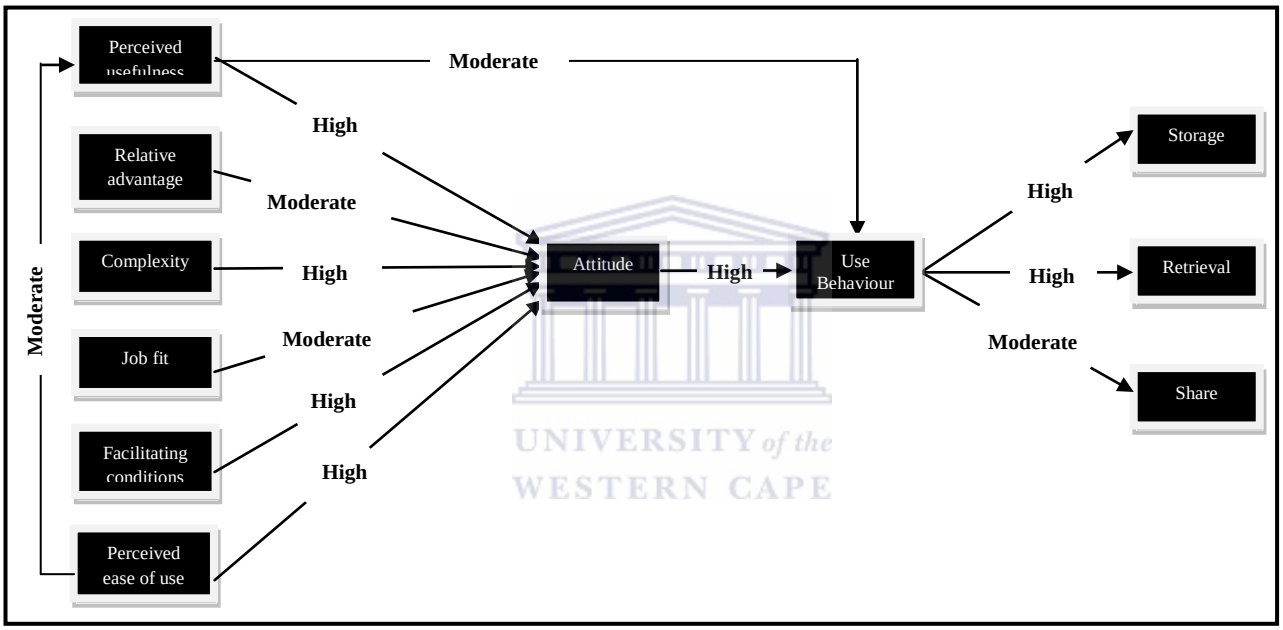
The findings are summarised here.

1. PU has a significantly **high** impact on ATT
2. PU has a significantly **moderate** impact on USE
3. PEOU has a significantly **high** impact on ATT
4. PEOU has a significantly **moderate** impact on PU
5. RA has a significantly **moderate** impact on ATT
6. COM has a negatively significant **high** impact on ATT
7. There is a **highly** positive relationship between FC and ATT

8. There is a **moderately** positive relationship between JF and ATT
9. ATT has a significantly **high** impact on USE
10. USE has a significantly **high** impact on STO
11. USE has a significantly **high** impact on RET
12. USE has a significantly **moderately** impact on SHA

A summarised conclusion of the technology use framework is diagrammatised below.

Figure 5. 5 Analysed technology use framework



Source: Researcher's framework

The need to understand the underlying problems associated with clinicians' attitude towards ECM is important. This is in-line with answering the research questions and meeting the study's research objectives. Clinicians were advised to indicate problems and solutions associated with ECM usage and the data is categorised under different headings such as problems, solutions and satisfaction. Clinicians' experiences and expressions are important as ECM is for daily use and its use directly impacts their work roles and health service delivery.

The next section explains strategies for improving the use of ECM at the hospital.

5.12. Strategies to improving EPR use

Additional questions were asked to each clinician during interview with an objective to improving ECM adoption and use at Tygerberg hospital. ECM is currently in use and discontinuing its use is not an option for hospital management. Possible issues are identified with regards ECM functioning and solutions suggested for each issue. Continuing, clinicians' were asked specifically what they used ECM for. A question asked is:

Question 16: What do you use the system for? Explain

A list of tasks is provided so clinicians can explain their use of ECM for performing the tasks. It includes reviewing patients problems, obtain tests results, obtain special investigation information, order any laboratory, X-ray or CT results, order treatment, write prescriptions or sick notes, refer patients to other departments for treatment, share patient information with colleagues or discharge patients.

Comments expressed included:

> *"I haven't used it for that"* (TG on sharing)
>
> *"We want to use it for the labs and for the X-rays and for everything else but currently it's not available"* (AP)
>
> *"our radiology works like that which is not ECM, it's a completely different system but not with ECM no, I haven't done that……."* (ZK)
>
> *"just to retrospective review and half the time the notes aren't there so it's basically pointless"* (SP)
>
> *"We can use the system it's just a question of how we use the system….."* (SP)
>
> *".....we use it for note keeping only"* (NT)
>
> *"……we only use it for accessing old notes"* (DH)
>
> *"…….that's what we use it for, it's just reviewing old notes"* (DH)

"....so we use it if we're looking for more information about a patient..." (MT)

".....we use it for is nuclear medicine results of all their patent bone scans and et cetera and those PDF files are uploaded onto the ECM" (MT)

Discussion on question sixteen

The general consensus is that ECM was used mostly for reviewing patient's information and clinical notes stored. ECM capability is limited to mostly reviewing information, it is not used to obtain special investigation information, order any laboratory, X-ray or CT results, order treatment, write prescriptions or sick notes, refer patients to other departments for treatment, share patient information with colleagues or discharge patients. The ordering of laboratory, X-ray or CT results are undertaken on a separate system requiring a separate access code.

Information input into ECM cannot be modified as any modification meant a new PDF file must be created and saved. This new file will be saved into the patients existing folder rather than replace the existing file. These interview results are synonymous with the survey pilot results (Figure 5.1, section D) where the mean scores indicate that clinicians used ECM the most for reviewing patients information.

The next section identifies ECM issues extrapolated from the qualitative data and possible solutions for its improvement.

5.12.1 Issues and possible solutions

Problems identified with ECM were made so as to understand clinicians' challenges and propose possible solutions. It is necessary that clinicians' issues are addressed as their ECM use has a direct impact on their attitude and it can motivate them to maximise its use. No direct question was asked to any clinician regarding the issues experienced when using ECM as the question format was somewhat like a discussion.

Clinicians were also asked to suggest possible solutions to the problems they themselves identified. The question asked regarding possible solutions to improving ECM was not standardised. It varied

according to the clinician interviewed and the depth of the interview. A typical example of a question on possible solution for ECM is:

Question 17: You did highlight some problems with the system which is typical of every IT system, I was thinking, if you were to advice the government about this system, where you think it should be fixed, what would you say?

All questions asked relating to suggesting solution to ECM centered on the idea of problem fixing. To understand solutions to the ECM and maximising its use, each problem and possible solution is presented and explained as categories such as system integration, system access, note labelling/bar-coding, features/functionalities, working relationships and turnaround time. These sub-themes are explained below.

5.12.1.1. System integration

Clinicians complained about the many ECM functionalities such as its non-integration. Some views are:

> *".....the problem in our system in Tygerberg is you have to get ECM, then you have to go into the radiology program, then you have to go into the laboratory program, nothing is combined"* (JT)

> *".....what we actually need in the system is different systems that talk to each other"* (RM)

> *"the ECM system needs to be fully integrated with the Clinicom system that the hospital use for their administration. So I should be able to have direct access to everything that the hospital, well……. everything that they, not accounts and that sort of thing but at least the demographic information, I should be able to have privy to that so these 2 systems need to actually speak to each other and not be parallel system"* (DH)

Discussion on question seventeen

The issue of integration is an important one. Clinicians would prefer ECM to be integrated with other hospital systems such as the orthoware, trackcare and clinicom system. The integration of these

systems would reduce their time moving around to access these other systems. Through integration, multiple access codes will be avoided thereby making access simple and probably more secure. The fact that ECM is also present in other hospitals should be another reason for integration as clinicians sometimes rotate in the course of their professional practice. Patients migrate so integration can help clinicians monitor and do follow-ups on patients conditions as well as acquaint themselves with patient's problems before consultation and treatment.

There is evidence to show that system integration is positively related to perceived system success. This is contained in the study by Chapman and Kihn (2009: 162-163) on information system integration, enabling control and performance which proved that the association between information system integration and perceived success of systems is positive and very strongly statistically significant. This is an indication that if ECM is integrated with other hospital systems, then clinicians' attitude towards ECM use will improve their performance and result in ECM efficiency.

The second issue identified is note-labelling and/or bar-coding which is explained in the next section.

5.12.1.2. Note labelling/bar-coding

The categorisation of both old and new medical notes incorrectly is an issue that increases clinicians' work time. It is an unnecessary waste of time to surf through tons of papers in search for a single item. In many cases, blank papers are included into files thus making search more time consuming and time wasting. Clinicians made it clear saying:

> *"maybe just categorising things better……. if it's possible to have folders the orthopaedics, nursing, surgery, gynaecology or something like that, it would make life easier"* (JR)

> *"……more bar code for instance because orthopaedic is spine orthopaedics, hand orthopaedics, shoulder orthopaedics, foot orthopaedics, trauma orthopaedics, there's different category within orthopaedics and we wanted a bar code for each of those categories……."* (NT)

> *".....the problem that we have is the, how can I say, the naming of the folders or the PDF files sometimes they get it incorrectly so you have to look through 50, 60 PDF documents before you find your specific document....."* (JR)

"……..the biggest problem is with all the old notes that were captured" (DH)

"……it was frustrating possibly to wait for files and yes paper copies can get lost but this does not save time in the sense of you still need to scroll through incorrectly labelled files to find what you're looking for" (MT)

"……..a simple solution for that problem would have been just to make a certain folders and maybe for each discipline in the hospital just to have a specific folder within that instead of seeing a list of PDFs, you'd have a folder there that you can just put those things in which you are able to do……" (DH)

Discussion on question seventeen

Time is a luxury to clinicians. Time wasting can cost a life. Inadequate and insufficient information can also cost a life. Clinicians do not have the luxury of time and a reason why nurses are always complementary to them and their work. Incorrect classification, labelling and filing of documents is compounding clinicians work task. The time spent searching through lots of information can better be simplified if documents and folders are correctly classified, labelled, filed and documented. In resolving this issue, clinicians should be allowed to partake in the labelling and bar-coding of their own notes since they are the primary users who will eventually use the same notes for future diagnosis and treatment. Where time does not permit, nurses should be assigned the task of note-labelling and bar-coding since they work hand-in-hand with clinicians. Although nurses workload has been highlighted as a burden, the use of hospital administrators should be encouraged. They should be trained and supervised to label notes, documents and file correctly. This will lighten clinicians work tasks.

According to Rosenbloom, Denny, Xu, Lorenzi, Stead and Johnson (2011: 183) in a study conducted on a perspective on the tension between structure and flexible documentation using data from clinical notes, they suggest that the choice of a documentation method can alter the balance between expressivity and structure in the resultant notes, hamper the healthcare provider's workflow, influence the process and products of recording clinical information, and influence how well the note can be incorporated into an electronic record system in such a way that the note's contents can be automatically reused and analysed. In simplifying the documentation issue to improve performance by clinicians, Rosenbloom *et al.* (2011: 184) recommended that management adopt a computer-based

documentation product that meets the needs of clinician users, rather than attempting to find a single best documentation method. Then a need to integrate specialised software into ECM to improve note-labelling and bar coding of clinical notes should be taken for as long as it will improve clinicians' performance and attitude towards ECM optimal use.

Another issue identified is system access as highlighted by clinicians and discussed below.

5.12.1.3. System access

There are insufficient computers available to clinicians at Tygerberg hospital at the moment. Some clinicians have individual offices with a computer while others share a common office and computers. The few available computers are old and ECM access using them can be a challenge. Clinicians said:

> *"there was a problem with my password and i….my password reset, it takes a couple of days, that's the only thing"* (TG)

> *"….the only problem we've been experiencing is sometimes, say if you get logged out for logging the incorrect password more than 3 times et cetera then the support, how can I say, IT support to change that is not adequate when you call the number….."* (JR)

> *"The problem is we don't have access to internet, we only use the intranet so if you click on the hyperlink, it doesn't work……."* (JR)

> *"……it's a problem with the amount of computers because you had classically one computer for clinicians in a ward of maybe I don't know, 40, 50 patients and every doctor and clinician and physiotherapy in that ward will need to use that one computer for X-rays, blood results, historical records and sometimes physically the distance between the computer and your patient is maybe 30metres so if they had maybe in every single room a computer that would help or mobile computer"* (JR)

> *".....the hospital has abit of a dead zone for cell phone reception so telephone reception and 3G or data reception is very poor in the hospital"* (JR)

"....if its internet-based so if they had free Wi-Fi or not, just Wi-Fi points in the hospital then you could use your own tablet or computer to access it" (JR)

Discussion on question seventeen

Sufficient computers with access to ECM should be made available to clinicians and where possible these access points should be closer to clinicians' treatment space. The IT support service must be readily available to assist clinicians with logging into ECM where a problem exists such as password reset. Internet and intranet connectivity should be considered as clinicians are embracing of technology. All clinicians interviewed are computer literate so the hospital should improve its infrastructure in accordance with clinicians' skills and knowledge. Security of patient information is always a challenge when using internet but it should not be used as an excuse to limit its use. The possibility of ECM access via web-links and wireless are suggested possibilities.

ECM access is shown to have a direct impact on the performance of clinicians. This is contained in the findings in a study undertaken by Kossman (2006: 339) on the perceptions of impact of electronic health records (EHR) on nurses' work. The findings indicate that nurses identified increased access to patient care information (spent less time searching for records), improved efficiency (quicker documentation and information retrieval processes) and organisation (provision of task lists, systematic charting and prompts, and less reliance on their memory or written notes) as EHR attributes that enhanced their work performance. Nurses also identified ways that EHR hindered their work such as increased time spent retrieving or documenting information, decreased time spent with the patient, interference with written interdisciplinary communication and hindered critical thinking (Kossman, 2006: 339-340).

Constant access and use of ECM can resolve some of the issues of increased time spent retrieving information and less time spent with patient. This is because consistent access and use can become second nature of how to locate the information they want thereby resulting in less time spent finding information and more time with patient. Practice makes perfect.

The fourth issue that needs resolving as a way to improving ECM use is the working relationship with Tygerberg hospital management. This is discussed in the next section.

5.12.1.4. Working relationship with management

The ECM system was implemented without clinician's input, opinions or suggestions. The working relationship between clinicians and the hospital management has not been fully explored in this regard so a need to work with clinicians in every implementation phase is necessary to allow for a smooth technology use. Clinicians' expressed their view saying:

> *"……..apparently this was tested somewhere I think in Khayalitsha hospital and the rumour was that it was poorly received on wherever that they rollout but when we got the information it was said that it was greatly received, it worked like a charm that's why they're doing a big rollout. But we, they never asked us, they never consulted us as I said at my level as far as I know at the head of department level as well"* (NT)

> *"……..when the ECM was developed, this scanning function that we're using now is a backup of ECM, it's not the main function. So we're using it the other way wrong……."* (JT)

> *"…….I think clinician input would be quite important in developing the software to work for us as well as educating the scanners of the documents to tell them exactly what is important to scan and what is not important to scan, what should be labelled and certain things……."* (MT)

> *"….I think if there's a pilot project then I think the clinicians are a big stakeholder in the people using the system so I think definitely they should involve clinicians also"* (JR)

> *"……unfortunately, never spoke to me, they don't do things like that, that way. It's not the way, y'know its unfortunately IT people making the decisions and the fact is it must be a team of people who use it every day like myself with the IT expertise and that's what's needed"* (AP)

A clinician suggested:

"the thing about it is to have a department representative, somebody one person from the department to attend a meeting or something like this where somebody comes and says what do you think is wrong with the system and they give you things, what would you need for the system and then everybody gives their 2cents worth about what not they should or shouldn't have in the system and then you can do it like that and make it so that you can actually use the system correctly" (SP)

Discussion on question seventeen

Input from clinicians should be solicited, acknowledged and incorporated into current and future design, development and implementations of all technologies at Tygerberg hospital. This will curtail the many problems expressed by clinicians today. Hospital management should allow clinicians contribute knowledge, skills and information before and during implementations since they are the primary users and know what they want. This way the ECM system would be tailored to meet their specific needs.

Clinicians hold vital information that can aid the smooth operation of the hospital. Their participation in decisions that directly affect their work roles and tasks is necessary. Clinicians are both internal and external stakeholders of Tygerberg hospital. Their contribution in decisions will play a leading role in the optimal use of ECM to deliver quality health service. And just as a clinician suggested, a representative from the different specialist teams can be assigned to represent clinicians when decisions of importance such as ECM upgrade is to be undertaken.

This representative will be involved in all official and unofficial meetings with stakeholders involved in a project. For example, if ECM is to be upgraded, a demo system can be developed and the representative be allowed to test with colleagues. Opinions and suggestions will be collected thereof and shared with team members and stakeholders. All decisions will be agreed upon before implementation after all representatives are in agreement that the system will deliver on its intended objectives. This process may increase the project time frame but will decrease project cost over the long-run. This is because it will address potential future problems which if ignored will eventually increase project time, scope and cost on the long run.

Hospital management and clinicians need to constantly interact and discuss. This can prove to be meaningful and productive in meeting the hospital goals and objectives in delivering better health service to all. Braithwaite (2004: 251-252) conducted a research on an empirically-based model for clinician-managers' behavioural routines in which he states that interaction is the social DNA of clinical management behavioural routines. Interaction typically involves exchanging views and mobilising influence. Hospital management and clinicians need to organise official meetings as it does represent a large investment in time and effort, and is the main way ideas and issues are processed, sense making about hospital events and issues occurs and the negotiated order is enacted.

Braithwaite continues (2004: 255) saying, clinician-management work activity is centred on ongoing interaction, coordinating work with and through others, influencing people and the constant creation and dismantling of relationships and teams. In addition, he claims management activity in clinical units is heavily social, centres on discourse, persuasion and negotiation, and involves working with and influencing individuals and groups. The idea of clinician representative can play a vital role here. So to be effective, it will require a well-developed social skill and verbal ability and the capacity to cope with multiple issues, tasks and responsibilities. Health environments are complex so constant interaction is necessary to understand each team in order to meet hospital requirements.

The features and/or functionalities of ECM is another issue highlighted and discussed in the next section.

5.12.1.5. Features/Functionalities

The ECM system lacks certain key features and functionalities such as search, edit and format where such features exists then additional training should be proposed for clinicians to acquaint them with ECM functionalities properly. Clinicians complained that:

> *"it's not really searchable……we still do paperwork lots of hand that touch this paperwork, there's a huge lag between when we do the notes to the point where the notes are actually scanned and available……..not all the notes are always scanned, there's obviously human error thing comes into play……it's not a well-integrated system either……."* (NT)

> *"…….there is a frustration factor in the sense of one having to search through a lot of notes……."* (MT)

".....we can't put discharge notes, the ideal will be from my own point of view, would be to be able to write discharge notes on the….and it's there immediately. So there's a lot of problems with ECM, I think it's better from where we were but it is not ideal or perfect at all, lots of problems" (JL)

"…….it is not 100% digital, this is still a paper system that we write our notes that gets scanned and then filed……its purely a note keeping system" (NT)

"…….you can't make summaries because it's a PDF files so you can't make a discharge summary out of your notes" (NT)

"……unfortunately once you've put something in there, you cannot change it again. So if you make a mistake on a, you can't change it yourself……" (DH)

".....try to make it more searchable……" (NT)

"……..the problem for me is the way that the data is being captured is problematic because firstly every document except if they do a pack of documents but its separate PDF folders so once that's done every new episode is a new file you have to open" (DH)

Discussion on question seventeen

The complaints highlighted above are testimonies of ECM shortfalls. Clinicians' complaints and suggestions should be taken seriously if ECM is to perform the tasks it was designed for. The need to train or re-train clinicians on using ECM more efficiently is a possible solution.

System features and/or functions can make a positive difference in its performance. For example, the search feature and functionality can greatly improve the clinician's performance in finding critical information quickly for patient diagnosis and treatment. The edit feature and functionality can also improve clinicians' performance through updating patient medical record and sharing. Another feature and functionality such as email and internet can improve ECM performance by secure and reliable access by clinicians from multiple locations to share information relevant for their work.

The literature supports an association between an electronic record system feature/functionality and performance. Poon, Wright, Simon, Jenter, Kaushal, Volk, Cleary, Singer, Tumolo and Bates (2010: 203) assessed the relationship between the use of an EHR and the use of specific EHR features with quality of care using a survey linked with Healthcare Effectiveness Data and Information Set (HEDIS). Poon *et al.,* (2010: 208) discovered that the use of certain EHR features was associated with better performance on a number of HEDIS measure group scores. They concluded that adopting EHR alone is insufficient to improve quality but rather specific features of the EHR must be available and used before an increase in quality is expected.

Lastly the turnaround time is an issue mentioned by clinicians. It is discussed in the next section.

5.12.1.6. Turnaround time

After clinical notes are made, they are taken to a different department for scanning into ECM. The time between the scanning of these notes and its appearance on ECM is lengthy, sometimes 2weeks as indicated by some clinicians:

> *"I don't know why there is such a backlog maybe just because there's so much information but I mean the turnaround is such an issue"* (EB)

> *".....it's about a year and a half now I think and there is still problem with the time delays of scanning"* (TG)

> *"……y'know it makes it difficult giving optimal medical treatment because you don't have the full information, you don't have the full picture so you, if there's gap so and that leads to often re-testing which is a waste of money and waste of resources, it delays and it's a cost to the institution because you have to admit somebody, you don't know what has been done before so you have to redo certain things"* (TG)

> *"Our problem with the ECM is that over the years, past years it's just been getting the turnaround time between sending the notes down to the archiving place and getting the scan into the system that delay as short as possible, that's been the only problem y'know"* (SH)

"……I think the biggest problems that I've had with ECM was the lag of note capturing because it's all being done manually" (DH)

"....the other huge problem we find although I must say it's getting better than it was a year ago or so is how quickly the notes gets scanned" (MT)

Discussion on question seventeen

The turnaround time is unacceptably lengthy and effort should be made to shorten it. Clinicians have no patient information to work with after their notes are taken away for scanning and this can result in mis-diagnoses and wrong treatment during follow-ups. Turnaround time was used here to describe the interval between when a clinical note is collected for input into ECM and the time it takes to have it appear on the system.

Theoretically, clinicians desire a rapid, reliable and efficient service delivered at low cost (Hawkins, 2007: 179). Of these characteristics, Hawkins claims timeliness is perhaps the most important to the clinician, who may be prepared to sacrifice analytical quality for faster turnaround time. His research is primarily a review that summarises the literature regarding laboratory turnaround time. Hawkins (2007: 191) concludes that turnaround time monitoring is the ideal choice of activity to illustrate the laboratory's commitment to providing a high quality service.

For Tygerberg management, turnaround time should be explicitly made clear, that is within 24hrs. This means the time from collecting clinical paper notes after patient is seen by a clinician and the information made available on ECM should not exceed 24hrs. Patient information is dire to patient, clinician and the hospital. Delays can result in the loss of a life. An electronic system such as ECM should be operationised to function like it was designed for; anything contrary is unacceptable.

With the issues identified and solutions suggested, the next section rates clinicians' actual satisfaction level using ECM.

5.12.2. Satisfaction

Clinicians were finally asked to rate their satisfaction level using ECM. They were asked:

Question 18: What is your satisfaction level with the system installed at your hospital between 1 and 10? Why?

Their responses were:

> *"Sometimes it's 10, sometimes its 1. But I mean I would give like say 5 out of10, it helps for instance if I'm screening for the clinic because I, we get a list of patients that, that we are expecting to come the next day so then we look at the X-rays but then sometimes I don't know why is this person coming back I can go look on the ECM as opposed to if were on the files system, I can't go and draw everyone's files because then I would be at records the whole day"* (EB)

> *"I would say 7……..because, well if you log on it's a very user friendly so I'd give it high score for user friendliness, effectiveness normally 9 out of 10 patients you can log on and you find what you need and we haven't had any software problems with the system that I'm aware of so it runs well, just like I mentioned maybe not be categorised adequately and turnaround time but, except that I mean I'm very happy with the system"* (JR)

> *"……the thing about is its not real-time. So any paper notes that's made takes a month to get unto the system so you can't, you can't see what somebody wrote a week ago, that's the big problem….."* (SP)

> *"currently as its been used, it's pointless its useless, 1 or 2. But the thing about it is it's a good program so there's nothing wrong with the program, it's just like I said its implemented badly……."* (SP)

> *"I would give it a 7 because its positive, its useful, the only thing is documents are scanned in and sometimes you have to go and look, quite a few documents to find the one you exactly you're looking for"* (TG)

> *"say it's a 5 because of the fact that it's so retrospective y'know it's an archive, it's not a true electronic paperless record system……. So for that y'know as an archive it's a 7 but as an electronic content management system y'know which you*

would like to input data into then it's just a 5 because that kind of option isn't really at its fullest capacity at the moment" (SH)

"I'd say 6. 6 again for me access when they change those passwords every 3 months is a big problem for me and also just the……" (ZK)

"4…….because I've worked in Sweden for 3months and I've worked on their electronic system and its much more efficient with regards to as I said, the problem…….there is a lot of problems so I think there's much room for improvement" (JL)

"it's probably at about 6 at the moment, I think currently we're about 6 but we want to be at 10. We have very good plan to get it to 10, we just need a little bit of funding and a few IT people who are willing to help us" (AP)

"I think I would probably be between 6 and 7. I think there is infact further work that needs to be done and the biggest frustration is the fact that different systems don't talk to each other, that is a big frustration……" (RM)

"1…….it's an archive system, it's not a proper paperless digital system……. there's no value added except for the fact that the notes now are not stored in a room……" (NT)

"at the moment I would say 3 or 4 but I think it has the potential to be closer to a 8 or 9 if used in the right way……." (DH)

"I'd probably rate it a 6 now…….but I must say it's definitely better than it was last year. I think the stuff is been uploaded a bit more quicker et cetera so but I'm not amazed by to give it higher mark so I'd give it a 6" (MT)

"2 at best…..The actual development of the ECM is probably a reasonable program, it's just the applicability we've been given is very poor" (JT)

Discussion on question eighteen

Satisfaction is the extent to which clinicians have accepted and adopted ECM for work purpose and the mean score is 4.65 (5+7+1.5+7+5+6+4+6+6.5+1+3.5+6+2=60.5/13). Clinicians see potential in ECM but are not satisfied that it is functioning as desired in its current state. At 4.65, it is slightly less than average meaning there is a great need for improvement to get clinicians satisfaction level to a 7 or 8. To meet the full expectations of clinicians, ECM will have to function optimally. As an electronic system, ECM is expected to digitise clinical notes so clinicians would have real-time access. The ability to edit and search as well as store, retrieve and share patient information between authorised users is also important. An ECM shortcoming such as non-searchability adds to clinicians' administrative work. This is substantiated in Pillay's study (2008: 257) on work satisfaction of medical doctors in the South African private health sector, where he found that on average, doctors were less satisfied with their current practice environment, administrative load and personal time. There is a sense that clinicians' frustration can also be attributed to an increase of administrative work using ECM. This is to say a clinician will spend more time searching through tons of information for a single item because ECM does not have search functionality. This can be another contributor to clinicians below average satisfaction level.

There is an association between clinicians' satisfaction and ECM performance expectations as indicated in the works of Wu, Tennyson and Hsia (2010: 161). Their study focused on student satisfaction in a blended e-learning system environment. They found performance expectations to be positively associated with learning satisfaction. Clinicians' satisfaction would mean that ECM met their expectation and a further motivation to want to continue use. Unfortunately, clinicians' satisfaction fell short of meeting ECM performance expectations.

Similarly, Wu *et al* (2010: 162) found that a higher level of interaction is positively associated with a higher level of performance expectations. Interaction is explained as physical contact between students, instructors, e-learning system environment (which includes learning technologies). When applied to this study, clinicians' interaction with each other and with ECM is said to be associated with their performance expectation. In view of this, it can be said that clinicians' interaction is associated with their performance expectation which is also associated with their satisfaction of ECM. This concludes that there is a relationship between system interaction, performance and satisfaction. This relationship can be improved if ECM functionality and features is improved.

The next section is a summary of the analysis and findings chapter.

5.13. Chapter five summary

The analysis and findings chapter is a detailed step by step analysis of qualitative data collected from clinicians regarding their daily experiences using ECM. Interview questions were adopted from questions of the quantitatively survey questionnaire met validity and reliability tests requirements. Qualitative credibility and dependability of the interview questions were also tested using truth-value, applicability, consistency and neutrality as trustworthiness criteria. Clinicians' identities are coded according to the anonymity agreement between researcher and respondents. Themes were identified from the literature and categorised as perceived usefulness, relative advantage, perceived ease of use, job-fit, complexity, facilitating conditions, affect and use behaviour. Clinicians were then interviewed individually about their experiences using ECM in meeting their expectations. One hundred (100) clinicians were contacted and re-contacted several times via emails but fifteen (15) were finally interviewed based on their willingness to participate in the study and availability. Interviews lasted between 20-30mins. Purposive sampling approach was initially proposed with snowball sampling later adopted to increase the sample size of participants.

Propositions developed in prior chapter are tested by analysing the data collected. All twelve (12) propositions were tested to ascertain the level of significance, relevance and fit. Each proposition results is explained and supported with academic literature. Each proposition result will help to ascertain its relationship and the level to which it fits into the developed framework. The technology use framework is developed and proposed as a strategic tool in future upgrades and implementation at Tygerberg hospital. The idea here is to improve ECM use.

This study concludes by making recommendations and highlighting areas for future research within the health information systems domain. Limitations and its contributions are also discussed, all in the next chapter. The conclusion and recommendation chapter will also explain the level of relationship between the themes in the proposed conceptual framework and attempt to answer the research questions and meet the research objectives.

CHAPTER SIX – CONCLUSION AND RECOMMENDATIONS

Chapter one dealt with an introductory and summarised detail of the objectives of the study, the problem at hand, research questions and formulated propositions to guide the study. Chapters two introduced the themes in general and selected themes used in developing the conceptual framework. Chapters three is a detailed literature of research conducted on electronic systems in the health domain and cases in a SA context. Chapter four introduced research methodology highlighting the methods used in the study as well as research design, population sample, sampling technique(s) and pilot study. Chapter five is an analysis of qualitative data collected and its findings in answering the research questions and achieving the research objectives. Propositions formulated were tested and conclusions drawn. Chapter six explains and summarises the study, make recommendations and suggest possible research areas for future study.

6.1. Conclusion

In understanding clinicians' cognitive attributes that influence their attitude to use the electronic record system (known as ECM) at work, explanation will be undertaken under each research question indicated below.

The main research questions and subsequent research objectives for each question is discussed below.

Research question one:

To what extent does cognitive attributes influence clinician's attitude to use EPR?

Using the qualitative data which formed the core data for this study, clinicians' cognitive attributes to a large extent influenced clinicians' attitude to use EPR. Clinician's cognitive attributes are perceived usefulness (PU), relative advantage (RA), complexity (COM), job-fit (JF), facilitating conditions (FC) and perceived use of ease (PEOU) all influence attitude (ATT) at varying extents. For example, PU, COM, FC and PEOU all have high influences on clinicians' attitude towards ECM use. On the other hand, RA and JF have moderate influences on ATT. It means all six (6) attributes influence clinicians' desire to use ECM even though the hospital's policy and procedure already mandates them to do so. That desire drives them to want to use ECM better and more efficiently in meeting both the hospital

and patients' needs. It is safe to say clinicians' cognitive attributes are not influenced by outside forces or influences such as friends or family. Rather it is driven by their direct experiences using ECM. Their moderate influences can be improved if hospital management support clinicians through better working relationship and involving them in decision processes that affects their work.

Clinicians perceive ECM to be useful and hopes that it will be able to function much better in aiding them perform their work tasks better. ECM is not much different from other systems installed at the hospital thus clinicians do not find it complex. They find ECM easy to use because the support they receive is adequate but more could be done. All these attributes contribute towards the positive attitude displayed in using ECM and enables clinicians to perform their work tasks as best as possible.

In the areas of RA and JF specifically, clinicians are somewhat frustrated with some functionalities and features that ECM cannot perform and find the system inadequate or lacking in these regards. While this frustration is not intense, they believe if these functions and features are improved, it will enable them perform better.

For research question two, it states:

To what extent does clinician's attitude influence clinician's EPR use behaviour?

Clinicians' attitude (ATT) has a high influence on their use of ECM as indicated in the revised technology use framework. This means if clinicians' attitude is negative then it impacts directly on their behaviour to use ECM. Alternatively, if clinician attitude is positive, then behaviour to use ECM will be positive. For this study, clinician attitude is positive meaning they have a positive inclination to use ECM irrespective of its shortcomings. Clinicians' attributed this attitude to the fact that they are mandated to use ECM and because they perceive it to be useful having the potentials to deliver better health service. From the data analysis, clinicians are optimistic that ECM has the potential to aid their work task through better storage and share, to secure information, and process information for decision making purposes. Though ECM still has teething problems as indicated by clinicians themselves, they still perceive the system (if improved) to be beneficial and the right way to go in health service delivery.

Research question three states:

To what extent does clinician's use behaviour impact information storage, retrieval and share purposes?

The themes; storage, retrieval and share indicate their usefulness in understanding what clinicians' use ECM for. Though clinicians' use ECM for many other tasks, storage, retrieval and share is considered a generic task. Clinicians' use behaviour is positive and has high impact on storing patient information as well as retrieving and sharing. Clinician's currently store information by physically writing on paper which is later scanned into ECM. A cardiologist interviewed actually uses ECM to store patient information during and after consultation by typing the information directly into ECM. Retrieval is through access codes comprising of username and password. Sharing of information using ECM is moderately as clinicians' understand sharing to mean communicating patients' information with colleagues at Tygerberg hospital or other hospitals. The sharing of patient information with colleagues at Tygerberg is via access points using access codes by each individual clinician. Sharing patient information with colleagues outside Tygerberg is not possible as at the moment. In summary, clinicians use behaviour has high impact on storage and retrieval but moderate impact on sharing.

Research question four states:

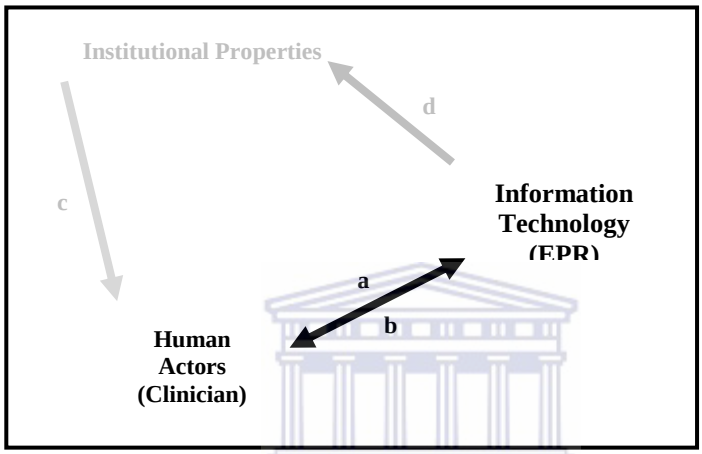
How is EPR currently functioning in the storage, retrieval and sharing of patient's record?

The ECM system functions as a note-keeping and archiving system where clinical notes are stored. After consultation and treatment with a patient, notes are taken and scanned into ECM. The turnaround time to view these notes on ECM takes between 1-2weeks. This is the main form of storage as indicated by most clinicians. Only one clinician indicated that he directly inputs information into ECM after consultation and treatment. All clinicians indicated that retrieving information is possible by entering their access codes and viewing patient information. Information retrieved is an exact copy of the notes scanned with no alterations or distortions.

Sharing of patient information is problematic as clinicians do not necessarily use ECM for this purpose even though they would prefer to. Their understanding of sharing is that other colleagues can access their patients' information by accessing ECM using their individual access codes. They cannot use ECM to refer a patient to a colleague within TBH or other hospitals. They cannot use ECM to

share information via internet as ECM lacks this functionality. In retrospect, they use ECM for sharing information within their abilities.

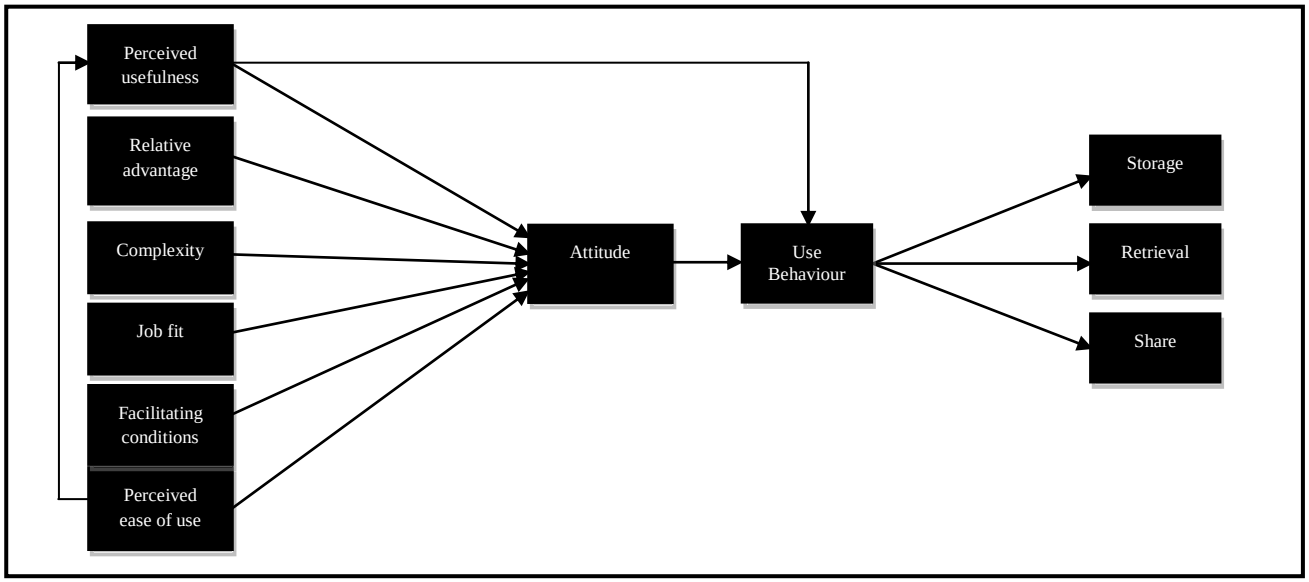
The technology use framework is derived from the structurational model of information technology shown below. This framework explains the partial structurational model of technology adopted for this study. The partial model involves human interaction with technology and vice versa. It excludes the influences of technology on institutional properties (arrow d) and the institutional properties influence on the human actors (arrow c). This is a reason why arrows "c" and "d" are omitted.



Source: Orlikowski, W.J., and Robey, D. (1991). Information technology and the structuring of organisations. *Information Systems Research*, *2*(2), 143-169.

The technology use framework is developed to act as a guide for improving ECM. The themes identified in the study are unique to Tygerberg hospital (TBH) situation and not necessarily all the themes required for the framework. Some themes (such as intent to use) were excluded in this framework because ECM is already in use. The model states that the introduction of a technology to an organisation will have an effect on its structure. This effect will not necessarily change the organisation's physical structure but its presence will provoke human interactions by virtue of work roles and social networks and thereby influence organisations. The introduction of ECM provoked clinicians' interaction by virtue of their operation of the system to perform their work roles. The generic technology use framework developed in this study is depicted below.

Figure 6. 1 Final technology use framework



The findings of the study are indicative of clinicians' expectations of ECM. The contributions of this study are contained in the next section with limitations discussed thereafter.

6.2. Contribution to IS body of knowledge

Within the discipline of information system (IS) and health information systems in particular (HIS), this study presents the technology use framework as a point of reference for hospital management planning to adopt a technology such as ECM but more importantly for those using it.

Many IS frameworks, models or theories have been applied in health research studies. For example, theories applied to health include the Diffusion of Innovations (DOI) and the Unified Theory of Acceptance and Use of Technology (UTAUT). Model applied to health is the Technology Acceptance Model (TAM).

In South Africa (SA), the study by Cilliers and Flowerday (2013) is one of the few researches that used a model as opposed to the other studies. Gregor (2002: 2) explicitly state that despite the recognition of the need for theory development and contributions to knowledge, there is surprisingly few discussions in IS forums of what constitutes theoretical contributions in this discipline and what form these contributions to knowledge can take. Gregor's (2002) claim is close to home in SA as many academic works still lack theoretical development underlining them.

The development of a technology use framework contributes to the body of IS knowledge taking into cognisance its ability to improve ECM at Tygerberg hospital. This framework is flexible, meaning some themes may be added or removed, depending on the research setting, hospital situation and the purpose of use. There is no single framework, model or theory that can be applied to health in SA as each has its limitations. This framework is not in comparison to the TAM and UTUAT model in a SA context since it provides an outcome for using technology. Theoretically, this framework combines various technology use themes. Each theme is useful towards developing this health information system framework that can be applied to any hospital with additional theme added or existing ones omitted to meet each hospitals' objectives. While this framework was developed for Tygerberg hospital, it can be applied to any SA public hospital having ECM in operation. This is because the clinicians and hospital environments have very similar characteristics. For this reason, the framework has an advantage of flexibility and generalisation. The latter is in contrast with qualitative study which has a limitation of generalisation.

South Africa is unique, in that, its history is permeated with discrimination based on race and gender and has had a pronounced effect on the health of its people and the health policy and services of the present day (Coovadia *et al.*, 2009: 817). Continuing, Coovadia *et al*. (2009: 817) says, before 1994, political, economic, and land restriction policies structured society according to race, gender, and age-based hierarchies, which greatly influenced the organisation of social life, access to basic resources for health, and health services. In addition, the authors highlight four concurrent epidemics plaguing SA, a health profile found only in the Southern African Development Community (SADC) region. For example, poverty-related illnesses, such as infectious diseases, maternal death, and malnutrition, remain widespread, and there is a growing burden of non-communicable diseases e.g. poverty-related diseases, chronic diseases of lifestyle and high rates of injury (Rispel and Barron, 2010: 802)..

This framework is unique to SA which is considered a middle-income country in terms of its economy, but has health outcomes that are worse than those in many lower income countries (Coovadia *et al.*, 2009: 817). Most South Africans access public health so a need to have their health information securely available and accessible is paramount. The technology use framework addresses the issues currently faced by clinicians who use EPR. The framework helps identify clinicians' attributes and their perceptions towards EPR use, thus equipping hospital management with better information where to improve the system. The EPR is important in helping to avail patient health information centrally, securely and real-time for clinicians to use in both diagnosis and treatment.

The technology use framework should be used a guide in addressing EPR current use. Judging from the data, the primary users (clinicians) have voiced their concern of how the system operates, are still positive of its potential but skeptical of management commitment towards its improvement. The researchers' stance on EPR is that it is an effective system that currently lacks the capabilities to meet health delivery objectives. If clinicians' concerns are duly addressed, EPR can be optimally utilised to deliver health services much better. The EPR system is used differently in SA as compared to other countries such as Australia. For example, in the study by Uren, Kirkman, Dalton Zalcberg (2013: 13) in Australia, the use of electronic medical record (EMR) has affected the way in which trial data can be managed as remote access to the systems, in a secure manner via the internet, offered the potential for review of source data by trial monitors without traveling to the trial site. Furthermore, large portions of source data (e.g., pathology and diagnostic imaging results, outpatient progress notes, radiology, chemotherapy prescriptions, and so on) can be accessed electronically.

In the USA, EHR adoption by family physicians has steadily risen reaching approximately 67% in 2011 in the study conducted by Xierali, Hsiao, Puffer, Green, Rinaldo, Bazemore, Burke and Phillips (2013: 17). Further to this, the authors say reasons for physicians embracing health information technology (HIT) include, innovative HIT funding mechanisms, which offer financial support for HIT adoption, such as EHR implementation, prescription drug tracking, and quality data reporting. South African clinicians use EPR more as a retrieving system which inhibits their ability to capture, store and share patient information.

The use of a qualitative method contributes to IS study which traditionally applies quantitative methods. Studies in SA do not use qualitative study approach thus this study brings new insights into clinicians' perceptions, thoughts, attitudes and expectations of technology. Qualitative approach has the advantage of in-depth information inquiry. Methodologically, this framework can be applied quantitatively or qualitatively, depending on the research problem or objectives.

The framework is not isolated from limitations as highlighted in the next section.

6.3. Limitations of the technology use framework

A limitation is that it applies to a hospital situation where the intent to adopt a technology is insignificant. It only applies to a hospital situation post-implementation of an innovative technology.

The theme known as intention to use is excluded from the framework because Tygetberg hospital already has ECM in operation. This theme does not limit a hospital hoping to adopt a technology like ECM from applying this framework as it should act as a useful a guide for both technology adoption but more for use.

There is also the limitation of the entire study which is discussed below.

6.4. Limitation of the research study

The current study faced some challenges and difficulties. The first challenge is accessing clinicians. The participation of clinicians in studies of this nature is worrisome. Clinicians are busy and not reluctant to participate in research studies especially if the researcher is not a clinician. This worry emanated from the qualitative data detailing clinicians' concern of ECM implementation. For this reason, one would expect a much higher clinician participation so as to devise solutions towards its future use. The sample size was also too small to undertake quantitative analysis because of low clinician participation. Using a mixed method would have enhanced the study if the sample size was much larger as power analysis such as inferential statistics, regression and structural equation modelling (SEM) could have been applied. Snowball sampling was introduced at a later stage as a measure of urgency so as to increase clinician sample size. This should have not been the case as random or purposive samplings are better suited for a study of this nature. The time spent with clinicians is also a challenge as clinicians interviewed in this study had very limited spare time to participate. A much longer interview time may have made a difference in this study.

The results in this study cannot be generalised across all Western Province hospitals as many hospitals lack an EPR system. Although the results are relevant and generalisable to clinicians working at hospitals where the ECM system is implemented. Another challenge is the processing time for ethics clearance. The researcher waited for almost 6months before ethics clearance was granted to undertake the study. The researcher had to communicate with multiple hospital staffs in identifying the stage where the processing was. The allocation of a dedicated staff or office to handle such research applications can help improve the application process.

A difficulty experienced by the researcher is communication. Clinicians do not communicate. The time spent contacting and re-contacting clinicians to participate in study is time-consuming and in many instances, is not fruitful. The researcher after making presentation to two hospital management

was elated at the positive responses and feedback to participate. Afterwards, both the hospital and clinicians did not follow on their commitment to allow their clinicians participate in the study.

Possible recommendations are explained in the next section. These recommendations are directed at Tygerberg hospital management and the Western Cape department of health as both authorities are responsible for ECM implementation.

6.5. Recommendations

- All further decisions regarding ECM functionality or customisation should be undertaken in consultation with clinicians. This is because clinicians are the primary users. A representative or clinician representatives should be initiated so they are involved in every decision–making process regarding ECM going forward.
- Persons scanning clinical notes into ECM should be selected by clinicians and probably should be persons who work with clinicians as administrators or support staffs as they will have the ability to understand what is required for scanning and what is not. This is important so as to streamline the process and improve quality and quantity of information scanned into ECM. Clinicians complained about many blank pages found in a patient's record as this further makes their search for a single piece of information time consuming.
- Since the cardiology division has been able to improve ECM use by direct input, it is important to learn from them how it was done and empower the other divisions within TBH.
- At current, there are successful working parallel systems and some of these other systems have been developed in-house thus a need to integrate them with ECM.
- Access to ECM should be possible within and outside TBH as clinicians have a need to work from home to acquaint them with patient information before treatment. Access can be via intranet, internet or Wi-Fi connections which are secure and safe.
- Clinicians should be motivated to suggest possible solutions to hospital management how best to maximise ECM use. A forum for this can be initiated and where it already exists, it needs to be improved.
- The ECM system is designed to function in such a way as to aid clinicians with many of their clinical tasks. At current, ECM has the potential to aid clinicians' tasks so additional training and possible customisation is required.

6.6. Future research study areas

The study commenced as a mixed method study but later changed to a mono-method of mixed research designs. The reason is because of the difficulty in accessing clinicians, thus a quantitative pilot study for validating questions and later a qualitative study adopted for the main study. A quantitative research study should be applied to ascertain clinicians' cognitive attributes towards technology using the proposed technology use framework developed in this study.

Further to this, hospitals such as primary healthcare facilities and district hospitals should be used for subsequent study since they cater for specific healthcare needs. This framework should be applied to ascertain clinician's cognitive attributes.

A deeper understanding of clinician's frustrations and satisfaction towards technology use should be investigated. This is important to mitigate further failures in technology implementations. A possible mixed method approach should be applied for future studies.

The small sample size used remains a source of concern. The technology use framework developed should be applied to a much larger sample and findings compared to this study. The framework should also be applied to a hospital hoping to adopt a technology such as an EPR.

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APPENDICES

Appendix A – University ethics clearance

UNIVERSITY of the
WESTERN CAPE

OFFICE OF THE DEAN
DEPARTMENT OF RESEARCH DEVELOPMENT

14 February 2014

To Whom It May Concern

I hereby certify that the Senate Research Committee of the University of the Western Cape approved the methodology and ethics of the following research project by:
Mr T Tokosi (School of Business and Finance)

Research Project:	Electronic patient record (EPR) system in South Africa: Information, storage, retrieval and share amongst clinicians.
Registration no:	14/1/24

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Private Bag X17, Bellville 7535, South Africa
T: +27 21 959 2988/2948 . F: +27 21 959 3170
E: pjosias@uwc.ac.za
www.uwc.ac.za

Appendix B – Mitchells Plain hospital (MPH) approval letter

Western Cape Government
Health

STRATEGY & HEALTH SUPPORT
Health.Research@westerncape.gov.za
tel: +27 21 483 6857; fax: +27 21 483 9895
5th Floor, Norton Rose House,, 8 Riebeek Street, Cape Town, 8001
www.capegateway.gov.za)

REFERENCE: 2014RP132
ENQUIRIES: Ms Charlene Roderick

Robert Sobukwe Road
Private Bag X17
Bellville
7535
Republic of South Africa

For attention: **Mr Temitope Oluwaseyi Tokosi and Prof Visvanathan Naicker**

Re: ELECTRONIC PATIENT RECORD (EPR) SYSTEM IN SOUTH AFRICA: INFORMATION, STORAGE, RETRIEVAL AND SHARE AMONGST CLINICIANS.

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 in accessing the following sites:

Mitchell's Plain Hospital **H Human** **Contact No. 021 360 4676**

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 (Health.Research@westerncape.gov.za).
3. The reference number above should be quoted in all future correspondence.

Yours sincerely

AT HAWKRIDGE.

DR A HAWKRIDGE
DIRECTOR: HEALTH IMPACT ASSESSMENT
DATE: 13/4/2015.
CC **P OLCKERS** **DIRECTOR: MITCHELL'S PLAIN / KLIPFONTEIN**

Appendix C – Tygerberg hospital (TBH) approval letter

Western Cape Government
Health

Tygerberg Hospital

REFERENCE: Research Projects
ENQUIRIES: Dr G G Marinus
TELEFONE: 021 938-6267

ETHICS NO: 14/1/24

Electronic patient record (EPR) system in South Africa: Information, storage, retrieval and share amongst clinicians.

Dear Mr Tokosi

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 here at Tygerberg Hospital.

Please note, that the Pilot Study is hereby approved and that you are responsible for administrative logistics of your research project.

DR D ERASMUS
CHIEF EXECUTIVE OFFICER
Date: 13 July 2015

Appendix D – University permission letter to conduct pilot study

UNIVERSITY of the
WESTERN CAPE

OFFICE OF THE REGISTRAR

18 May 2015

Mr. TO Tokosi
St No 9914091

Dear TO Tokosi

PERMISSION TO CONDUCT RESEARCH AT UWC

Electronic patient record (EPR) system in South Africa: Information, storage, retrieval and share amongst clinicians.

Thank you for complying with our requirements for obtaining permission to do research at the University of the Western Cape.

I hereby grant permission for you to pilot your online survey questionnaire to UWC academic staff at the school of Nursing, Pharmacy and Dentistry.

You may contact the following staff members to assist you further;

Pharmacy – Benita van Rooyen Tel 9593667 or email- bljohnson@uwc.ac.za or Room K2 Level 1 Pharmacy Building.

Dentistry – Zulfa Smith Tel 937 3184 or email zsmith@uwc.ac.za or Dentistry Faculty on the Tygerberg campus, please call her for directions.

Nursing – N Johannes Tel 9593482 or email njohannes@uwc.ac.za or Nursing Department, Senate Building: second floor room G6.

Your research will make an important contribution to our knowledge base and I wish you every success with the completion of the study.

Yours sincerely

Nita Lawton-Misra
REGISTRAR

Private Bag x17, Bellville 7535,
South Africa T: +27 21 9592111.
registrar@uwc.ac.za. www.uwc.ac.za

Appendix E – Final questionnaire

CLINICIANS QUESTIONNAIRE

A. Age, gender and work

Age	**Gender**	**Occupation** (clinicians only)	**Work experience (yrs)**
(Type age here)	☐ Female ☐ Male	(Type occupation here)	(Type total work experience at this facility)
Race	**Highest education**	**Disability**	
(Type race here)	(Type education here)	(If yes, type name of disability here)	
A clinician is any health professional whose practice is based on direct observation and treatment of a patient at a healthcare facility.			

B. Ability to use computer Yes ☐ No ☐

(*Check like this:* ☒ or √)

	Very good	**Good**	**Fair**	**Not good**	**Poor**
1. What is your level of ability to use a computer?	☐	☐	☐	☐	☐

C. About the availability of the computers at your working place at the hospital

(*Check like this:* ☒ or √)

	Yes	**No**

1. Do you have a computer in your office? (answer no If you have no office at all)		☐	☐
2. Concerning other rooms you use for clinical work, (e.g. ward, outpatient clinic offices, investigation rooms)			
	a. Are there any computers available for you here?	☐	☐
	b. If yes, do you use these computers?	☐	☐
If you responded "no" to both questions 1 and 2a, you do not have to fill out the rest of the questionnaire			

3. About the computers installed in the ward, at the outpatient clinic offices, investigation rooms and so on.

		Never	**Rarely**	**Monthly**	**Weekly**	**Daily**
	a. How often are you prevented from using the computers because others are using them?	☐	☐	☐	☐	☐
	b. How often are you prevented from using them because of computer errors, forgotten passwords or other machine-related problems?	☐	☐	☐	☐	☐

D. About your use of <u>Personal Computers</u> (PC) for clinical tasks in the hospitals

(*Check like this:* ☒ or √)

How often do you use a personal computer (PC) to assist you with the following tasks:					
	Never/ almost never	Seldom	About half of the time	Most of the time	Always/ almost always
	1	2	3	4	5
1. Review the patients problems	☐	☐	☐	☐	☐
2. Seek out specific information from patient records	☐	☐	☐	☐	☐
3. Follow the results of a particular test	☐	☐	☐	☐	☐
4. Obtain the results from new tests or investigations	☐	☐	☐	☐	☐

5. Enter daily notes	☐	☐	☐	☐	☐
6. Obtain information on investigation or treatment procedures	☐	☐	☐	☐	☐
7. Answer questions concerning general medical knowledge (e.g. concerning treatment, symptoms, complications and so on.)	☐	☐	☐	☐	☐
8. Produce data reviews for specific patient groups (e.g. complication rate, diagnosis	☐	☐	☐	☐	☐
9. Order clinical biochemical laboratory analyses	☐	☐	☐	☐	☐
10. Obtain the results from clinical biochemical laboratory analyses	☐	☐	☐	☐	☐
11. Order X-ray, ultrasound, CT investigations	☐	☐	☐	☐	☐
12. Obtain the results from X-ray, ultrasound, CT investigations	☐	☐	☐	☐	☐
13. Order other supplementary investigation	☐	☐	☐	☐	☐
14. Obtain the results from other supplementary investigation	☐	☐	☐	☐	☐
15. Refer the patient to other departments or specialist	☐	☐	☐	☐	☐
16. Order treatment directly (e.g. medicines and so on.)	☐	☐	☐	☐	☐
17. Write prescriptions	☐	☐	☐	☐	☐
18. Write sick leave notes	☐	☐	☐	☐	☐
19. Collect patient information for various medical declarations	☐	☐	☐	☐	☐
20. Give written individual information to patients e.g. about medications, disease status	☐	☐	☐	☐	☐
21. Give written general medical information to patients	☐	☐	☐	☐	☐
22. Collect patient info for discharge reports	☐	☐	☐	☐	☐
23. Check and sign typed dictations	☐	☐	☐	☐	☐
24. Other (specify).					

What is the name of the system you use at work?

E. About your choices or reasons to use EPR* at work

How many years (or months) of experience do you have using an EPR system**? .....**

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
	5	4	3	2	1
1. **Perceived usefulness**					
a. Using the system improves my performance in my job.	☐	☐	☐	☐	☐
b. Using the system enhances my effectiveness on the job.	☐	☐	☐	☐	☐
c. I find the system to be useful in my job.	☐	☐	☐	☐	☐
d. Using the system in my job increases my productivity.	☐	☐	☐	☐	☐
2. **Relative advantage**					
a. Using the system enables me to accomplish tasks more quickly.	☐	☐	☐	☐	☐
b. Using the system enables me improve the quality of the work I do.	☐	☐	☐	☐	☐
c. Using EPR increases my productivity.	☐	☐	☐	☐	☐
3. **Job-fit**					
a. Use of the system will have no effect on the performance of my job.	☐	☐	☐	☐	☐
b. Use of the system can decrease the time needed for my					

important job responsibilities.	☐	☐	☐	☐	☐
c. Use of the system can significantly increase the quality of output on my job.	☐	☐	☐	☐	☐
d. Use of the system can increase the effectiveness of performing job tasks	☐	☐	☐	☐	☐
e. The system can increase the quantity of output for same amount of effort	☐	☐	☐	☐	☐
4. **Perceived ease of use**					
a. My interaction with the system is clear and understandable.	☐	☐	☐	☐	☐
b. I find the system to be easy to use.	☐	☐	☐	☐	☐
c. I find it easy to get the system to do what I want it to do.	☐	☐	☐	☐	☐
d. interacting with the system does not require a lot of my mental effort.	☐	☐	☐	☐	☐
5. **Complexity**					
a. Using the system takes too much time from my normal duties.	☐	☐	☐	☐	☐
b. Working with the system is so complicated; it is difficult to understand what is going on.	☐	☐	☐	☐	☐
c. Using the system involves too much time doing mechanical operations (e.g., data input).	☐	☐	☐	☐	☐
d. It takes too long to learn how to use the system to make it worth the effort.	☐	☐	☐	☐	☐
6. **Affect**					
a. The system makes work more interesting.	☐	☐	☐	☐	☐

b. Working with the system is fun.	☐	☐	☐	☐	☐
c. The system is okay for some jobs, but not the kind of job I want.	☐	☐	☐	☐	☐
7. **Facilitating conditions**					
a. A specific person (or group) is available for assistance with software difficulties.	☐	☐	☐	☐	☐
b. Specialised instruction concerning the popular software is available to me.	☐	☐	☐	☐	☐
c. A specific person (or group) is available for assistance with hardware difficulties.	☐	☐	☐	☐	☐
d. Guidance is available to me in the selection of hardware and software.	☐	☐	☐	☐	☐

***EPR** is a repository of information regarding the health status of a subject of care in a computer processable form within a health facility, stored, retrieved and transmitted securely, and accessible by multiple authorised users*

F. About the satisfaction of the EPR functions

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
	5	4	3	2	1
1. **Storage**					
a. I have the ability to use the system to store information	☐	☐	☐	☐	☐
b. I know how to use the system to store information	☐	☐	☐	☐	☐
c. I know how to operate the system to store my work	☐	☐	☐	☐	☐
d. I can store my work on the computer system					

properly	☐	☐	☐	☐	☐
2. **Retrieval**					
a. I have the ability to use the system to retrieve information	☐	☐	☐	☐	☐
b. I know how to use the system to retrieve information	☐	☐	☐	☐	☐
c. The information I retrieve is exactly how I want it	☐	☐	☐	☐	☐
d. The information I retrieve is exactly how I stored it	☐	☐	☐	☐	☐
3. **Share**					
a. I have the ability to use the system to share information	☐	☐	☐	☐	☐
b. I know how to use the system to share information	☐	☐	☐	☐	☐
c. I can share information with colleagues in my hospital using the system	☐	☐	☐	☐	☐
d. I can share information with other hospitals using the system	☐	☐	☐	☐	☐

G. Global assessment of the EPR installed in your department

1. How much do you agree with the following statement about the EPR system:	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
a. The EPR is worth the time and effort required to use it	☐	☐	☐	☐	☐

	Non-existent	**Poor**	**Fair**	**Good**	**Excellent**
2. All considered, how would you rate your satisfaction	☐	☐	☐	☐	☐

with the EPR installed in your department?					
3. All considered, how would you rate the success of the EPR installed in your department?	☐	☐	☐	☐	☐

4. All considered, to what extent has the system changed these two aspects of <u>your own</u> department?

	Significantly Decreased	**Decreased**	**No Change**	**Increased**	**Significantly Increased**
a. Ease of performing our department's work	☐	☐	☐	☐	☐
b. Quality of our department's work	☐	☐	☐	☐	☐

H. Comments

E.g. Were parts of the questionnaire unclear or ambiguous? Do you have any suggestions to the improvements of the EPR system? .....

……

……

……

Can the researcher do a follow-up, i.e. a one-to-one interview or focus group interviews with you at a later stage? ..... If yes, provide contact details here……

……

……

Appendix F – Interview questions

CLINICIANS INTERVIEW QUESTIONNAIRE

1. In your own words, what do you understand by electronic patient record system?
2. Do you have access to the hospitals electronic record system? How? Egg password and so on.
    a. Do you have one access code to all systems or multiple access codes? Describe
3. What is the name of the system you currently use at work?
    a. What other systems do you use at work other than ECM?
4. What do you use the system for? Explain.

Review the patients problems
Check and sign typed dictations
Collect patient info for discharge reports
Enter daily notes
Follow the results of a particular test
Give written individual information to patients e.g. about medications, disease status
Obtain information on investigation or treatment procedures
Obtain the results from new tests or investigations
Obtain the results from X-ray, ultrasound, CT investigations
Order clinical biochemical laboratory analyses
Order treatment directly (e.g. medicines and so on.)
Refer the patient to other departments or specialist
Write prescriptions
Write sick leave notes

5. What are your opinions/views about the EPR system when it comes to:
    a) Usefulness? e.g. do you find it useful in your job? Explain?
    b) Relative advantage? e.g. using it enables you improve the quality of the work over paper. How?
    c) Job-fit? e.g. Can the system improve the quantity of output for same amount of effort? How? Does the ECM fit into the kind of job you do??
    d) Ease of use? e.g. do you find it easy to get the system to do what you want? Example.
    e) Complexity? e.g. is it difficult to understand the system & how it works? Explain?
    f) Affect? e.g. the system makes work more interesting. Explain? Do you find ECM interesting or fun?
    g) Facilitating condition? e.g. are specific support staffs available for assistance with difficulties? Explain?
    h) Storage? e.g. do you know how to use the system to store information? Explain?
    i) Retrieval? e.g. do you know how to use the system to retrieve information? Example. Will patient information be in the same format stored with no alterations when retrieved?
    j) Share? a. Can you share information with colleagues in the hospital using ECM? If so how/

        b. What about sharing information with other hospitals?

i. In general, what is your general view of the EPR?

    a. Is it worth the time and effort required to use it?

    b. What is your satisfaction level with the system installed at your hospital between 1 and 10? Why?

    c. Any other information you want to share with me?

Appendix G – Interview guideline and consent form

Project title: Electronic Patient Record (EPR) system in South Africa: information storage, retrieval and share amongst clinicians

Primary investigator: Mr. Temitope O. Tokosi, PhD scholar, UWC

Primary supervisor: Prof. Visvanathan Naicker, UNISA

Dear Research participant,

You are invited to participate in a research study that forms part of my formal PhD research study. This information leaflet will help you to decide if you want to participate in this study. Before you agree to take part, you should fully understand what is involved and what is expected of you as the study participant. You should not agree to take part unless completely satisfied with all aspects of the study.

What is the study all about?

Patient record used in hospital by hospital staffs especially clinicians is important to improve information flow process in order to strengthen healthcare capacities. By this an Electronic Patient Record (EPR) system is necessary to cater for patient record because of its capacity to store, retrieve and share patient information. An appropriate EPR definition for this study is, '*a repository of information regarding the health status of a subject of care in a computer processable form within a health facility, stored, retrieved and transmitted securely, and accessible by multiple authorised users'.*

Additional information

1. There is **no** financial compensation or reward for participation in this study.
2. Your participation in this study is entirely voluntary.

3. The results of the study can only be made available to the participant upon written request stating reasons for its access.
4. Your answers will be totally anonymous and your identity will never be revealed under any circumstance. Also nobody outside the study panel will have access to your answers with intent to connect you to the study.
5. Your co-operation and participation in this study will be greatly appreciated.
6. The primary investigator, Mr Temitope O. Tokosi, can be contacted during office hours at telephone (021) 959 3682, or on his cellular phone at 076 047 1328, e-mail: toksymoore@gmail.com. The study leader, Prof. Visvanathan Naicker, can be contacted during office hours at telephone (011) 652 0223 and by e-mail: naickv@unisa.ac.za.

A final word:

Your co-operation and participation in this study will be greatly appreciated. Please sign the informed consent form if you agree to partake in this study. In such a case, you will greatly be contributing towards the development of our community and your participation is highly appreciated.

Thank you.

INFORMED CONSENT FORM

I hereby confirm that I have been adequately informed by the researcher about the nature, conduct, benefits and risks of the study. I have also received, read and understood the above written information. I am aware that the results of the study, including personal details will be anonymously processed into a research report or other research outputs. I understand that my participation is voluntary and that I may, at any stage, without prejudice, withdraw my consent and participation in the study. I had sufficient opportunity to ask questions and of my own free will declare myself prepared to participate in the study.

Participant's name _____ **(Please print)**

Participant's contact_____ **Email** _____

Participant's signature _____**Date**_____

Researcher's name Temitope O. Tokosi

Researcher's signature _____ **Date**_____