UNIVERSITY OF KWAZULU-NATAL

The Impact of Information and Communication Technology (ICT) on the efficiency of healthcare delivery at Radiology department of Inkosi Albert Luthuli Hospital

By

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Abstract

Healthcare service provision is undoubtedly a major priority for any governmental policy makers and society at large. Access to quality health care is declared a basic human right globally, yet there are many factors that still make it hard for countries to make this a reality. Issues such as shortage of skilled healthcare workers, high costs of healthcare provision and poor economic outlooks are some of the major contributors to gaps in provision of equitable healthcare services. Information and Communication Technology (ICT) has become an integral part of our daily life. The study aimed to investigate the role that ICT can play in improving the efficiency of healthcare delivery processes and spreading access to communities that are left behind in the provision of this basic human need. A quantitative methodology was used to evaluate the perception of professionals with regards to the adoption of ICT and its impact on healthcare services delivery at the radiology department. The target population was made up of administrators, radiographers and radiologists at the radiology department of Inkosi Albert Luthuli Central Hospital. Data was collected through questionnaires which were physically administered on site. A convenience sampling technique was used to identify and recruit study participants. The results revealed that 70% of respondents agree that ICT adoption does indeed increase efficiency of healthcare service delivery. The study did not find significant relationship between users' attitude towards ICT adoption and the ability of ICT to improve efficiency in a healthcare facility. It is recommended that healthcare facilities adopting ICT should invest more time and resources in training and offering technical support to end users. The study can benefit healthcare facilities who seek to improve the quality, speed, accuracy of healthcare services by using ICT systems.

List of Abbreviations and Acronyms

ICT   Information and Communication Technologies

HIS   Hospital Information System

CIS   Clinical Information System

EHHC   eThekwini Hospital & Heart Centre

IALCH   Inkosi albert Luthuli Central Hospital

eHealth   Electronic Health

QA   Quality Assurance

mHealth   Mobile Health

PHR   Personal Health Record

PPP   Public Private Partnership

GE   General Electric

WHO   World Health Organisation

ICU   Intensive Care Unit

GDP   Gross Domestic Product

UKZN   University of Kwazulu-Natal

SaaS   Software as a Service

LOS   Length of Stay

GUI   Graphical User Interface

IoT   Internet of Things

Contents

List of Tables and Figures

CHAPTER ONE: Introduction

1.1   Introduction

Information and Communication Technology (ICT) has become an integral part of our daily life. ICT has been integrated in many parts of business and industries such as education, manufacturing, mining and transportation to name but a few. ICT has exponentially entered our daily lives through availability of various multimedia interfaces that offers the opportunity to develop and adjust ICT solutions to all aspects of societal needs including health care (Haluza & Jungwirth, 2014).

The healthcare sector at large has seen a major uptake of ICT as a key facilitator and driver in the delivery of healthcare services. To stay competitive, effective and profitable, healthcare providers such as private and state hospitals have had to adopt ICT as a core building block of their operations. The maturity of various telecommunications and infrastructure building blocks as well as widespread availability has raised expectations from users that healthcare services will become more affordable and accessible due to technology growth (Gururajan & Hafeez-Baig, 2014).

Uses of ICT in healthcare includes the management of patient demographics and related information through the Hospital Information System (HIS); the automated monitoring of a patient's vital signs through a Clinical Information System (CIS); automated submission of medical bills to medical insurance companies (Masrom, et al., 2015).

It is widely accepted that healthcare, like many other industries is subjected to powerful forces seeking to shape the future and evolution of an industry. The forces are economic (this refers to the reduction of cost and maximization of profits), outcome driven approach (better quality), improved customer (patient) experience, and the general appeal of "Sophisticated technology" and moving with the times. This devotion to everything disruptive follows the almost religious fascination with online and ''app-based" everything, which supposedly supports the faster pace of life that is lived now (Petito, 2017).

1.2 Motivation for the study

Various studies have focused on the rate of ICT adoption in healthcare, the barriers associated with it and the solution thereof (Gururajan and Hafeez-Baig, 2014; Marlien, Pottas and Ruxwana, 2014). Factors such as lack of proper quality assurance (QA) methods, insufficient training and consultation in eHealth Projects were cited as major contributors to poor adoption rates.

A comparison of adoption rates between private and public hospitals revealed that private hospitals are leading in adoption mainly due to availability of funds and competency of the workforce (Qureshi, et al., 2015). The profit centric nature of private healthcare providers was also cited as a key driver for ICT adoption.

The adoption of ICT for use in Healthcare has the potential to help broaden access by connecting healthcare professionals and patients across dispersed geographical locations. Currently a concept known as eHealth (Electronic Health) is more predominantly used in the developed nations with developing countries like South Africa slowly catching up. Denmark, for example is shown to be a leader in the national healthcare information exchange (Beardsley, et al., 2010). As developing nations, such as South Africa are playing catch-up to nations like Denmark, there seems to be some resistance in fully adopting ICT in healthcare. A study into the reasons for poor adoption of ICT in rural hospitals in the eastern cape focused on Quality Assurance (QA) as integrated part of ICT projects in healthcare revealed that lack of proper QA methods in eHealth Projects resulted in the poor user adoption of ICT and therefore less impact of the technology on healthcare delivery (Marlien, Pottas & Ruxwana, 2014).

Even though various studies have shown how South Africa can use ICT to broaden access to healthcare to the rest of the population that was previously excluded and segregated through apartheid laws, various innovative ways of broadening this access should be investigated. Not enough focus has been paid to the real impact of ICT in healthcare in efficiency of delivery.

There is a need then, to validate why ICT adoption can be used as a key driver for the much-needed improvement of efficiency in healthcare delivery. This is especially

true in developing countries where availability of healthcare professionals such as doctors, nurses and other specialists are very limited (Spies & Muwanguzi, 2014).

1.3   Significance of the Study

By determining a compelling and significant link between ICT adoption and the improved efficiency in healthcare delivery, policy makers and healthcare administrators would be in a position to drive:

- A more deliberate and rapid adoption of ICT in Healthcare
- Better investment in ICT for Healthcare by Government and Private Sector
- Training and development of healthcare providers in ICT
- Help hospitals that have already adopted ICT to derive more value from their investment

The community and 'consumers' of healthcare services could also benefit if we manage to determine that ICT adoption does increase efficiency in service delivery:

- More patients would now be reached through implementation of ICT
- Quality of healthcare services could be improved

1.4   Focus of the study

This study focused at the Radiology department of Inkosi Albert Luthuli Central Hospital (IALCH) in the Durban area of the Ethekwini Municipality. The hospital has, since inception, integrated ICT into their healthcare service delivery strategy. We focused on healthcare professionals and administrators who have experience of using ICT as part of their daily duties.

1.5   Problem Statement

ICT has no doubt played a key role in the expansion and growth of various industries worldwide. A comparison study between developing and developed countries concluded that ICT plays a crucial role in the macroeconomics of both these country types across industries such and manufacturing, mining and tourism (Samimi, et al., 2015).Globalization as driven by the information age has made it easy for integration of industries by sharing and adopting best practice strategies across board. ICT usage in healthcare is still a bit behind when compared to other industries especially in developing nations (Spies & Muwanguzi, 2014).

Healthcare services in developing countries continue to suffer a talent brain-drain as developed countries are more able to attract qualified and talented healthcare professionals by offering better compensations and working conditions. Studies by the world health organisation(WHO) indicates an estimated shortage of approximately 4.3 million healthcare personnel worldwide (Aluttis, Bishaw & Frank, 2014). This has contribtued to complex pattern that sees health professionals moving from low income to relatively high income countries. It therefore highly imperative that developing countries like South Africa, who are faced with this shortage of healthcare professionals while at the same time trying to broaden healthcare access to previously neglected communities, look at innovative ways of providing healthcare with limited human and financial resources.

There has been extensive research and reporting on how both Public and Private healthcare providers are taking up ICT as part of their strategic functioning. There is however not enough research on the positive impact that ICT adoption has brought to healthcare efficiencies, quality and cost reduction. More research in these

areas could help accelerate the adoption and implementation of ICT by healthcare policy makers.

The adoption of ICT by many healthcare facilities is been seen largely as just keeping up with the times and perhaps automating for the sake of automating. It has not been thoroughly researched and demonstrated whether the introduction and adoption of ICT affect the efficiency of healthcare delivery at Hospital.

1.6   Research questions

This research aims to pull together empirical data to provide passable solutions to the following questions:

- Does ICT adoption lead to improved clinical outcomes?
- Does ICT positively affect the work of healthcare providers?

1.7   Objectives of the study

This study will help to determine if ICT adoption in healthcare delivery is a real necessity or just a luxury exercise that should be ditched in economic times where contain cost and driving up profitability is the biggest focus of many businesses, Healthcare included. The objectives are therefore to:

- Determine if ICT adoption has improved the efficiency of healthcare delivery.
- Determine if ICT helps to improve the jobs of healthcare providers

1.8   Methodology

Quantitative approach was followed to conduct this study. Quantitative research referrers to research strategy that values quantification in the collection and analysis of data. This further allows for a deductive relationship between theory and research which places emphasis on testing of theories (Bryman, 2015).

The population in this study is made up of Radiologists, Radiographers and Administrators at IALCH Radiology department. Out of this population, a sample of 38 Professionals was chosen to participate in the study using convenience sampling technique. A sample of convenience was chosen from the target population based willingness of respondents to participate in the study.

1.9   Chapter Summary

This Chapter has served as an introduction into the study that will be conducted. The stage has been set by briefly looking at how ICT has transformed various industries including healthcare. The motivation of the study is to help drive a more deliberate and rapid adoption of ICT in Healthcare thereby increasing efficiency and quality of services.

This study focused on the hospitals in the Durban area of the Ethekwini Municipality that have already integrated ICT into their healthcare service delivery strategy.

Through a carefully constructed questionnaire administered to a sample of healthcare professionals at IALCH, we will find answers to our research problem and determine whether the introduction and adoption of ICT affect the efficiency of healthcare delivery.

More details on the study will be presented on the chapters to follow. In the next chapter, we will review various literature that is available in the topic.

CHAPTER TWO: Literature Review

2.1 Introduction

In this chapter literature that has been done on concepts identified in this study is reviewed. The first literature concept to be explored is the Adoption of ICT in Healthcare as an independent variable to our study. We will start with a broad definition of ICT to lay the ground and introduce its application in Healthcare. Literature relating to the adoption of ICT globally and specifically in South Africa will be reviewed. Literature will be chosen by its specific focus on ICT adoption in the Healthcare services industry. Adoption will be looked at in terms of rate of adoption, the reach of ICT (the extent to which the specific technology is being adopted), etc. Literature will be divided per subset of Healthcare technology being evaluated (ICT only).

The second part focused on reviewing literature available on the efficiency of healthcare delivery. Efficiency was reviewed from access, quality, work flow turn-around times, and accuracy of healthcare services as affected by ICT systems. The concept of efficiency and its measurement parameters are looked at and introduced from a global perspective first and then narrowed down to South Africa to reach the area of focus. Literature on Efficiency is chosen based on the extent to which it incorporates ICT as factor.

2.2 What is ICT?

There are various ways that are often used to define ICT. ICT is widely used and therefore it often means slightly different things to different people depending on the industry and the direction they are looking from. Akande & Van Belle, (2014, p.1) defines ICT as "technologies with the capability of storing, transferring, processing and disseminating data". This definition of ICT covers all bases as it also introduces various categories that ICT can be divided into.

For our purpose, we will stick more with (Masrom, Karim & Hussean, 2015), who defines ICT in the sense of computer hardware, software and interfacing peripherals applied for the purpose of storing, processing and manipulating data thereby turning it into useful information. The application of these technologies in healthcare has helped to transform conventional and manual healthcare into digital format).(Masrom, et al., 2015)

2.3   ICT Adoption in Healthcare

ICT has transformed the way business is operated globally and has also helped to increase the efficiency in the delivery of products and services to our end customers. ICT has also played a vital role in addressing daily social issues and delivery of basic services (Haluza & Jungwirth, 2015).

It is reported that the Healthcare sector is one of the slowest adopters of Information & communication technology. There was huge resistance in the beginning with reasons ranging from complaints against decrease in number of patients seen, loss of reimbursements, lack of patient contact and so on coming mainly from clinicians (Gogia, et al., 2016). According to (Haluza & Jungwirth, 2014), factors such as financial viability, acceptance by advocacy groups, data security and privacy were amongst the top barriers to rapid ICT adoption in healthcare. Poor integration of ICT systems into complex clinical workflows as well as limited funding for ICT projects were cited as two major barriers for the slow uptake (Westbrook & Braithwaite, 2010). A study by (Andreassen, Kjekshus & Tjora, 2015) argue that ICT adoption in healthcare is mainly beneficial in management work than it is in clinical which results in huge resistance from clinicians and other healthcare professionals. The United States of America recognised the need for expedited adoption of ICT in healthcare and passed as special act called the Health Information Technology for Economic and Clinical Health (HITECH) Act into law in 2009. HITECH made an estimated amount of $14–27 billion available to incentives healthcare practitioners and facilities to adopt electronic health records more deliberately (Buntin, et al., 2017) .

The slow and arduous adoption of ICT in healthcare can be attributed to the noticeably limited   availability of definitive scientific evidence supporting its positive

impact on clinical practice, efficiency and economic outcomes (Saigí-Rubió, Torrent-Sellens & Jiménez-Zarco, 2014). On the other hand, a research conducted on 31 European studies argues that there is enough scientific evidence on the potential of ICT adoption and its use to positively influence and improve the quality and efficiency of care. The study cited the ability of ICT to encourage adherence and compliance to standardized policy and clinical guidelines as some of the motivations for widespread and rapid adoption of ICT in healthcare ((Rosis & Chiara Seghieri, 2015). Even though ICT adoption can bring added benefits to healthcare delivery, they also bring some level of complexities and challenges; certification of these systems and their relevance for clinical use (Kuhn, et al., 2015).

Other studies sought to investigate the level of adoption and the influences thereof at individual user level (Saigí-Rubió, et al., 2014) (Deng, et al., 2014). These studies concluded that users' personal use of ICT, attitude towards ICT adoption in healthcare, perceived value, technology anxiety are reliable variables that can be used to measure adoption at end-user level.

At Healthcare facility level, A study conducted in South Korea, which found the adoption rates to be as lows as 50.2% and 35% in tertiary and general hospitals respectively, attributed high capital outlay and maintenance costs as the major barriers (Oh, et al., 2015). The same study conclude that cloud based Software as a Service (SaaS) could serve as a great catalyst to enable small-medium sized healthcare facilities to adopt ICT without the burden of initial capital outlay. The impact and viability of Saas is yet to be realised though since it is fairly a new concept in the ICT world. This is especially true for the African continent and the healthcare industry in particular.

It is evident that Information and Communication Technology (ICT) will continue to enter various aspects of our lives daily. ICT gadgets are available in various forms today and they seem to grow exponentially. Today different types of multimedia interfaces such as Apple's 'iStore', Android or GE's Predix platform offers the opportunity to develop custom-made solutions to all industrial aspects including healthcare (Haluza & Jungwirth, 2015).

According to (Gururajan & Hafeez-Baig, 2014), A healthcare facility (Hospital, clinic, or health centre) base their decision to adopt ICT purely on the drivers and barriers of the use posed by the chosen technology. ICT in healthcare has been adopted in various forms depending on the type of technology, underlying infrastructure, geographical area, etc. A few of these variations will be briefly discussed below.

mHealth

Mobile communication technology continues to play a vital role the global community increases interconnectivity both economically and socially. Pew Research Centre reported that the percentage median of people using Smart phone has risen from 45% in 2013 to 54% in 2015 as determined from study conducted across 21 emerging and developing countries. This figure is still low when compared to a median of 87% measured across 11 advanced economies which includes the U.S and the U.K (Poushter, 2016).

The mobile communication revolution in Africa has exceeded growth expectations and continue to grow exponentially. In 2013, mobile phone access in Africa was estimated at 80%. Although a relatively low proportion of that had access to 3G connectivity, the access factor gave a lot of people optimism that the infrastructural gaps which excluded a large proportion of African communities from basic services could be overcome using mobile technology as one of the tools (Hampshire, et al., 2015).

The evolution of mobile technology and ease of accessibility thereof has presented a lot of opportunities for growth for some industries that use ICT. Banking, as an example was one of the first industries to take advantage of mobile phone evolution. Concepts such as mobile banking applications are common ground today (Sørensen, et al., 2015).

Healthcare as an industry also started riding on the mobile phone technology wave with the introduction of mHealth. According to (Hoque, Rakibul, Karim, Rezaul & Bin (2015)), mHealth can be generally described as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices"). It involves the use

of mobile technology to facilitate the delivery of healthcare services. The drivers for adoption of mobile technology by healthcare professionals is noted to emanate mainly from the communication and collaboration needs (Ventola, 2014).

The mobile technology can be either a short-distance or long-distance technology, or be device driven. Healthcare solutions providers and healthcare professionals have leveraged the boom of mobile phones to accelerate improvements in healthcare provisions. Adoption of mobile phones for healthcare has huge potential to improve delivery of healthcare services (Agarwal, et al., 2015). mHealth is indeed at the forefront of reducing or eliminating geographical barriers between patients and healthcare providers. It is thus central to the concept of pervasive healthcare where information and resources services can reach anyone, anytime, and anywhere, by removing geographical, temporal, and other barriers (Gagnon, Ngangue, Payne-Gagnon, & Desmartiset, 2015)

In a study focusing on the adoption of mHealth by healthcare professionals, Gagnon and others revealed that there are several factors influencing adoption categorised as individual, organisational and contextual levels. Usefulness, ease of use and perceive cost where identified as the key leading factors that influence adoption (Gagnon, et al., 2015). Perceived cost is an interesting finding in this study as the results revealed a higher cost associated with mHealth adoption which goes against the general expectation that ICT in general should drive healthcare costs down.

For mHealth to be effective as a driver for broader healthcare access, there is a need for a more directive policy drive. Current data shows that mHealth adoption seems to more incidental than intentional (Mehl & Labrique, 2014). There is currently no clear regulatory framework which is meant to speed up the widespread adoption of mobile technology to address healthcare needs. This is one of the inhibiting factors towards mHealth's potential growth. (Hoque, et al., 2015).

The attitude of end-users is a key driver towards moving mHealth projects beyond the pilot stages. Ensuring the end-users are positively inclined to technology adoption in the early phases of the healthcare ICT projects should be considered as a mandatory step (Kenny, et al., 2017). A study evaluating the attitude of patients towards the adoption of mobile phone based health technology (mHealth) revealed that most patients (79%) were more willing to try the technology if it came at no extra

cost to them ((McGillicuddy, et al., 2013). Another study conducted in 2016 concluded that there is a significant relationship between a users' attitude towards mHealth and their intention to use it. Positive attitude therefore can reliably predict a users' intention to adopt and use mHealth applications ((Hussein, et al., 2017).

On the other hand, there are studies that revealed negative attitude of users towards adoption of mHealth for various reasons. In a study conducted to evaluate patient's attitude towards mHealth using determinant factors such as 'expected performance', 'level of effort' and 'flexibility', the results revealed a largely negative attitude. Influencing factors for the negative attitude revealed in the study were attributed to lack of trust for the technology and time required to use the mobile apps (Woldeyohannes & Ngwenyama, 2017).

There are not many studies that have interrogated the extent to which mobile technology has been adopted particularly in South Africa. One of the biggest inhibiters of mHealth adoption in mostly rural provinces like Kwazulu-Natal is poor signal coverage. One of the few studies conducted in this province revealed that most of the areas did not have 3G coverage at all. The best available connection in most rural area was GPRS which offered upload speeds as low as 44kbps and download speeds of around 64kbps (Malcolm & Maurice, 2015).

A study focusing broadly on Sub-Saharan Africa's adoption concluded that adoption of this of this ICT subset for healthcare is very small scale and mostly fragmented (Brinkel, et al., 2014). The results revealed that lack of a supportive government policy, the technological complexity of ensuring interoperability and integration of ICT and securing privacy of information were some of the major challenges identified.

Most literature in this area did no interrogate the impact that mHealth, as part of broader ICT, has on the efficiency of healthcare delivery.

2.3.2 Personal Health Record (PHR)

Personal Health Record (PHR) refers to an application that allows individual patients to document and maintain an electronic record relating to their medical history. A PHR application is usually web-based and therefore allows access from anywhere, provided there's internet. PHR systems also enables the patients to share this record with various interested parties such as Physicians, Nurses, Medical Insurance and other entities at the owners' consent (Mxoli, et al., 2014). Personal Health Records (PHR) stored electronically has great potential to play an important role of creating a valuable relationship between patients and care givers. PHR keeps and maintains important information such as a patient's medical history, previous and ongoing medications as well as allergies (Kraan, et al., 2015).

PHR gives the patients the power and ownership of their health records, but also serve as an accurate record that can be used to track the patient's progress along a specific care path. Armed with accurate and more complete information, Physicians and patients alike, are better placed to make good healthcare decisions (Krist, et al., 2014).

PHR applications are often divided into 4 categories namely: Stand-a-lone, health plan patient's portals, Electronic Medical Records (EMR) patient portals and consumer centric PHR. (Krishnan & Dhillon, 2015). The most commonly used PHR applications are EMR patient portals and health plan patients' portals.

Medical aid providers like discovery have popularised health plan based PHR by giving the patient the power to 'take' their records wherever they go and give access to physicians within the discovery network. The limitation of health plan based ones like the Discovery health is the restriction that physicians must belong to the discovery network to be allowed access (Discover Health, 2017).

EMR based PHR are often owned by specific hospital network or group of hospitals like Netcare, Life healthcare, Mediclinic, etc. EMR based ones therefore limit a patient to access and share the record when consulting at a hospital or practitioner within that specific hospital network.

As evident in the figure 2.1 below, PHR allows a patient to have access to their health records from various hospitals or care points.
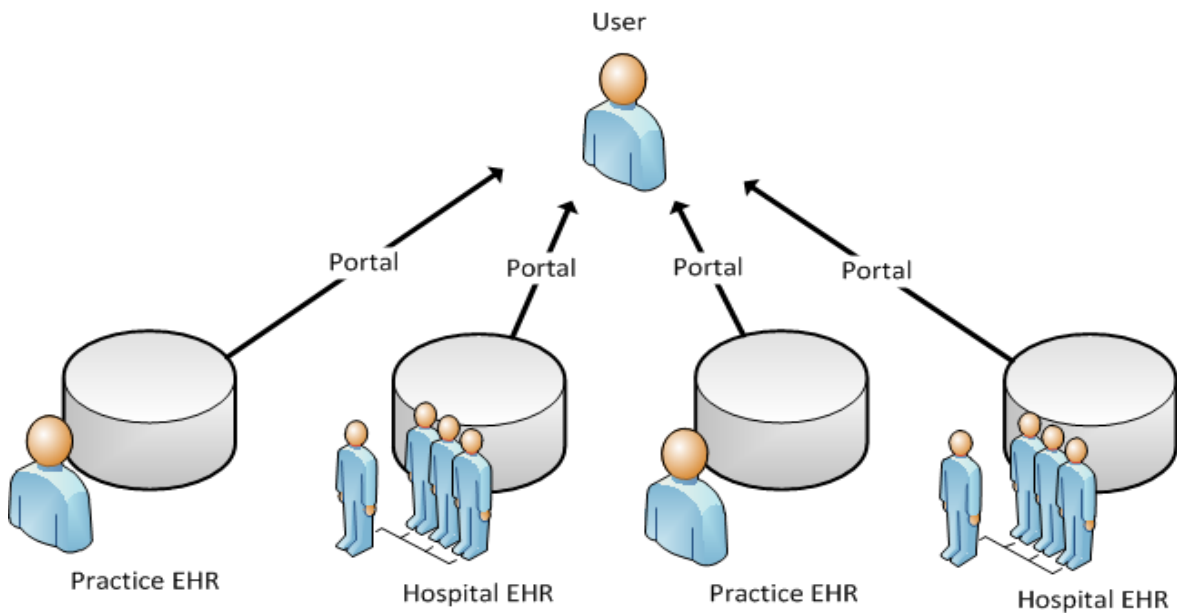
Figure 2.1 PHR access

A PHR allows an individual patient to have access to, manage and share a consolidated record of their medical history in secure electronic environment. The record includes all previous healthcare encounters from various care provides like community health centres, clinics and hospitals of all sizes. A patient can then choose to give access to a physician or any other healthcare professional attending to him/her at a period (Ozok, et al., 2014).

Despite the great potential benefits of PHR, there are still lots of challenges in the development and widespread of adoption globally. A study conducted in Malaysia (Krishnan & Dhillon, 2015), discovered issues such as Privacy, Usability, Access to Computers, Low literacy and Medical terminology to be among the highest barriers slowing down the required widespread adoption of PHR.

In South Africa, the adoption of PHR has not kicked-off the way it was anticipated. A study titled "Personal Health Records in the South African Healthcare Landscape" (Mxoli, et al., 2014), revealed that lack of awareness of PHR's existence among South Africans and lack of access to internet through traditional channels where the two main barriers limiting adoption of PHR.

2.3.3 Telemedicine

Telemedicine is another subset of eHealth. The term *telemedicine* literally means "healing at a distance" through the Latin "medicus" and Greek "tele″ (Kvedar, et al., 2014). The use of telemedicine can reportedly be traced as far back as 1906 however the term itself was only introduced in the 1970s. (Petito, 2017). The development and of telemedicine in the early stages was largely crippled by limitations such as lack of infrastructure and high cost of peripheral devices allowing user access (Wilson & Maeder, 2015).

The first real usage of telemedicine In Africa was noted in 1984 using a satellite link using slows can television transmission between Swaziland and London. On this case, Crouzon's syndrome was diagnosed (Mars, 2013).

There are various definitions used today for telemedicine most of which are narrowly focused on the specific use case. One definition that seems to be broad enough is "the provision of health care services, clinical information, and education over a distance using telecommunication technology that existed long before the Internet " (Krishnan & Dhillon, 2015). Mars on the other hand describes it as "the use of medical information exchanged from one site to another via electronic communications for the health and education of   the patient or healthcare provider and for patient care" (Mars, 2013). Considering this vast definitions and lack of consensus among practitioners, the World Health Organisation (WHO) defines telemedicine as ''The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities" (Petito, 2017).

As part of the definition above, the WHO further stipulated the following items to be essential part of telemedicine:

- Its purpose is to provide clinical support.
- It is intended to overcome geographic barriers, connecting users who are not in the same physical location.

- It involves the use of various types of information and communication technology.
- Its goal is to improve health outcomes.

Throughout various literature, telemedicine systems are often classified and distinguished into "Synchronous or real-time" and Asynchronous systems. The former facilitates immediate interaction between participating parties (collaborating specialists or doctor-patient). This has a great benefit as the interaction allows for improved efficiencies gained through an ability to clear up ambiguous issues in real time. Clinical decision making is therefore quicker in synchronous systems. The typical video-consultation between a doctor and patient is an example of a synchronous model. Asynchronous systems on the other hand allow for acquisition of data and interpretation or diagnosis to happen at different time periods. This approach can still bring improved efficiencies if the task does not require back and forth interaction between the specialist and patient or referring party. Typical example of Asynchronous approach is found in teleradiology. (Wilson & Maeder, 2015)

A study focusing on the application of telemedicine in eye care conclude that it is not possible to analyse risk/benefit ratios, or comparative effectiveness/cost ratios of telemedicine compared to traditional delivery of healthcare. Therefore, claims of equality, superiority, or cost-effectiveness cannot be accurate or relied on. (Petito, 2017). This study however, narrowly focused on eye care as a speciality and therefore the findings cannot be generalised to all healthcare disciplines. What can be deduced from the study is rather the fact that maybe telemedicine is not suitable for all healthcare fields. It is not a "one size fits all".

In a different study which was conducted across various specialities within a hospital, it was concluded that telemedicine offers a significant cost-effective alternative method of delivering healthcare services with the equivalent quality of face-face consultations (Cerbo, et al., 2015). Telemedicine can also be instrumental in reducing the high rate of Potentially avoidable hospitalizations by remotely screening and managing illnesses to avoid escalations (Jullia Driessen & Handler, 2016).

A study conducted to measure the attitude of patients towards using telemedicine revealed an overall positive result from a paediatric context. The positive result of this study was largely attributed to the technology profile of the respondents. A high technology profile, measured by prior access to technology devices and usage of social media platforms proved to be significantly related to the user's acceptance of telemedicine (Luisa Russo, et al., 2017).

The past few decades have seen telemedicine rapidly becoming a cost-effective alternative to contact care. The massive boom in the availability and drop in cost of underlying ICT Infrastructure has seen telehealth taking advantage of the situation and really taking off (Wilson & Maeder, 2015). An evolution of inter-connected hospitals powered by growing ICT infrastructure investments has brought physicians and patients closer together. (Kvedar, et al., 2014) Telemedicine basically encompasses various subsets of ICT in healthcare used to bridge the geographical gap between patient and healthcare provider.

Below we will look at few medical disciplines that have benefited from the evolution of telemedicine.

2.3.3.1   Teleradiology

Radiology is a key discipline positioned to diagnose and combat conditions such as pneumonia, tuberculosis and even HIV. Unfortunately, radiology services are very limited in areas in the Sub-Sahara Africa most hit by the conditions above. The patients in rural areas like Kwazulu-Natal, Northwest at Eastern Cape in South Africa are isolated and have limited access to doctors, hospitals and specialised radiology services. (Griggs, et al., 2014)

Teleradiology, a subset of telemedicine, refers to the transmission of diagnostic images from one location to another for interpretation and diagnosis. (Bess & Roberge, 2016). Teleradiology is reported to originate from way back in 1947 with the successful transmission of radiographic images through telephone lines. (Bashshur, et al., 2016). Diagnostic radiology has become the eye of medicine in terms of diagnosing and treating injury and disease.

Even though Teleradiology is potentially one of the simplest telemedicine solutions to implement in Africa, a study conducted in Durban, South Africa concluded that the uptake for this discipline has not kicked off as expected. (Mars, 2013) Several reasons for the low update was cited in the study such;

- few rural hospitals have digital radiographic equipment, requiring X-Ray films to be scanned or photographed for transmission
- Image file sizes are large and transmission time can be long.
- Some areas have with no radiologists at all and most and in many countries radiologists are only available in the capital or major cities.
- There is no the human capacity to manage the potential workload.

Another study noted that most barrier to adoption of teleradiology are due to low bandwidth, slow Internet connections, and high Internet service charges. (Andronikou, 2014). This is especially true in developing countries such as South Africa where the cost of data has been very topical in recent years. Another limitation cited in the same study is the quality of the images referred for interpretation, because the radiologist is distant from the site where the imaging is performed and has little influence over the technologists performing the studies.

The evolution and development of technical ICT infrastructure and networks that enables huge number of images of diagnostic quality to transferred quicker coupled with a decrease in workstations and server hardware has accelerated the adoption of teleradiology in recent years. A survey by the European Society if Radiology that adoption of teleradiology within the European union was relatively high at 89%. The study also revealed that there were some negative attitudes towards outsourcing of radiology services through teleradiology. This came mainly from in-house professionals who saw teleradiology to take away their jobs (European Society of Radiology (ESR), 2016).

2.3.3.2   Tele-ICU

Intensive Care Unit (ICU) is one of the most important and specialized units in a hospital. Patients found in this type of a ward are usually in critical conditions and require specialized attention and medical care. The ICU is often most affected by shortage of resources like specialist nurses, doctors and even amount of beds. The increasing number of critical patients from illnesses and accidents coupled with the escalation in cost of care requires that interventionists look for innovative ways of meeting these demands (Bauman & Hyzy, 2014). For these reasons, ICU is then an important candidate for telemedicine and it is covered by Tele-ICU ((Saghaeiannejad-Isfahani, et al., 2016).

Tele-ICU is a subset of telemedicine that provides comprehensive monitoring of critical care patients by an off-site team of specialists utilising audio, video and other electronic connectivity tools. This ensures that patient in remote area get reasonable access to clinical professionals who can detect clinical problems, prescribe treatment and management and monitor progress. (Ward, et al., 2015). Tele-ICU is sometimes referred to as virtual ICU or remote ICU essentially meaning that there's a centrally located ICU which is connected through ICT to a number of hospitals in different geographical areas (Saghaeiannejad-Isfahani, et al., 2016).

Studies conducted by organisations such as the NEHI (Network for Excellence in Health Innovation) in collaboration with the University of Massachusetts revealed that Tele-ICU adoption can decrease mortality by more than 20 percent, decrease ICU lengths-of-stay by up to 30 percent, and reduce the costs of care. (Kvedar, et al., 2014). A study conducted in Iowa City of the United States focused of staff perception on the values of Tele-ICU revealed that most respondents had positive views about all facets of Tele-ICU. The study revealed that there was no significant variation in acceptance of the technology between different professionals (administrative, managerial and clinical staff). The study concluded that the value of Tele-ICU is more apparent where critical patients have a higher length of stay (LOS) and extended monitoring is required (Ward, et al., 2015).

A study measuring the perception of nurses regarding the impact of Tele-ICU revealed that majority of respondents agreed that Tele-ICU improved the efficiency, encouraged collaboration between healthcare experts and positively affect the job performance of nurses in an ICU. Benefits cited by the respondents in this study includes detection of vital sings trends, provision of patient management and enhanced patient safety (Kleinpell, et al., 2016). In another study focusing ICU staff in rural areas in the US, there was an overall acceptance of Tele-ICU by staff. The benefits cited by the staff in this study included the reduction of patient transfers from lower level hospital to tertiary hospitals in the community. The respondents in this study view Tele-ICU as a very useful in the provision of critical healthcare services (Goedken, et al., 2017). In a different study conducted in the US, the implementation of Tele-ICU has shown to effectively decrease the cost of healthcare while improving outcomes such as mortality rates and patient length of stay (LOS). A saving of 24% in cost through a reduction in LOS was noted in this study (Stacie & Alberto, 2014).

For South Africa, telemedicine promises to be a good fit to address issues of shortages of medical professionals, limited healthcare budget and massive inequalities highlighted earlier in this paper. A study conducted into the status of telemedicine in South Africa revealed huge percentage (142%) increase of telemedicine facilitates in 2013 with the biggest number found in KZN (Owolabi, et al., 2016).

Most of the literature reviewed on the adoption of ICT for healthcare application revealed that capital cost is one of the key barriers towards adoption. Where governmental policy frame work drove fiscal investment, it was found that cultural resistance was the main barrier for use acceptance and adoption of ICT programmes like telemedicine. It is therefore imperative that policy makers and investors become aware that adoption of ICT in healthcare will not necessarily yield economic benefits in the short term (Hassibian & Hassibian, 2016).

2.4   Efficiency in Healthcare

Studies into the efficiency of healthcare systems often use the Data Envelopment analysis (DEA) model as a preferred methodology ((Nayar, et al., 2013) (Hadad, et al., 2013)). The DEA modelling allows researchers to categories variables of a healthcare system into technical inputs and technical outputs. Efficiency generally refers to producing more outputs with limited input resources at acceptable quality levels. Other literatures often refer to efficiency as using the minimum amount of inputs to produce an output. It follows then that to thoroughly measure efficiency, we must attempt to define clearly the inputs and outputs to a healthcare service delivery process. Below, we will look at various literature divided into healthcare systems inputs and outputs (Gururajan & Hafeez-Baig, 2014).

2.4.1   Inputs

(Medeiros & Schwierz, 2015) argued that it's often difficult to apply efficiency concepts to healthcare systems from both a theoretical and practical standpoint. The study notes that activities such as hospital discharges, are often seen as intermediate outputs because health care activities do not necessarily have an immediate impact on improving health outcomes, which is what patients and practitioners are looking for." (Medeiros & Schwierz, 2015). On the other hand, (Nayar, et al., 2013) used number of beds available, non-clinical staff available and other auxiliary personnel as technical inputs into their DEA model used to measure efficiency of a healthcare system.

In book titled "Methods for the Economic Evaluation of Health Care Programmes" (Drummond, et al., 2015) argue that resources, made up of People; time; equipment; facilities and skills are all scarce inputs into the healthcare system. An economic evaluation is therefore important to guide the correct allocation of this inputs based largely on cost vs benefits.

Other literature, for example (Hadad, et al., 2013) classifies healthcare systems inputs into categories. One considered to be within control of healthcare policy makers and administrators (i.e., Number of Healthcare personnel, Number of hospital beds, total healthcare budget, etc.), and another, which is mostly out of

control of healthcare systems (i.e., Country's GDP, population's lifestyle choices, environmental factors, etc.).

2.4.2 Outputs

Output of healthcare system on the other hand is often not very clear cut. For business people for example, output is purely profit, or bottom line. But for the strict purpose of healthcare as a service, outputs are the commonly reported health outcome indicators, such as life expectancy, healthy life expectancy and amenable mortality rates. (Medeiros & Schwierz, 2015). A study by (Huerta, et al., 2016), attempted to look at 'Patient satisfaction' as the sole output and compared that to cost as an input. Using patient satisfaction as an output proved to be very difficult to the researchers as this is largely a subjective measure depending purely on individual patient's sentiments towards a healthcare service. In a book focusing on the impact of operations management in healthcare (Langabeer-II & Helton, 2015) the authors noted that excessive waiting times, lack of coordination among various specialities within a hospital, duplicate entry of patient demographic and other relevant information in manual or even electronic formats are some of the typical factors cited in measuring patient satisfaction (or lack thereof) as an output of a healthcare system.

Efficiency improvement should therefore form part of key areas of focus to help expand access to healthcare delivery in underserviced countries. While trying to add more resources into the healthcare system, it is also imperative to ensure that existing resources are utilised efficiently. A research done by (Kirigia, et al., 2013) using the Data Envelopment Analysis (DEA) methodology found that 40% of hospitals in KwaZulu Natal had some degree of technical inefficiency and 58% where scale inefficient. The study went further to evaluate the efficiency of various individual inputs into the healthcare system and revealed some useful results such as: 15% of healthcare staff in the province were utilised inefficiently while 7.1% of hospital beds were also wasted (Kirigia, et al., 2013).

Turnaround times in healthcare facilities workflows is another interesting area of focus that needs attention as an output to a healthcare system. Technologies such as Speech Recognition technology (SR) have proved to significantly improve the report turnaround times (RTT) in emergency and radiology department settings (Johnson, et al., 2014). Deploying ICT based modes of communication to exchange information and foster collaboration amongst professionals in different geographical locations can improve the turnaround time, decision making process and ultimately the Length of stay for required for patients in a healthcare facility (Barr, et al., 2017).

Cost reduction in healthcare is another output expected from mass adoption of ICT. Research predicts that through concerted policy driven adoption of electronic medical records (EMR), a potential cumulative saving could be as high as $371 billion over 15 years (Hillestad, et al., 2017). Data from studies focusing on cost containment in healthcare reveal that implementation of electronic financial management systems leads to lower operation costs in hospitals due to automated record keeping and traceability of healthcare related transactions (Bardhan & Thouin, 2013).

The impact of ICT on the quality of services in healthcare has enjoyed significant research focus over the years with various studies yielding mixed results. One study concluded that there is a significant relationship between adoption of clinical information systems and conformance to standard operation procedures and quality standards which results in improved care quality (Bardhan & Thouin, 2013) . In a study focusing on the impact of ICT in nursing practice, the results revealed that most nurses felt the quality of care is compromised as they needed to focus on usage of complex IT solutions instead of giving care to their patients (Fagerström, et al., 2016).

Accurate diagnosis of illness is very important to ensure that proper treatment interventions are followed. The adoption of mobile devices for healthcare has shown to offer the same quality of diagnosis accuracy especially in diagnostic imaging. Participants in one study revealed that they could accurately diagnose acute stroke on CT brain scans using an iPhone (Ventola, 2014). In a study focusing on the accuracy and quality of perinatal data electronically stored, the researchers concluded that even though the quality was much higher relative to paper formats,

there was still a lot of negativity from the nurses regarding lack of standards and consistent terminologies (Craswell, et al., 2016).

Human errors in healthcare are said to a great cost that needs to be curbed. The cost is not only financial (in case of mistakes, repeat examinations are required where extra resources will need to be allocated), the greater cost lies in deterioration of patient's status and some instances, loss of life (REF). In a study conducted across 4 Intensive care units (ICUs) in Australia, the researchers found that ICT plays a major role in human error reduction as long at the technology reinforces the doctors place in care delivery and is not seen as managerial policing tool (Plumb, et al., 2017). Another study argues that medical errors often occur due to the patient's historic medical data being unavailable. This is largely the case in paper based documentation as records can easily get lost. The study concluded that adoption ICT in healthcare in the form of interconnected technologies through ac concept know as Internet of things (IoT) can significantly reduce medical errors (Turcu & Turcu, 2013).

A study evaluating the efficiency of patient portal concluded that there is no sufficient evidence that patient portals have a positive impact on health outcomes (Goldzweig, et al., 2013). The same study cautioned that when measuring efficiency from a patient point of view, it is important to design an instrument that achieves a balanced consideration of aspects of utility, aided by the matrix.

Examples of inefficiencies in healthcare are excessive hospital length of stay, over-prescribing, over-staffing, use of branded over generic drugs, wastage of stock. Long queues, high mortality rates of patients, etc. (Hsu, 2011). The biggest concern in healthcare service delivery revolves around spreading access to everyone that needs healthcare when they need it.

2.5 Equity

Equity in healthcare basically relates to the distributive access and rides on the notion that every human being should have access to quality healthcare affording them a fair chance to live a full healthy life. In South Africa equity in Healthcare remains just a policy document to date. The country's historic background of apartheid which ensured that a huge majority of people are excluded from governmental planning on provision of basic resources has resulted in this huge gap that the democratic government has been trying to close since it came to power in 1994.Disparities in wealth and health are still unacceptably high. In 2008, for example, 54% of South Africans had an income below \$3/day. The top 10% of South Africans account for 58% of annual national personal income, while the balance of 70% received a mere 16.9%. The Gini co-efficient, which measures income inequality, was reported at 0.7 for 2011 (Baltussen, et al., 2013).

Various studies have focused on the rate of ICT adoption in healthcare, the barriers associated with it and the cost the solution thereof. The studies have looked at ways in which adoption rates can be increased and some success have realised in that direction.

A study into the reasons for poor adoption of ICT in rural hospitals in the eastern cape focused on Quality Assurance (QA) as integrated part of ICT projects in healthcare. (Marlien, et al., 2014) revealed that lack of proper QA methods in eHealth Projects resulted in the poor user adoption of ICT and therefore less impact of the technology on healthcare delivery. Even though various studies have shown how South Africa can use ICT to broaden access to healthcare to the rest of the population that was previously excluded and segregated through apartheid laws, various innovative ways of broadening this access should be investigated (Day, et al., 2011); (Akande & Van Belle, 2014). Not enough focus has been paid to the real impact of ICT in healthcare in efficiency of delivery.

2.6   Summary

The literature review chapter started introducing key concepts of ICT in healthcare. A broad definition of ICT as well as application in healthcare was given. This further provided definitions and contextual explanations of key terminology and explored the theories involved.

The chapter also interrogated ICT adoption in healthcare by looking at various technology sub components and their adoption rate. Literature on efficiency in healthcare was reviewed with a goal of formulating a bench mark for the study. Efficiency was reviewed by looking at subcomponents of a healthcare system which are classified into inputs and outputs. In general, through the literature reviewed, majority of healthcare professionals and patients showed a positive attitude towards ICT adoption and mostly agreed that efficiency in the delivery of healthcare services can be significantly improved by using these technologies.

Literature reviewed revealed a gap of research in the Impact of ICT systems adopted in the South African environment.

The next chapter will focus on the research methodology used in this study.

CHAPTER THREE: Methodology

3.1   Introduction

This chapter will lay out the foundation for the research methods, strategy and design of the research study. This section will discuss the available methodologies, and will then focus on the chosen approach. The methodology together with the relevant techniques used will be described. The target population, sample size and chosen sampling technique will be outlined. The research instrument design, a questionnaire, is defined as well as method of administration. The procedures for the statistical data analysis are described. This is followed by how reliability and validity is embedded into the study and how biasness was eliminated. The chapter finally closes with a review of how good ethical practices have been adopted into the study.

3.2   Research Design and Methods

Research design maps-out a framework for how data is collected and analysed. A research design chosen is therefore considered a reflection of the order of importance placed on various research dimensions such as; causal connections between variables, ability to generalise data to larger groups of samples being researched, etc (Bryman, 2015).

Figure 3.1 below further explains the assertions by Mikko Ketokivi and Thomas Choi who argue that scientific and social research typically comprise of theories that already exist, these theories are then tested against new data that is collected through various research instruments. In the end, the original theories are either confirmed, adjusted or rejected ad replaced by newly generated ones back up by evidence (Ketokivi & ThomasChoi, 2014).
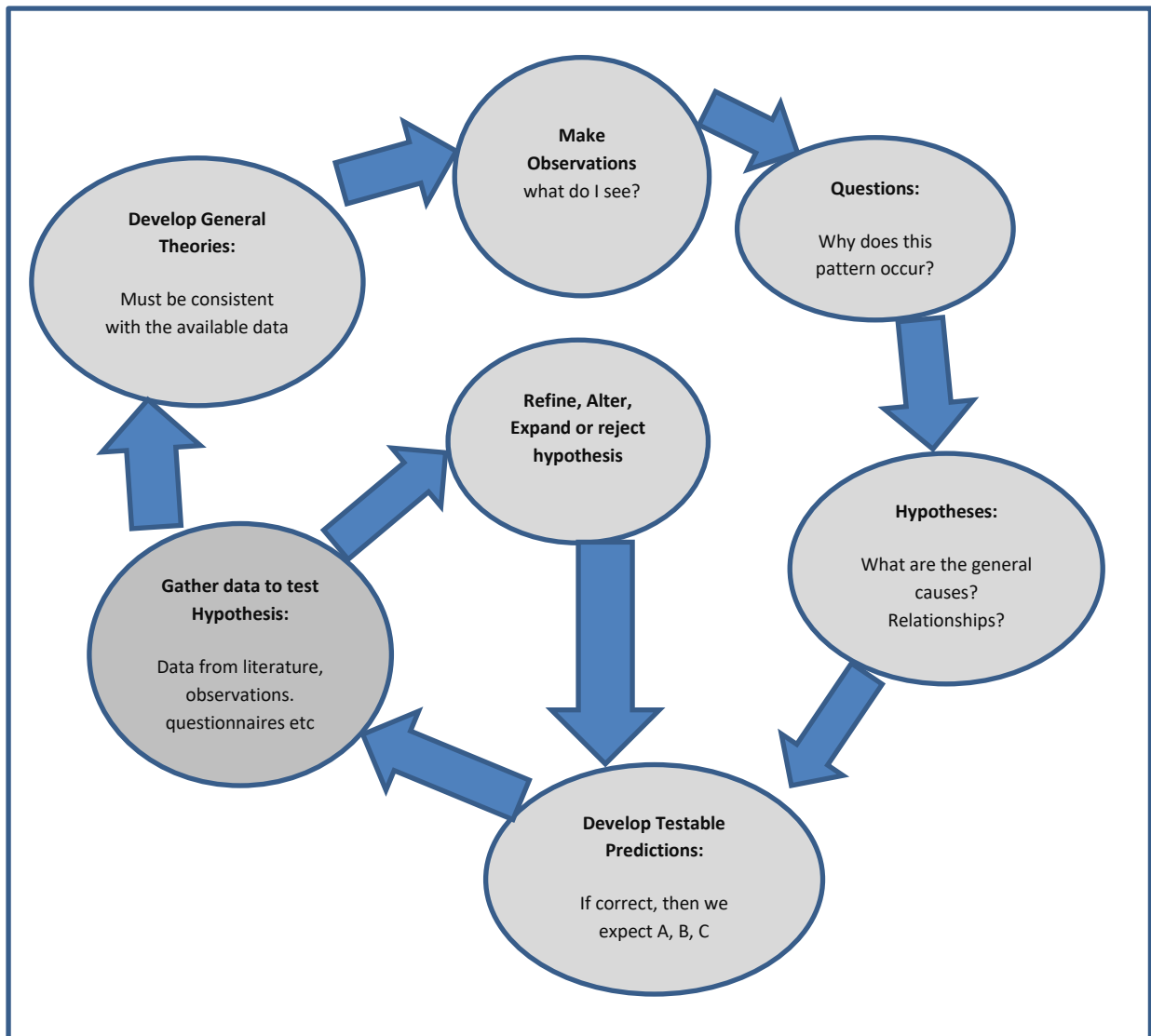
Figure 3.1 Scientific method as an ongoing process

Adapted from Mildred L. Patten & Michelle Newhart, 2017.**Understanding Research Methods: An Overview of the Essentials**. Taylor & Francis. P9

A research method is largely a technique used to collect data. research methods can further be defined as the building blocks of the scientific enterprise which have the 'how' for building systematic knowledge (Patten & Newhart, 2017). In conducting a research, there are predominantly three methodologies that could be followed: qualitative, quantitative and mixed-method.

Qualitative, is generally viewed through fieldwork, case study and theory. (Creswell, 2013) further describes qualitative research method as "an approach for testing objective theories by examining the relationship among variables".

Quantitative is usually hypothesis based, allowing investigation of feeds, such as hypothesis testing and regression analysis. According to Alan Bryman, (Bryman, 2015), quantitative research referrers to research strategy that values quantification in the collection and analysis of data. This further allows for a deductive relationship between theory and research which places emphasis on testing of theories.

Mixed-method on the other hand, involves collecting both qualitative and quantitative data. Mixed Method approach therefore can be said to use a combination of the first two methodologies.

In this study, the quantitative approach was followed. This method was chosen mainly because:

- the results can be generalised to a larger population.
- Relations between variables as well as cause and effect can be established under controllable circumstances.
- It allows for testing of theories and hypotheses easier

3.3   Study Setting

The study is conducted at Inkosi Albert Luthuli Central Hospital in the Durban area of eThekwini Municipality, KwaZulu-Natal. The Hospital was chosen because it is one of the first hospitals to adopt ICT as a key component of healthcare provision in South Africa. The hospital is a public, private partnership initiative which makes it more useful in measuring efficiency of healthcare from both equity and productivity dimensions. Within the hospital, the radiology department was chosen to be a focus point because the Radiology speciality is considered to have the most matured ICT systems in healthcare globally.

3.4   Population

According to (Patten & Newhart, 2017), research population refers to all subjects or items within a category of things or people that are being researched. The population in this study is made up of Radiologists, Radiographers and Administrators at IALCH Radiology department in the Durban area of eThekwini Municipality, KwaZulu-Natal. The population is chosen because they represent hospitals that have adopted ICT in the provision of healthcare and the fact that the hospital is a public private partnership initiative (PPP). The total population in this study is approximately 40 personnel.

3.5   Sample

A sample is generally defined as a subset of a larger population that enables us to draw conclusions on the behaviour or responses that can then be generalised to the entire population (Zikmund, et al., 2013). The population was relatively at 38, therefore the entire population was targeted as a sample of the study.

Sampling techniques are further classified into probability and non-probability sampling.

According to (Acharya, et al., 2013), Probability sampling ensures generalisability of the results to the larger population and means that each subject in the population has an equal chance of being selected. Probability sampling includes the following sub-categories:

- Systematic random sampling
- Simple random sampling
- Stratified random sampling
- Cluster sampling
- Multiphase sampling
- Multistage sampling

In Non-Probability sampling on the other hand, the probability that a subject will be selected is unknow and might result in selection bias. The common types of non-probability sampling include:

- Convenience or Purposive sampling
- Quota Sampling
- Snowball sampling

For this study, convenience sampling technique was used. Convenience sampling technique is a type of nonprobability or non-random sampling where members of the target population that meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are recruited for participation (Etikan, et al., 2016). This technique was chosen mainly due to lack of flexibility in the clinical environment where the study was conducted. The investigator had travelled from Johannesburg and was granted a specific period in which he could approach potential respondents. A sample of convenience was selected as per availability and willingness of respondents to participate in the study from a population Radiologists, radiographers and administrators.

The disadvantage of this technique however is mainly that variability and bias cannot be adequately measured or controlled.

3.6   Questionnaire / Data Gathering Instrument

A questionnaire was designed to gather the relevant data of each subject as well as the information required for statistical analysis of the independent and dependent variable.   Questions where structured to cover the subject matter being investigated and was aligned with the research question and purpose. The questionnaire was carefully designed to take only 15 minutes to complete to encourage participation of enough respondents.

The questionnaire is divided into four sections; The first part of the questionnaire, Section A, was aimed at collecting demographic data such as gender, race, profession and years of experience in healthcare.

The second part had Sections B, C and D are designed to collect various data that will help to answer the research questions.

- Section B collected data relating to exposure to ICT. This was to determine the extent to which the respondents are exposed to ICT in their daily work
- Section C was aimed at collecting data on ICT impact on daily jobs. These questions could then be used to address the object of ICT Impact on efficiency.
- Section D, labelled ICT adoption was aimed at collecting data relating to the usability of ICT systems and overall adoption.

3.7   Collection of data

Data was collected through the administration of a questionnaire on site on physical hard copies on Fridays while target professionals are at work during their lunch break to ensure validity. Due to the criticality of work done by respondents, the researcher had to wait to for an opportunity to approach them during their break and lunch times. The questionnaire took approximately 15 minutes to complete by each respondent.

3.8   Data Analysis

Descriptive statistical techniques were used to analyse the data collected. The data analysis tools extended to the following:

- Mean and standard deviation of variables as grouped into different categories according to the data collection instrument (questionnaire).
- Frequency distribution tables as well as related percentages per category
- Mann-Whitney Tests
- Kruskal-Wallis Tests
- Spearman's correlation tests were also conducted to find relationship between variables in category groups

3.9   Reliability

Reliability in a quantitative study measures the accuracy of a research instrument. In other words, the extent to which a research instrument consistently has the same results if it is used in the same situation on repeated occasions (Heale & Twycross, 2015).

In testing the reliability of the instrument used in this study, a Cronbach's alpha test was used. Based on this test, a Cronbach's alpha value of 0.78 was achieved. Most literature indicate that an acceptable alpha value ranges between 07 and 0.95 (Tavakol & Dennick, 2011)

3.10   Validity

Validity in research refers to the appropriateness of the tools, processes, methods and data. In essence, this is the degree to which a concept is accurately measured. This includes questioning whether the research questions are valid for the desired outcome, the choice of methodology is appropriate for answering the research questions, the design is valid for the methodology, the sampling and data analysis is appropriate, and finally the results and conclusions are valid for the sample and context (Leung, 2015).

Validity on this study was established by selecting the most appropriate methodology, survey instrument, sample size and the target population.

At the data collection stage, the instrument was fist tested on a pilot sample made up of healthcare professionals from a different hospital. The questionnaire was then tailored and modified carefully to ensure validity keeping to a consistent and standard procedure for data collection. Lastly, by physically administrating the questionnaires onsite, the researcher limited the non-return of questionnaires and dropout rates

3.10   Ethical Considerations

Getting ethical clearance for the study proved to be a bit long and somewhat difficult. Firstly, a provisional gatekeeper letter was obtained from the IALCH medical management. This letter had to be used as part of submission for permission at the provincial health research council. On this basis, the final clearance was given by UZKN ethics committee. The research does not gain access to any confidential patient records. No access to any patient and financial data was requested by the researcher. The respondent where made aware through a consent declaration, that their participation is totally voluntary and no monetary or other benefit was offered for participating in the study.

3.10   Summary

In this chapter, the research design and method for the study was outlined. The reasons for choosing a quantitative method for the study where provided. The chapter also introduced the study setting as well as the population at Inkosi Albert Luthuli Central Hospital. A properly representative sample was selected from the population using the convenience sampling technique. A questionnaire was developed as a research instrument that could obtain the desired data within the short timeframe with the required level of accuracy. The data collection process was outlined as well as the methods by which the data was statistically tested, analysed and relevant logical outcomes drawn. Ethical compliance was addressed through formal ethical clearance approval received from UZKN ethical committee as well as the KZN Department of Health's Provincial Health Research Council. The validity and reliability of the research instrument was discussed in detail.

CHAPTER FOUR: Presentation of Results

4.1   Introduction

This chapter presents an interpretation of the results and findings obtained from the quantitate survey. The primary data collection tool used in this study was a questionnaire which was distributed to respondents at Inkosi Albert Luthuli Central Hospital radiology department. Descriptive statistics as well as chi-squared analysis is used to present the results.

4.2   Response Rate

A total of 38 questionnaires were distributed with an intention to get to all the elements of the population to participate. A total of 28 respondents completed and the returned the questionnaires which makes a response rate of 76%. Table 4.1 below demonstrates the response rate.

Table 4.1: Response Rate

Number of Individuals invited to participate in the survey	38
Number of respondents that started the survey	29
Number of surveys completed	28
Completion rate	96%

4.3   Presentation of results

The questionnaire is divided into four sections, the presentation of the results does therefore follow the same order. The demographic data will be presented first. This part of the questionnaire was useful in categorising participants according to their profession, years of experience as well as obtaining generic biographical data such as gender and race.

The second and third parts were aimed at collecting data relating to respondents' exposure to ICT as well ICT adoption for healthcare delivery. This essentially addressed the independent variable of the study. The last part aimed to collect data relevant to the Impact of ICT in healthcare delivery, this part therefore addressed the depended variable.

4.3.1   Biographical data

The first section of the questionnaire was made up of six biographical questions, the purpose of which was to categorise the respondents according to their profession (to indicate a balance of professionals in radiology), years of experience in the field as well as race, gender and managerial role of respondents. the distribution of the biographical information was illustrated in graphical format and a summary was provided.

Most participants to this study were females, accounting for 67.9% of the total respondents. The distribution of respondents' gender is presented on Figure 4.1 below.
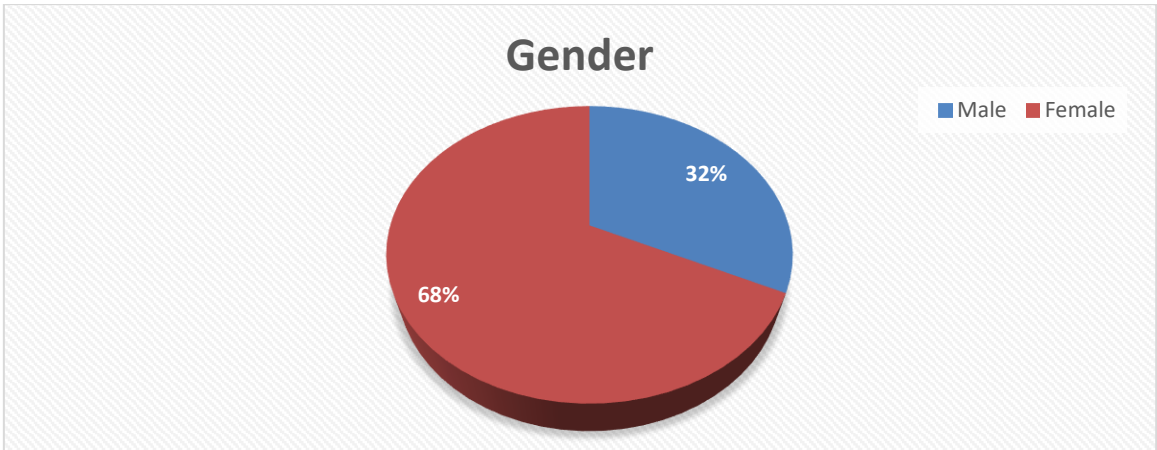
Figure 4.1 Gender Distribution

Race composition of respondents is shown on the graph 4.3 below. Majority of the respondents are Indian while no people from the white race group participated in the study.
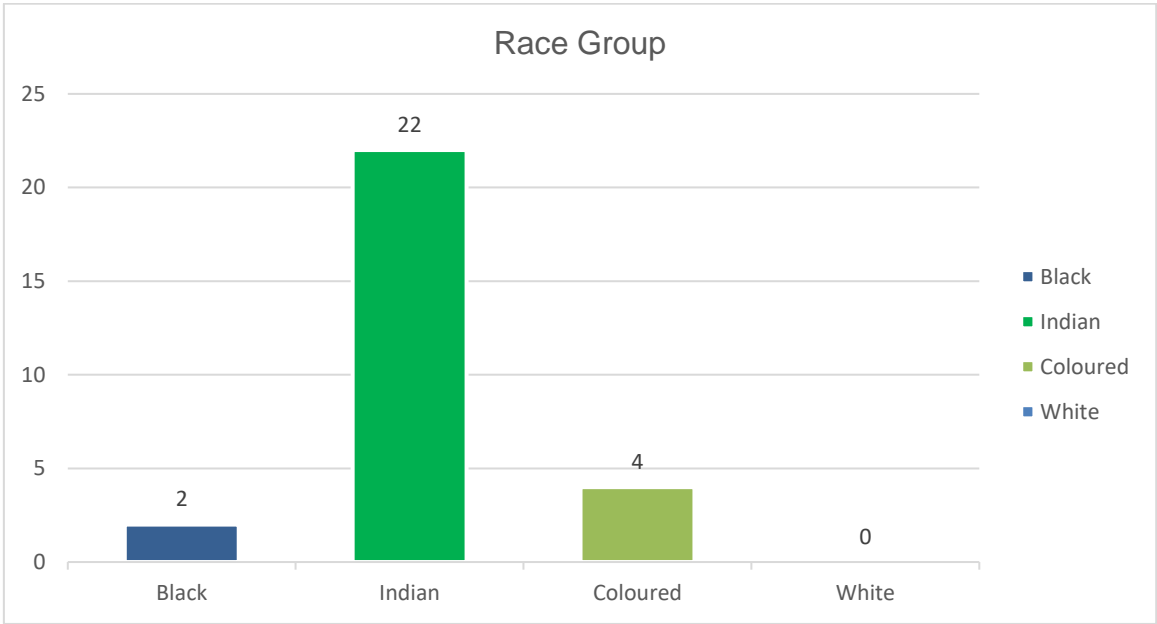
Figure 4.2 Race Group representation

The next figure presents a composition of different professionals who took part in the study. Majority of the respondents were radiographers as shown on graph 4.4 below. This is consistent with the overall staff composition at IALCH's radiology department which has more radiographers than any other profession.
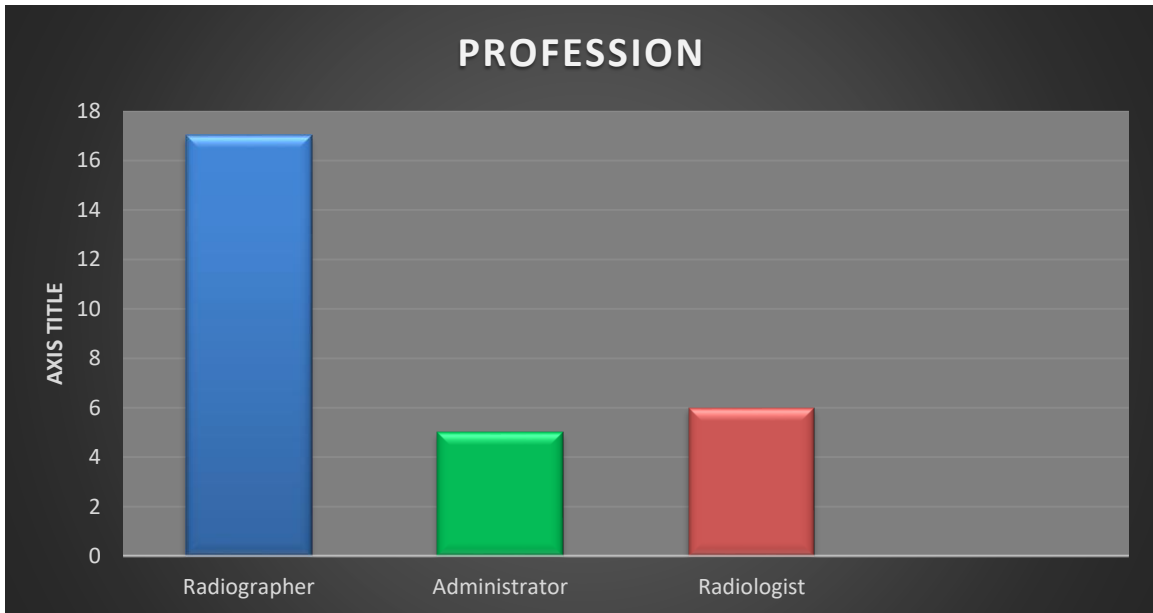
Figure 4.3 Professions representation

Table 4.5 below presents the data regarding the experience of respondents. Most respondents have 5-10 years of industry experience.

Table 4.2: Industry experience

Years of experience	Frequency	Percentage
< 3 Years	8	28.6
5-10 Years	14	50.0
> 10 Years	6	21.4
Total	28	100

4.3.2 Exposure to ICT

Section B of the questionnaire was made up of six questions. As part of measuring the independent variable, this section gathered data on the extent to which respondents were exposed to ICT as part of their job at this hospital or previous ones. The section also checked the generic level of computer proficiency of respondents.

As show on table 4.6 below, most respondents have worked with ICT in their jobs before joining IALCH's radiology department.
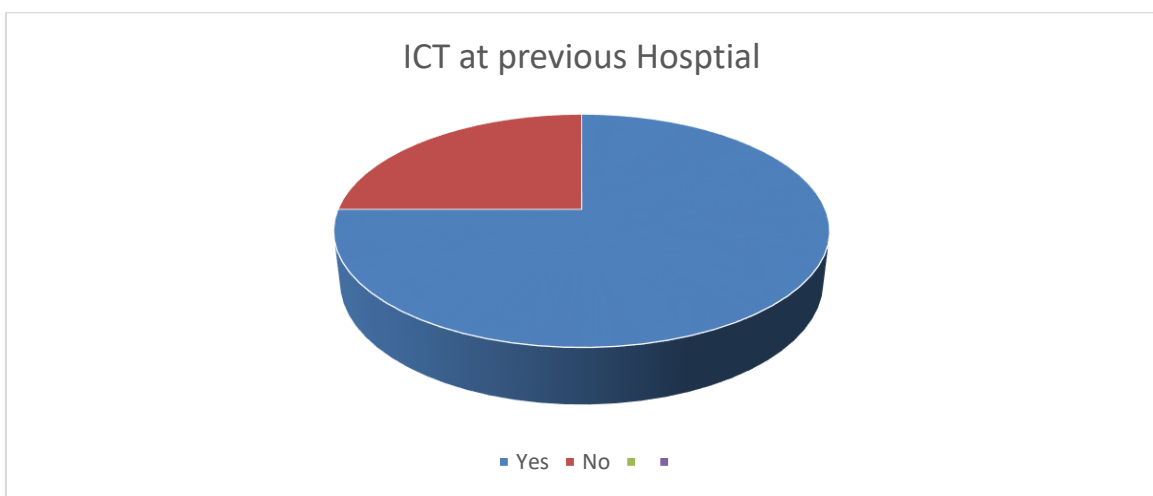
Figure 4.4 Prior Exposure to ICT

Question 2 asked if respondents had access to a PC at home. Graph 4.7 below shows the results.
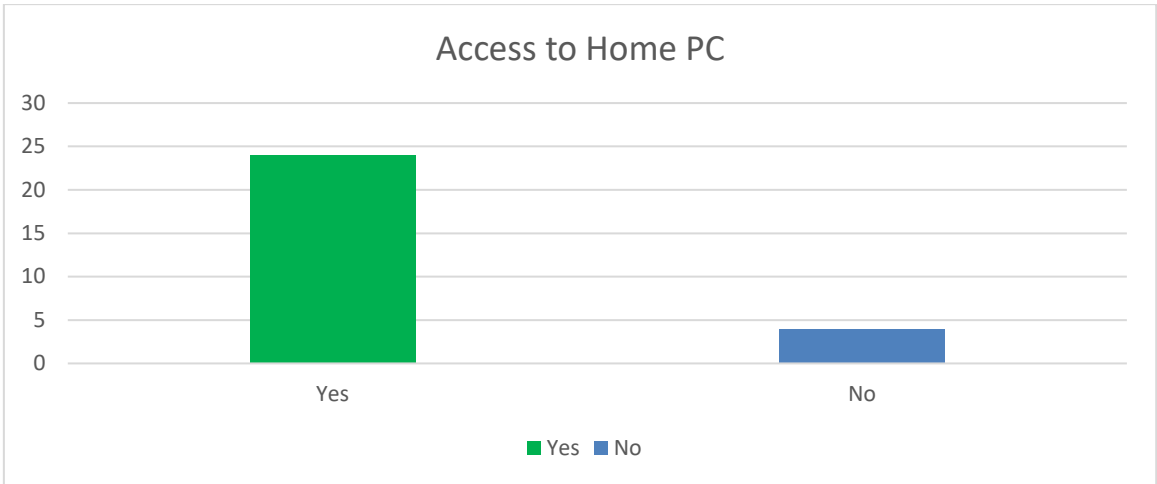
Figure 4.5 Access to home PC

Most of the respondents (82%) have had some basic course either as part of formal studies or as part-time short course as shown on graph below.
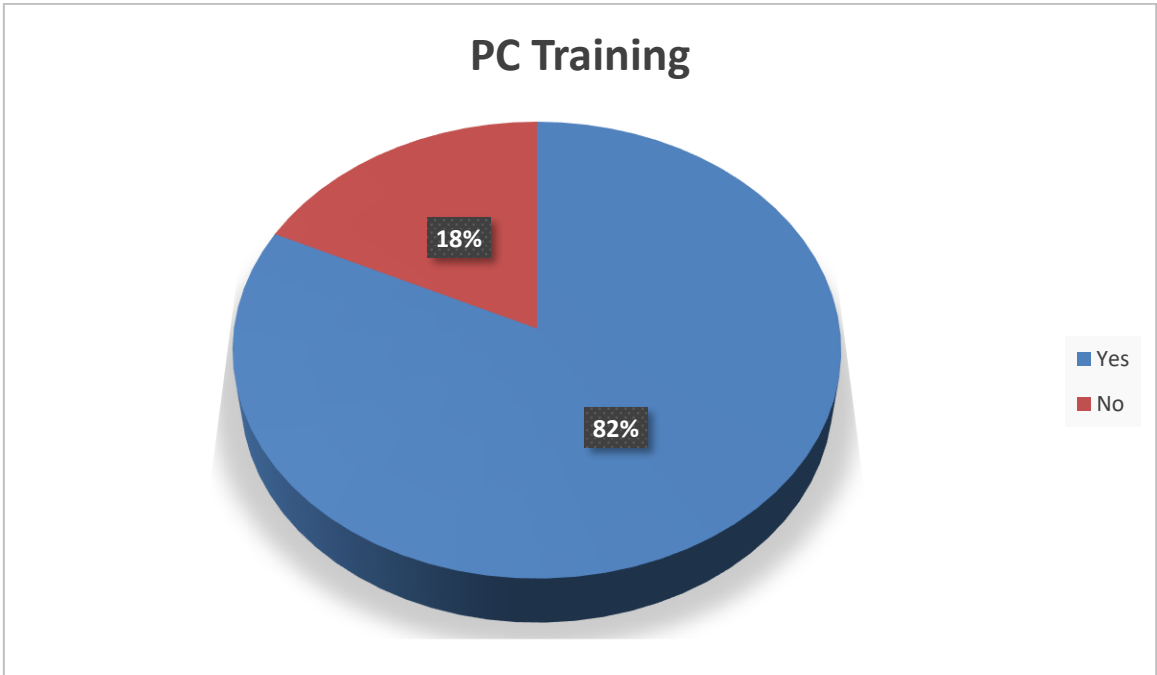
Figure 4.6 Basic Computer Training

4.3.3 Attitude towards ICT Adoption

On Section C, the questionnaire was made up of five questions which aimed to gather data on the respondent' attitude towards ICT adoption in their department. Respondents were asked to rank their attitude towards ICT adoption using a 5-point Linkert scale type of questions. Questions ranged from usability to technical support of the ICT systems used. Taking into consideration all the questions in this category, the overall attitude of users towards ICT adoption tends to be positive.

Majority (75%) of the respondents strongly agreed with the statement of using ICT as an exclusive means of record keeping and other functions within their roles. An overwhelming majority (96.4%) of respondents indicated that they are confident in their ability to use the current ICT systems at the department.

The results to from the questions on this section are combined and presented on figure 4.7 below.
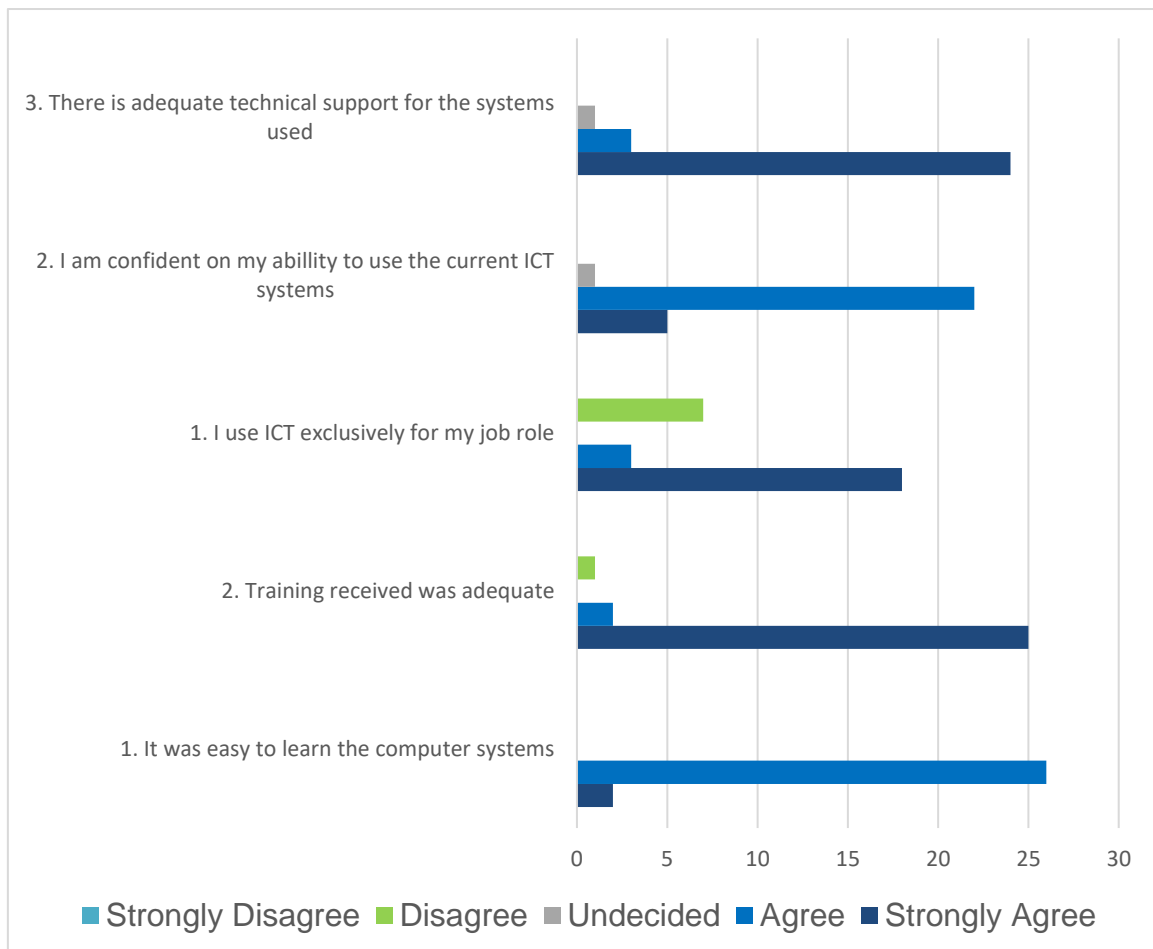
Figure 4.7 Attitude towards ICT adoption

To further understand the results above, we grouped the results into positive, negative, neutral attitude towards ICT adoption. Table 4.3 below represents these results. Most respondents showed a positive attitude towards ICT adoption at the department

Table 4.3 Percentage representation on attitude

	Frequency	Percent
Positive	19	67.9
Neutral	8	28.6
Negative	1	3.6
	28	100

Mann-Whitney tests were conducted for this group of variables and collated against the demographical variables.

Results from Mann-Whitney tests of respondents' attitude towards ICT adoption in relation to their gender on tables below are presented. Table 4.4 below shows that there is no significant difference between males and females with regards to attitude on ICT adoption.

Table 4.4: Mean Analysis: Gender vs attitude

	N	Mean	Std. Deviation	Minimum	Maximum
Attitude	28	5.7143	1.11744	5.00	9.00
Gender	28	1.6786	0.47559	1.00	2.00

The mean rank table below shows that both the gender groups had a mean of around 15. This means that means that both male and female have an equally positive attitude towards ICT adoption/

Table 4.5: Ranks: Gender vs attitude

Attitude	Gender	N	Mean Rank	Sum of Ranks
	Male	9	15	135.00
	Female	19	14.26	271.00
	Total	28		

Mann Whitney statistics tests result presented on table 4.6 below indicates that there is no significant relationship in a person's gender and their attitude towards ICT adoption.

Table 4.6: Man-Whitney Test Statistics: Grouping Variable= Gender

	Attitude
Mann-Whitney U	81.000
Asymp Sig (2-tailed)	0.786

Secondly, through Mann-Whitney tests, we wanted to find out if the respondents' position affected their attitude towards ICT adoption. Results for these tests are presented on following tables.

Table 4.7: Descriptive Statistics: Supervisory vs attitude

	N	Mean	Std. Deviation	Minimum	Maximum
Attitude	28	5.7143	1.11744	5.00	9.00
Supervisor	28	1.7857	0.41786	1.00	2.00

The mean ranks table below indicate that respondents in a supervisory or managerial role had lower mean rank at 10 compared to 15.73 of those that are not in supervisory roles.

Table 4.8: Ranks: Supervisory vs attitude

	Supervisor	N	Mean Rank	Sum of Ranks

Attitude	Yes	6	10	60.00
	No	22	15.73	346.00
	Total	28		

The test statistics from Mann-Whitney test presented below indicate that that a valued of 0.064, there attitude towards ICT adoption is not significantly affected by whether one is in a supervisory role or not.

Table 4.9: Mann-Whitney UTest Statistics: Grouping Variable= Gender

	Attitude
Mann-Whitney U	39.000
Asymp Sig (2-tailed)	0.064

4.3.3 Perception on efficiency

To investigate the respondents' perception towards whether ICT improved the overall efficiency at the radiology department, section D of the questionnaire was designed. Participants were asked to rank their perception to statements on Linkert scale type of questions ranging from strongly agree to strongly disagree. Most the respondents (82.1%) agreed that ICT adoption has helped to increase the quality of documentation. The efficiency of healthcare is also affected by the continuity of care. For this reason, we included a question on whether ICT reduces the chances of data loss. Most of the respondent (96.7%) strongly agreed that storing data electronically reduces the chances of loss. A huge majority of the respondents (89.3%) strongly agreed with the statement that ICT usage at the radiology department has helped to reduce turnaround times. 2 respondents out of 28 agreed with the statement while 1 person strongly disagreed. In response to a statement concerning the improvement of diagnosis and decision accuracy, 82.1% of the respondents agreed with the statement. Only 7.1% of the respondents disagreed with it. Lastly, we asked

a generic question on efficiency, all the respondents agreed or strongly agreed with this statement.

The overall perception of respondents with regards to efficiency lies on the positive side as collated from responses to various questions in this category. In general, only less than 10% of the participants disagreed or where undecided on the ability of ICT to improve efficiency.

In Figure 4.9 below, we present the result which is summarised below.   Majority of the respondents agreed that ICT has improved efficiency of workflows at the radiology department.
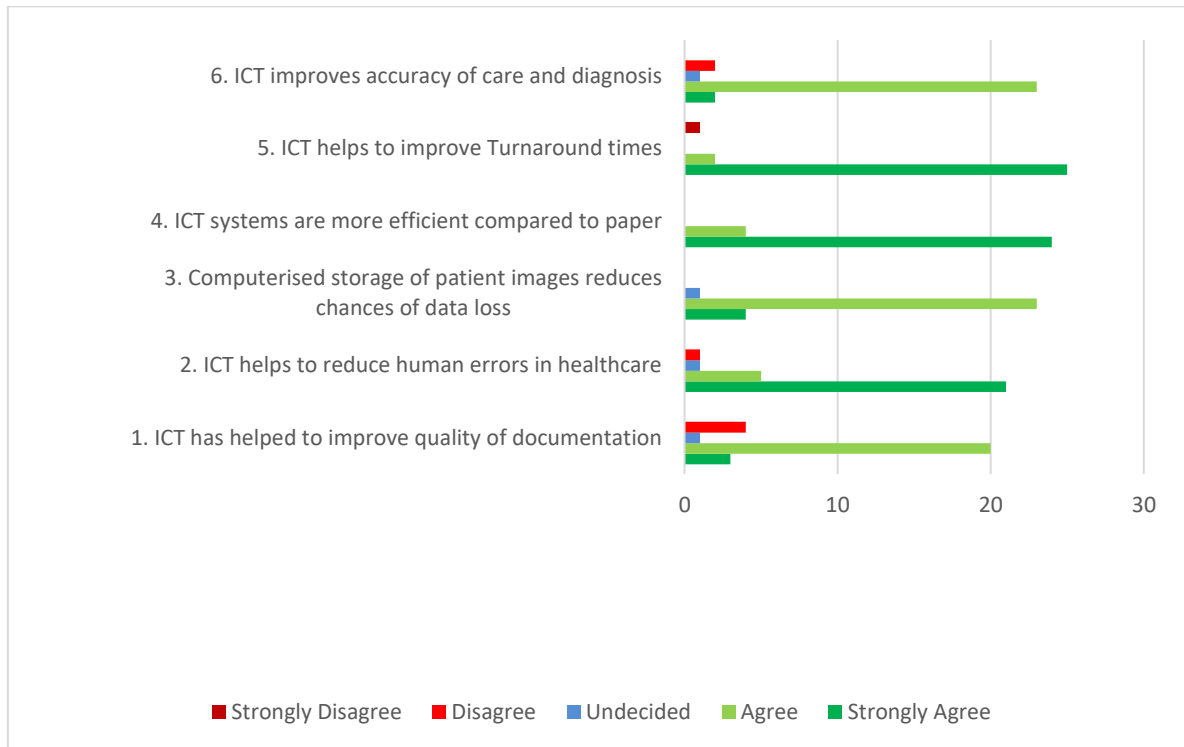
Figure 4.9 Evaluating the impact of ICT on efficiency of healthcare delivery

Table 4.10 below present the category mean analysis results. Overall Mean, standard deviation and median of the category variables are presented.

Table 4.10: Efficiency category mean analysis

Efficiency	N Statistic	Mean	Std Deviation	Median
	28	10.000	2.6667	9.000

Next, we present results from Mann-Whitney tests of respondents' perceptions on ICT efficiency in relation to demographic data below.

Interestingly, the mean analysis as presented on table 4.11 indicates a huge difference in means of gender and efficiency perceptions at 10 and 1.6786 respectively.

Table 4.11: Descriptive statistics: Gender vs Efficiency

	N	Mean	Std. Deviation	Minimum	Maximum
Efficiency	28	10	2.6667	7.00	22.00
Gender	28	1.6786	0.47559	1.00	2.00

Table 4.12: Ranks

	Gender	N	Mean Rank	Sum of Ranks
Efficiency	Male	9	15.67	141.00
	Female	19	13.95	265.00
	Total	28		

The Mann-Whitney tests statistics on table 4.13 indicate that the is a significant difference between males and females with regards to their perception on ICT's ability to improve efficiency.

Table 4.13: Test Statistics: Grouping Variable= Gender

	Attitude
Mann-Whitney U	75.000
Asymp Sig (2-tailed)	0.556

The Kruskal-Wallis Test conducted on this category against the respective professions show that there is no significant difference in the attitude of Radiologists, Radiographers and Administrators towards the statements related to how ICT improves efficiency in the radiology department. The results to these tests are presented on tables below.

Table 4.14: Kruskal-Wallis Test: Ranks

	Profession	N	Mean Rank
Efficiency	Radiologist	6	13.71
	Radiographer	17	17.00
	Administrator	5	14.20
	Total	28	

Table 4.15: Chi-square analysis

	Efficiency
Chi-Square	0.933
Df	2
Asymp. Sig.	0.627

4.4.1.2 Relationship between ICT Adoption and Efficiency

We further analysed the data to determine the relationship between variables in 'ICT Adoption" and efficiency. The results are presented below.

On table 4.16 below, we present Spearman's correlation tests conducted on efficiency variables versus attitude towards ICT adoption. Spearman's coefficient calculated is 0.051. this is statistically insignificant at p=0.795. This means that generally respondents' attitude towards ICT adoption do not affect their perception on ICT's ability to improve efficiency in healthcare delivery.

Figure 4.16 Relationship between Crosstabulation of ICT Adoption and Efficiency

			Efficiency	Attitude
Spearman's rho	Efficiency	Correlation Coefficient	1.000	0.051
		Sig. (2-tailed)	0	0.795
		N	28	28
	Attitude	Correlation Coefficient	0.051	1.000
		Sig. (2-tailed)	0	0.795
		N	28	28

4.4   Summary

In this chapter, the results of data obtained from the research instruments were presented. The data obtained from the research instrument (questionnaire), was analysed using the Statistical Package for Social Sciences (SPSS) program. Data was input into SPPS as coded on the questionnaire. SPSS was then used to present results in various visual formats.

Firstly, the biographical data of the respondents was presented in graphical and table formats to clearly show the broad representation of respondents in terms of gender, race and profession. We then presented the data as per various sections of the questionnaire. Data from section B of the questionnaire was explored and indicated that most participants (82%) had prior exposure to ICT on their work before joining IALCH radiology department. Majority of the participants have taken a basic computer course as part of their formal education or on short course basis.

Data from section C & D which focused on the respondents' attitude towards ICT adoption and their perception on ICT's impact on efficiency was analysed through Mann-Whitney tests and presented in graphical and tabular forms. Lastly, the relationship between data from both variable groups was analysed using Spearman's correlation tests and presented in tabular form.

In the next chapter, we will discuss how results presented here relate to the reviewed literature and study objectives.

CHAPTER FIVE: Discussion

5.1   Introduction

This chapter seeks to draw and present some logical conclusions from the results presented in chapter 4. The results will be related with the literature and determine if study objectives were met.

5.2   Overview of study objectives

This study was aimed to help determine if ICT adoption in healthcare delivery is a real necessity or just a luxury exercise that should be ditched in economic times where containing cost and driving up profitability is the biggest focus of many businesses, Healthcare included. The identified study objectives were:

- Determine if ICT adoption has improved the efficiency of healthcare delivery
- Determine if ICT helps to improve the jobs of healthcare provides

5.3.1   Response rate statistics

A total of 28 respondents completed and the returned the questionnaires which makes a response rate of 76%. The response rate is indicative of the sampling technique adopted, which was the convenience sampling technique.

There was a fair representation of 3 categories of professions in the study namely Radiologists, radiographers and administrators. The number of responses by each profession were proportionally related to the composition at the department were Radiographers makeup the bulk of the staff count.

5.3.2   Attitude towards ICT Adoption

The introduction of an ICT system in an institution does not always result in adequate user adoption, this is often rated as the main reason why ICT projects fail in healthcare facilities (Haluza & Jungwirth, 2014). The extra time it takes to learn

the new technology coupled with the often highly sophisticated graphical user interfaces (GUI) is another major barrier to user adoption in healthcare ICT projects (Miller & Sim, 2017).

In this study, we found that there was a high adoption rate with most of the participants displaying a largely positive attitude towards the adoption of ICT at the IALCH radiology department. As shown on figure 4.7, majority of the respondents in the study agreed that the technology adopted at IALCH was easy to learn and the training provided was also adequate. The largely positive attitude towards ICT at IALCH radiology department as discovered in this study corroborates the view expressed by the data in literature review as cited above on factors that influence adoption.

Prior access to, and ability to comfortably use electronic gadgets could also have an impact on how easily users adopt a new technology in a work environment. The results of this study support this argument as figure 4.4 shows that 75% of the respondents had prior access to ICT usage in a healthcare environment. Most respondents (80%) indicated that they have access to computers at home, this could also be a contributing factor to the high rate of user adoption and positive attitude towards ICT at IALCH radiology department.

An overwhelming majority (96.4%) of respondents are confident in their ability to use the current ICT systems at the department. Most respondents, (75%) indicated that they use ICT as an exclusive means of record keeping and other functions within their roles. Literature reviewed linked a consistent connection between exclusively documenting electronically and the improved quality of documentation (Miller & Sim, 2017). The results of this study are therefore in agreement with literature regarding the confidence of users in their ability to use the use the system leading to exclusive use and positive attitude towards quality improvement in patient care documentation.

Other studies reviewed in the literature (Ajami & Bagheri-Tadi, 2013); (Brinkel, et al., 2014)) cited technical support of the adopted technology as a major contributing factor to user adoption. Without adequate support, ICT projects are bound to collapse as users will feel despondent and easily revert to old manual workflows. In this study, we found that there is indeed enough technical support with the majority

(84%) of the participants responding positively to this question as shown on figure 4.7. Technical support is essential to facilitate adoption in the initial phases but also on an ongoing basis as user's experience grow.

The study did not note any significant relationship between the demographic profile of respondents and their attitude towards ICT adoption. The respondents' gender, race of position did not influence their individual adoption of ICT. It was interesting to note that the few percentage of respondents that showed a negative attitude towards ICT adoption belonged to the radiologist's profession and their negativity was mostly related to the adequacy of training provided on the systems. Literature reviewed argue that ICT adoption by older population is slightly lower compared to younger generation due to perceived complexity (Heart & Kalderon, 2013).The demographic composition of most radiologists, reflect an older and generation who might need extra training and special attention compared to their younger counterparts.

Results from some of the literature noted a significant relationship between a users' attitude towards ICT in healthcare and their intention to use the technology. Attitude can therefore can reliably predict a users' intention to adopt and use ICT systems ((Hussein, et al., 2017). Results is this part of the study support prior research with a few exceptions such the positional rank of employees not influencing their attitude towards ICT adoption. The results reveal the complexity of this change and suggest several avenues for future research and for the implementation of IT in healthcare.

5.3.3 Efficiency of healthcare delivery

Accuracy in first time diagnosis of illnesses is very important to ensure that proper treatment interventions are followed. The literature reviewed showed that adoption of mobile devices for healthcare has shown to offer the same quality of diagnosis accuracy with added benefit of speed (Ventola, 2014). The results in this study revealed that a significant percentage of the users (89%) responded positively and agreed that ICT does improve accuracy of diagnosis at IALCH radiology.

Workflow turnaround times was cited as major output and measure of efficiency in a healthcare facility. Most literature reviewed supported the notion that adopting ICT solutions such as Speech recognition technology (Used for reporting in radiology) significantly reduce the waiting times in the department ((Johnson, et al., 2014); (Barr, et al., 2017)). In this study, data reveals that all the participants responded positively to the statement agreeing that ICT adoption does improve turnaround times. ICT system at the department provided for a single-entry point for patient data which means that the details flows electronically to the imaging equipment.

The speed at which healthcare services are provided is of crucial importance and ICT adoption can, through improved turnaround times as discussed above, plays a significant role. The other aspect of efficiency that can be easily compromised by speed is quality of care documentation. ICT systems should be able to facilitate documentation that is accurate, complete and most importantly useful towards a continuous treatment plan of a patient (Kuhn, et al., 2015). In this study, we found out that an overwhelming majority of participants (82%) responded positively that quality of documentation has increased due to adoption of ICT at the radiology department. These results corroborate sentiments from the literature reviewed. Interestingly, all the participant who responded negatively to this statement are from the radiologist group.

The reduction of human errors in medical care is an important aspect of improving efficiencies. Literature reviewed concluded that by adopting ICT in healthcare we can reduce the need for repeat examinations, incorrect procedures on patients and therefore improve patient safety((Turcu & Turcu, 2013); (Plumb, et al., 2017)). In our study, we found that ICT adoption does indeed reduce human errors as majority (92%) of the participants responded positively to this statement as shown on figure 4.9.

The results in our study overall reveals that participants at IACLH radiology department are positive towards ICT's ability to improve efficiency in healthcare. We did not find any significant difference influenced by the respondents' demographics. For example, all respondents (3.6%) who did not believe that of that ICT improves the quality of documentation were radiographers while all those who did not agree with the ability to reduce human errors in healthcare where radiologist. All

administrators were positive that ICT improves efficiency of workflows in the department. The results of our study do not deviate from the literature reviewed on this subject.

5.3.4 Relationship between attitude on ICT adoption and efficiency of healthcare delivery

To investigate whether a relationship exists between ICT adoption and respondents' perception on efficiency improvement, the present study did not find significant relationship between the two. This means that generally respondents' attitude towards ICT adoption do not affect their perception on ICT's ability to improve efficiency in healthcare delivery.

It is important to note that as explained above, majority of users can be concluded to have fully adopted ICT judging from their positive attitude towards, the majority also believe that ICT have indeed improved efficiency of healthcare. It appears therefore, that the users' perception on ICT's ability to improve efficiency is not influenced or affected by their attitude towards ICT adoption. These results are contrary to most of the literature reviewed, for example, (Deng, et al., 2014) suggest that perceived value and attitude determine level of adoption of ICT systems in healthcare, more particularly.

5.3.5 Summary

This chapter presented a discussion of the research results. The descriptive part of the survey results was briefly discussed first, followed by results relating to the study objective. Results from the questionnaire sections that addressed the study objectives were linked to the literature reviewed were possible. The chapter proceeded to correlate the study's results with concepts and data from the previous studies presented in the literature review.

The next chapter will present conclusions as well as recommendations emanating from the study. Insights for future research projects on the similar topic will also be presented on the next chapter.

CHAPTER SIX: Conclusions and recommendations

6.1   Introduction

This chapter presents a conclusion to the study by summarising the findings in relation to the study objectives. Key challenges that were encountered during the research will be highlighted together with recommendations for further studies in this topic of interest.

6.2   Implications of this research

The research into the impact of ICT adoption on the efficiency in healthcare as conducted by this researcher at IALCH had aimed to fulfil the following objectives as identified in chapter 1.

- Determine if ICT adoption has improved the efficiency of healthcare delivery
- Determine if ICT helps to improve the jobs of healthcare providers.

6.3   Key Findings

A detailed analysis of the research data as discussed in the preceding chapter formed the basis for a deep insight into various elements that impact on users' attitude towards ICT adoption, the barriers and perceptions on ICT's role in efficiency improvement in healthcare service delivery at IALCH radiology department. Those discussions together with correlation to the literature reviewed provided a basis from which conclusions can be deduced.

The results of the study revealed that ICT adoption plays a significant role on the improvement of efficiency of healthcare delivery at Radiology department in aspects such workflow turn-around times, quality of documentation, continuity of care reduction of data loss. It is also evident from the results and data analysis that respondents at IALCH radiology department generally agree that   accuracy of diagnosis, continuity of care are positively impacted by the adoption of ICT.

6.4   Conclusions

From, the data and results presented, it can be concluded that ICT does improve efficiency in workflow and general healthcare service delivery at IALCH radiology. ICT adoption also positively affects and improves the productivity of healthcare professionals at the radiology department

Given the highly positive outcome towards our study objective, we believe that the study has demonstrated the need for ICT in healthcare facilities. The study therefore, by addressing the research objectives, will contribute to the advanced of healthcare in South Africa and help to drive:

- A more deliberate and rapid adoption of ICT in Healthcare
- Better investment in ICT for Healthcare by Government and Private Sector
- Training and development of healthcare providers in ICT

The advancement of healthcare delivery stands to benefit the community at large as More patients would now be reached and given access to faster and higher quality healthcare services.

6.5   Recommendations from the study

The study revealed that IALCH has taken important steps to ensure the high adoption rate of the ICT systems at the radiology department. Most of the barriers to adoption that were cited in literature review were not present or had been adequately addressed at IALCH. Data gathered through the research instrument revealed a few gaps which should be addressed to make ICT systems more impactful at IALCH. To address this theses gaps, the following steps are recommended:

- More training on the ICT systems should be given to professionals
- Professionals, especially Radiologists should be given an ability to report and view images remotely within the hospital to speed up workflows.

6.5   Recommendations for future studies

For researchers interested in studying this topic further in future, the following recommendations should be considered.

- The study should be expanded to include an investigation into whether ICT improves profitability or not
  - o This is especially important in the economical context were financial resources are being contested by various parts of a healthcare system.
- The future studies should also measure the patients' perception on the impact of ICT in healthcare delivery
- A mixed method approach could help to put better context into answers provided by respondents. This could be done by conducting interviews with some professionals to give them a chance to contextualize the challenges that ICT adoption might have brought.

6.6   Limitations to the study

It is important to note the following limitations as acknowledged by the researcher:

- The study only focused on the radiology department of Inkosi Albert Luthuli Central Hospital and therefore the results cannot be generalized to the entire hospital or all healthcare facilities in South Africa
- Given the limited time and criticality of the work environment, the study sample targeted was not achieved. Future studies with more time and budget should aim to get a better response rate.

6.7   Challenges encountered and overcome

Challenges below were encountered and dealt with during cause of the study: -

- Ethical clearance and Gatekeeper letter

- o It was difficult to get keeper letter allowing the research at the hospital because the process was not clear in the beginning. The researcher had to get provisional ethical clearance before gatekeeper letter could be issued. There are three approval layers before the research could be allowed viz: department level, hospital level and provincial Department of health level. This long process of getting gatekeeper letter and ethical clearance caused a long delay in the research project.

- Availability of respondents
  - o Willingness and availability of professionals to participate in the study was a bit difficult. There was no response to the email invitation sent to respondents and eventually the researcher had to physically approach participants on a convenience basis.

6.6   Chapter Summary

The study aimed to investigate the impact of ICT adoption on the efficiency of healthcare delivery at Inkosi Albert Luthuli Hospital radiology department. The research results concluded that ICT adoption improves efficiency. The study also revealed that respondents' perception on improved efficiency was positive irrespective of their attitude towards ICT adoption.

Challenges relating to ethical clearance were dealt with even though they caused significant delays to the research project. Future studies in this topic should be allocated more time and resources. An academic hospital like IALCH should have its gatekeeper letter issuing process well communicated with UKZN GSB &L to allow researchers to adequately prepare.

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Appendixes

Appendix A: The questionnaire

Research Questionnaire

The Impact of Information and communication Technology(ICT) on the efficiency of healthcare delivery at Radiology Department: Inkosi Albert Luthuli Central Hospital

I **Kagiso Gabonewe,** an MBA student at UKZN GSBL, am conducting a research project on The Impact of Information and communication Technology(ICT) on the efficiency of healthcare delivery.

The survey will take approximately 15 minutes to complete. Your time in this regard will be highly appreciated.

The results of this questionnaire will be used for academic purposes. There is no monetary gain from completing it. Please note that you are free to participate or withdraw from the survey at any time without any negative consequences.

I thank you in advance for your time and contribution.

……………………………….

Kagiso Gabonewe

A. Demographic Information

1. Gender:

Male 1	Female 2

2. Race group:

Black 1	White 2	Indian 3	Coloured 4

3. Profession:

Radiographer 1	Radiologist 2	Administrator 3

4. Total Years of Experience in healthcare:

< 3 Years 1	5 -10 Years 2	>10 Years 3

5. Number of years in this Hospital:

< 3 Years 1	5 -10 Years 2	>10 Years 3

6. Are you on a supervisory/ managerial role?

Yes 1	No 2

B. Exposure to ICT:

1. Did you use ICT at your previous hospital?

Yes	1	No	2

2. Do you have access to a home PC or Tablet?

Yes	1	No	2

3. Do you have access to internet at home?

Yes	1	No	2

4. Did you take a formal basic computer training?

Yes	1	No	2

5. Do you use computers to diagnose and report remotely?

Yes	1	No	2

6. How long have you had access to a computer/ tablet?

< 3 Years	1	5 -10 Years	2	>10 Years	3

C. ICT Impact on Job function
Please Select the box that best describes how you feel about the statement.

1. Using computers in my department has helped to improve the quality of

   documentation?

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

2. Using computers helps to reduce human errors in care giving?

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

3. Computerised storage of patient images and records reduces the chances of

   information loss

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

4. Using a computer system helps improve turnaround time

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

5. Using a computer system makes me feel more accountable in my work as I know that everything is recorded.

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

6. I feel that computer systems are here to police my work instead of improving it

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

7. Using computers systems for remote diagnoses removes the human touch in healthcare and is not good for the patient

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

8. I'm confident in the accuracy and integrity of the information in computer system to help make accurate decisions.

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

D. ICT Adoption

Please Select the box that best describes how you feel about the statement.

1. It was easy to learn the computer system used in my department

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

2. I received adequate training on the computer system used

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

3. There is adequate technical support for the computer system

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

4. I feel comfortable/confident using the computer system for my daily duties

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

5. Compared to manual paper work, I think computer systems in radiology are

   more efficient.

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

6. I use computer system exclusively in my role.

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

7. I use computer systems and duplicate my work on paper for security.

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

8. I use computer systems and supplement it with paper records to ensure

   thorough documentation.

Strongly Agree	1	Agree	2	Undecided	3	Disagree	4	Strongly disagree	5

Appendix B: Informed Consent Form

<div style="border:1px solid black; text-align:center">

Informed Consent Letter 3

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UNIVERSITY OF KWAZULU-NATAL
GRADUATE SCHOOL OF BUSINESS AND LEADERSHIP

Dear Respondent,

MBA Research Project
Researcher: Kagiso Gabonewe (0820865981)
Supervisor: Dr Muhammad Hoque

Research Office: Ms P Ximba 031-2603587

I, **KAGISO GABONEWE,** an MBA candidate, at the Graduate School of Business and Leadership, of the University of KwaZulu Natal. You are invited to participate in a research project entitled "**The Impact of Information and communication Technology(ICT) on the efficiency of healthcare delivery."**

The aim of this study is to: Determine if adopting ICT as a core component of a Hospital operations have an impact on the efficiency of healthcare delivery.

Your participation in this project is voluntary. There will be no monetary gain from participating in this survey/focus group. Confidentiality and anonymity of records identifying you as a participant will be maintained by the Graduate School of Business and Leadership, UKZN.

If you have any questions or concerns about completing the questionnaire or about participating in this study, you may contact me or my supervisor at the numbers listed above.

The survey should take you about **15** minutes to complete. I hope you will take the time to complete this survey.

Sincerely

Investigator's signature_____ Date_____

UNIVERSITY OF KWAZULU-NATAL
GRADUATE SCHOOL OF BUSINESS AND LEADERSHIP

MBA Research Project
Researcher: Kagiso Gabonewe (0820865981)
Supervisor: Dr Muhammad Hoque
Research Office: Ms P Ximba 031-2603587

CONSENT

I………………………………………………………………………(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT   DATE

…………………………………………………………………………………………

Appendix C: Hospital Approval

health

Department:
Health
PROVINCE OF KWAZULU-NATAL

DIRECTORATE:

Physical Address: 800 Bellsir Road, Mayville, 4058
Postal Address: Private Bag X06, Mayville, 4058
Tel. 0312401059 Fax: 0312401050 Email: ursulanun@ ialch.co.za
www.kznhealth.gov.za

Office of The Medical Manager
IALCH

Reference HSS/0342/017M
Enquiries Medical Management

15 May 2017

Mr K Gabonewe
Graduate School of Business & Leadership
Westville Campus

Dear Mr K Gabonewe

RE: PERMISSION TO CONDUCT RESEARCH AT IALCH

I have pleasure in informing you that permission has been granted to you by the Medical Manager
to conduct research on: **The impact of Information and Communication Technology (ICT) on
the efficiency of healthcare services delivery at Radiology Department of Inkosi Albert
Luthuli Central Hospital.**

Kindly take note of the following information before you continue:

1. Please ensure that you adhere to all the policies, procedures, protocols and guidelines of the
   Department of Health with regards to this research.
2. This research will only commence once this office has received confirmation from the
   Provincial Health Research Committee in the KZN Department of Health.
3. Kindly ensure that this office is informed before you commence your research.
4. The hospital will not provide any resources for this research.
5. You will be expected to provide feedback once your research is complete to the Medical
   Manager.

Yours faithfully

....
Dr L P Mtshali

Appendix D: Department of Health Approval

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

DIRECTORATE:

Physical Address: 330 Langalibalele Street, Pietermaritburg
Postal Address: Private Bag X9051
Tel: 033 395 2805/ 3189/ 3123 Fax: 033 394 3782
Email: hrkm@kznhealth.gov.za
www.kznhealth.gov.za

Health Research & Knowledge
Management

HRKM Ref: 224/17
NHRD Ref: KZ_2017RP22_485

Date: 20 June 2017
Dear Mr K Gabonewe
UKZN

Approval of research

1. The research proposal titled 'The impact of Information and Communication Technology (ICT) on the efficiency of healthcare delivery at Radiology Department of Inkosi Albert Luthuli Central Hospital' was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken at Inkosi Albert Luthuli Central Hospital.

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the identified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mr X. Xaba on 033-395 2805.

Yours Sincerely

Dr E Lutge

Appendix E: Ethical Clearance

UNIVERSITY OF
KWAZULU-NATAL

INYUVESI
YAKWAZULU-NATALI

30 June 2017

Mr Kagisho Gabonewe (215080702)
Graduate School of Business & Leadership
Westville Campus

Dear Mr Gabonewe,

Protocol reference number: HSS/0342/017M
Project title: The impact of Information and Communication Technology (ICT) on the efficiency of healthcare services delivery at Radiology Department of Inkosi Albert Luthuli Central Hospital

Approval Notification – Expedited Application

With regards to your response received on 28 June 2017 to our letter of 25 April 2017, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

Dr Shamila Naidoo (Deputy Chair)

/ms

cc Supervisor: Dr Muhammad Hoque
cc Academic Leader Research: Dr Emmanuel Mutambara
cc School Administrator: Ms Zarina Bullyraj

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 Facsimile: +27 (0) 31 260 4609 Email: ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

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Appendix F: Turnitin Report

The Impact of Information and Communication Technology (ICT) in the efficiency of healthcare delivery at Inkosi Albert Luthuli Hospital Radiology department

ORIGINALITY REPORT

3%	**4**%	**0**%	**3**%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	**Submitted to University of KwaZulu-Natal** Student Paper	**2**%
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