An analysis of the Diffusion and Adoption of Technologies and Innovations in the Public Healthcare Sector in Zimbabwe.

BY

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DEDICATIONS

This research is dedicated to my family; my husband Albert, daughters Tanyaradzwa and Mukudzei, and to the yet-to-be-born “baby Dodo” Musakwa.
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Firstly I want to thank the Lord almighty that through His grace and love, I managed to complete this research on time. I carried out this research at a time when I was going through a difficult patch in my life, but God gave me the strength to go on.

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I further record my acknowledgments to my supervisor Prof G. Kabanda for his guidance, inspiration and wisdom throughout the whole research exercise.
DECLARATION

I, Miriro Muvoti, do hereby declare that this dissertation is the result of my own investigation and research, except to the extent indicated in the acknowledgements and references included in the body of the report, and that it has not been submitted in part or in full for any other degree to any other university.

Student signature  Date

Supervisor signature  Name  Date
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ABSTRACT
The study investigates the rate of diffusion and adoption of technologies and innovations in the public healthcare sector in Zimbabwe. Samples of sufficient numerical sizes were collected from a number of public health institutions in Zimbabwe including Parirenyatwa hospital and Harare hospital among other hospitals and clinics. The research specifically analysed what taxonomy of technologies existed in the sector, internet and mobile penetration rates, ICT literacy vis a vi effective utilisation of technologies as well as benefits that have so far been realised from the use of technologies and innovations. Interviews with department heads at the various institutions, as well as questionnaires, were used in data collection to produce the desired information.

The research paper concludes that the public health sector has done commendable work in beginning to acknowledge the usefulness of technology in improving health and have considerably done well in beginning to use technology and innovations in spite of a difficult economic environment. Benefits of doing so are evident in improved research, improved patient care and diagnosis, safe storage and easy handling of patient records and improved communication. However, the diffusion and adoption of innovations and technologies in the public healthcare sector is not as rapid as in other developing countries in the region and there is more that still needs to be done to benefit more from the capabilities of technologies and innovations. The major reason for the slow rate of adoption, according to management, is poor financing. Also, while there is evidence of the use of technologies at most institutions, there is no standard nomenclature for these technologies in the Zimbabwean context and each institution is perusing individual interests. There is no effective utilisation of available technologies and innovations at public health institutions due to lack of proper skills by health professions to effectively use the technologies.

The recommendations from the research include incorporation of basic ICT training to all health professionals and possible inclusion of the training in the curriculum, come up with a uniform taxonomy for the sector, to make more use of the 100% mobile density by applying mobile health applications like telemedicine to healthcare and to address issues of investment and sustainability.
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CHAPTER ONE

1.0. INTRODUCTION
This chapter gives an introduction to the study into the diffusion and adoption of technologies and innovations in healthcare in the public health sector in Zimbabwe. It outlines the background to the study, the research problem (its aim and objectives), research questions, justification, scope, ethical considerations and limitations. The chapter also outlines the significance of this study to the public health sector and to the nation at large.

1.1. INTRODUCTION TO THE STUDY

Globally, all nations, rich and poor strive to continuously improve the accessibility, affordability and responsiveness of healthcare for citizens. The use of technologies has evolved as one of the pivotal ways to achieve this feat (Chetley, et al., 2006). One of the many ways in which technologies can improve healthcare is through bridging geographical barriers; taking healthcare to otherwise geographically isolated areas. It allows these remotely located communities to access healthcare through the use of such technologies as medical expert systems and telemedicine (The Virtual Doctor Project, n.d). Regionally, nations like South Africa, Zambia and Ghana among others, have used mobile technology for the management of chronic illnesses like diabetes by actively involving the patient (Littman-Quinn, 2011; Shivute, Maumbe, & Owei, 2008; Asabere, 2012).

Besides increasing the accessibility of healthcare, technology also has the capacity to improve efficiency which in turn reduces costs (Shekar & Otto, 2012). Electronic records for example, can minimise costs arising from duplication in the handling of paper records. Through technologies, players in the healthcare sector (Ministries, medical aid companies, medical practitioners etc) can also share vital information which helps in improving the quality of health delivery and management. Despite Healthcare delivery industry having much to gain from technology, it appears that in Zimbabwe the industry is the slowest from all industries in the adoption; at least this is true for public health institutions. Some strides have been made in embracing the use of technologies in health, however there is more to be explored in order to reap maximum benefits for the country’s healthcare sector.
This study is a critical analysis of the diffusion and adoption of technologies in public health delivery in Zimbabwe. The study further seeks to identify gaps and proffer more ways to leverage from the use of technologies in healthcare delivery, thereby providing policy and decision makers with valued information to assist them when they formulate policies and strategies for health. The research was motivated by the realisation that public health delivery in Zimbabwe continues to suffer from a number of challenges, chief among them being the shortage of medical doctors and other specialised practitioners. Other challenges include high costs of medical care, acute shortage of drugs, old equipment, and inadequate infrastructure. Zimbabwe is yet to recover fully from the decade long decay in its economy, as at December 2011 the per capita for Zimbabwe was recorded as $345.56 (World Bank, 2013), which is one of the lowest in Africa.

While the Ministry of Health and Child Welfare (MOHCW) has set up a technical working group to spearhead the use and application of technologies in health, no documented research has been carried out to assess the uptake of technologies in public health institutions as well as the application of these. This research intends to provide this missing overview of Zimbabwe’s public health system regarding diffusion and adoption of technologies in healthcare.

1.2. BACKGROUND OF THE STUDY

1.2.1. Definition of health

Health has been defined by the World Health Organisation (WHO), since 1947 as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (Ottawa Charter, 1947). This definition seems to suggest that the absence of disease is the major component of health. The Mexican Commission on Macroeconomics and Health (2004) gives a definition for health that agrees with this definition when they define health as not only the absence of illness but also the ability of an individual to develop to their full potential. However, a new dimension to health is brought forth in this definition, that of the development of an individual to their full capacity; the development of individuals speaks to the development of an economy at large. According to Bjornland, Goh, Haanaes, Kainu, & Kennedy (2012), an effective and accessible health care system is a prerequisite for socio-economic benefits across society.
1.2.2. Zimbabwe’s public Healthcare system

In Zimbabwe, public health is the largest provider of health services. This is mainly because the majority of the population still lives in the rural areas where the most number of health institutions are public. Despite the fact that urban population is rising over the years while rural population declines, Figure 1 indicates that as at January 2010 more than 50% of the Zimbabwean population still lived in the rural areas.

![Figure 1.1: Zimbabwe’s rural population (% of total) in Zimbabwe. From Trading Economics, www.tradingeconomics.com](image)

The other reason why most people still rely on public health is the high costs associated with private health facilities which are beyond the reach of many average Zimbabweans. As at December 2011 the per capita for Zimbabwe was recorded as $345.56 (World Bank, 2013), which is one of the lowest in Africa. The majority of Zimbabweans cannot afford private healthcare and still rely heavily on public health institutions whose rates are comparatively lower.

1.2.3. Organisation of public health in Zimbabwe

The Government of Zimbabwe, through the Ministry of Health and Child Welfare (MOHCW), aims to provide quality and safe health services to its citizens(MOHCW, Zimbabwe, 2013). This is achieved through a well-organised system of hierarchical health facilities. Each level of the hierarchy provides the best possible medical care
administered by well-trained health personnel. Complex cases are escalated up the pyramid of levels in a systematic and orderly manner up to the highest level of central referral hospitals. Figure 1 gives a diagrammatic representation of the levels.

As outlined in the National Health Strategy for Zimbabwe (2009-2013) the public health sector operates as follows:

The primary level is the first point of call for a patient seeking medical care. Each primary level institution is manned by nurses and midwives. It is ideally supposed to cater for a population of 10000 people, although that is not the actual situation on the ground due to resource constraints. Patients are also required not to walk more than 8km to their nearest primary health care centre. Again, this is opposite to the situation on the ground due again to resource constraints and the recent land reform programme which saw people migrating to remote areas far from the reach of health care.
At the secondary level, there are district hospitals. Patients are referred here from primary health centres; it is their first contact with a doctor. Each district centre is ideally supposed to cater for 140000 people.

Above the district hospitals there are provincial hospitals. All provinces have at least one district hospital. Matabeleland North is the only exception. At this level patients get various specialist services that are not available at district hospitals.

The highest level is the quaternary level. This level forms the country’s central referral hospitals where sophisticated services are obtained. There are five such hospitals (three in Harare and two in Bulawayo, the second largest city).

1.2.4. Problems in the health sector in Zimbabwe

Problems in public health (much as the economy at large) can be traced back to Friday 14 November 1997, a day that has been christened the “black Friday”. On this day, the Zimbabwean dollar lost its value by 71.5% measured against the United States Dollar (USD). Investors divested and the country went on a downward economic spiral for the subsequent 11 years. There was massive skills flight in the industry and the health sector was not spared. The CEO of Harare Central Hospital, Mr Nderere conceded in his 2010 implementation progress report that human resources constraints continue to haunt public health in Zimbabwe (Nderere, 2010). Rural hospitals in particular are the most affected as professionals shun these remotely located areas preferring the cities where there are opportunities to increase financial rewards from their profession; Most opt for private practice or to join private medical institutions. The University of Zimbabwe College of Health Sciences (UZCHS) which is the premier centre for health professions in Zimbabwe currently does not have the capacity to produce general practitioners and specialists to meet the healthcare priorities of Zimbabwe. This has contributed hugely to the continued decrease of Zimbabwean doctors practicing in Zimbabwe. Latest statistics put the doctor-to-patient ratio in Zimbabwe at 1:15000 compared to 1:200 patients per doctor in developed countries or the standard set by the World Health Organisation of 1:5000 (WHO, 2011). This shortage of staff often means the few that are available are often overworked, fatigued and irritable as a result. This compromises on the quality, safety and timely delivery of medical care to patients.
Rural communities in Zimbabwe are also disadvantaged in terms of accessibility—rather inaccessibility—of health facilities. The land reform programme saw a number of people randomly relocating into areas that are geographically isolated and outside the MOHCW recommended radius for accessibility of primary health facilities. This derails efforts that have so far been made by the MOHCW to make health facilities accessible within reasonable radii.

The hyperinflation era also caused reduction in the value of funds availed to health from the country’s fiscus. This led to failure by the industry to sustain growth and development; wages continued to drop, infrastructure depreciated without proper care and maintenance and there was no due replacement of old equipment (Osika, Altman, Ekbladh, Katz, Nguyen, Rosenfield, Williamson, & Tapera, 2011).

1.2.5. The 2009-2015 national health strategy

In 2009 Zimbabwe’s fortunes took a turn for the better. On 30 January that year, the government adopted the multicurrency system which has brought some stability in the economy—“a new normal”. Subsequently in February of the same year, the Government of National Unity was signed. These two moves brought some semblance of hope to the Zimbabwean situation. A lot of industries began to resuscitate from demise, public health is one of them. In the same year the MOHCW developed a five year strategic plan that was aimed at turning around the state of public health. The plan is coming to an end at the end of 2013.


1.2.6. Global and regional trends in the use of technologies in health

Globally, the use of Technologies in health care dates back as far as the 60s in the form of hospital information systems (HIS) (Rudowski, n.d). The first HIS used the
traditional huge mainframe computers. Today it has evolved to distributed systems.
The use of telemedicine in Italy dates back as far as 1935 where medical assistance was given to ships at sea from Italy’s International Radio Medical Centre.

In 1970 there was a breakthrough in medical history when Edward Shortliffe of Stanford University developed the first expert system-MYCIN. It was the first medical expert system on which subsequent systems were to be based(haifa.ac.il, n.d). The most common expert system today is NHS Direct of England.

Today a lot of countries are using technologies in various divisions of the health sector, from management information systems (MIS), administrative systems, electronic records, research databases, telemedicine, expert systems (decision support systems) and computer imaging to name but a few.

Regionally countries like South Africa, Zambia, Ghana, Uganda, Namibia and Mozambique have benefited from using telemedicine and other technologies to reach geographically isolated communities and provide web-based assistance for disease management. Some of the works in South Africa include the implementation of an expert system that allows HIV patients to interact with it and determine the best home remedies to treat common HIV symptoms they experience(Mburu & Dr Mbogho, 2012). Zambia, in partnership with Virtual Development UK, is embarking on a project to install telemedicine services in three centres in rural districts. They intend to do three more centres by the end of 2013(The Virtual Doctor Project, n.d).
1.3. RESEARCH PROBLEM

In the five year strategic plan for health-running from 2009 to 2013, MOHCW acknowledge the important role that technology can play in the improvement of health delivery. In November 2012 they also drafted an e-health strategy again to strengthen the use of ICT technologies in health and to better achieve the Millennium Development Goals (MDGs). The ministry has undoubtedly done commendable work into applying the use of technologies in health. There are also a number of organisations that are working with the MOHCW and some directly with health institutions. However, despite all these efforts, it appears there is no clear record or publication on what systems have been implemented at public health institutions and what benefits they have brought to these institutions and to the population at large. This kind of information is beneficial not only to decision makers but also to current and potential investors. As the MOHCW’s strategic plan comes to an end, and they prepare to review and develop yet another strategic plan for the coming five years, it is critically important that these policy makers have adequate information of what is on the ground and what other capabilities of technologies in health can be explored to enable them to make better informed decisions. According to Kazanjiani and Green as cited in Lewis, Hodge and Whittaker (2011), policy and decision makers often make decisions unaware of how much information they lack in terms of effectiveness, costs, and social implications of technology; they rarely obtain feedback on the consequences of their decisions. It is the thrust of this research to analyse the current status of the public healthcare system in Zimbabwe with regards to the adoption and use of technologies, with the view to suggest ways in which Technologies can be further harnessed to improve healthcare delivery in general and to address in particular the issue of staff shortage and geographically isolated areas.
1.4. RESEARCH OBJECTIVES

The aim of the research is to explore the level of penetration and application of technologies and innovations in Zimbabwe’s public healthcare sector with the view to suggest strategies for further leveraging on technologies to increase safety and lower costs in public healthcare.

The specific research objectives are:

1. To identify the taxonomy of technologies which are currently in use in Zimbabwe’s public healthcare sector.
2. To assess the internet penetration rate and mobile density at public healthcare institutions.
3. To determine the level of computer literacy and effective utilisation thereof at public healthcare institutions.
4. To find out the perceived benefits which have been brought about by the adoption of technologies in healthcare in Zimbabwe.
5. To recommend on strategies for adoption, application and value-adding contribution of technologies in health.
1.5. RESEARCH QUESTIONS

1. What are the different classifications of technologies which are currently in use in Zimbabwe’s public healthcare sector?

2. What is the level of internet and mobile availability, access and use at public healthcare institutions?

3. Does medical, support, administrative, clerical and general hospital/clinic staff have basic ICT skills to effectively use technology?

4. What are the perceived benefits which have been brought about by the use of technologies and innovations at public health institutions?

5. What strategies can be adopted by policy makers to increase the penetration of technology in health and to reap more benefits from the use of technologies in public health?
1.6. RESEARCH PROPOSITION

It is proposed that the rate of diffusion and adoption of technologies and innovations in Zimbabwe’s public health care sector is low and that ICT literacy is also very low. This has led to technologies not being fully utilised at these public healthcare institutions to offer the best improvement to healthcare provision.
1.7. JUSTIFICATION OF THE STUDY

In Zimbabwe the majority of the population still relies heavily on public healthcare; this is mainly due to the fact that the larger population still lives in the rural community and also the high costs associated with private healthcare facilities. Yet the public healthcare sector continues to be marred with massive shortages of doctors and specialist physicians, old and inadequate equipment, deteriorating infrastructure and bad corporate governance among others.

Technologies have proven to be an avenue to address many of the challenges facing public health care systems in the world. This research will give an insight into what efforts are currently on the ground to improve health using technologies to enable policy and decision makers to make informed decisions. It is hoped that the research will critically analyse the problems faced by the public health sector which hinder the adoption and diffusion of innovations and technologies. This information will be useful for stakeholders such as hospital management and the responsible ministry to make better informed decisions.

Information resulting from the research will also give investors and potential investors valued insight into how best they can invest in public health.

Patients will be enlightened to what technologies are available for them to improve and better manage their health.

Overall, the research should help to improve the nation’s health and well-being and increase productivity.
1.8. SCOPE OF THE RESEARCH

This research was conducted in Zimbabwe, covering public health institutions in both rural and urban communities. The study was conducted at five hospitals and two clinics. The five hospitals included three provincial and two central hospitals. At each of these institutions the target was to hand out questionnaires to at least 30% of staff.

Documents found in the Ministry of Health and Child Welfare and at the public healthcare institutions were analysed in search of an understanding into how the public health institutions operated as a way to get answers to some of the research questions.
1.9. ETHICAL ISSUES

The research was conducted in line with ethical guidelines in that participation was voluntary and completely confidential. The employees were free to participate or not to. Their responses were kept as confidentially as possible. No name or identification was required from the employees.

Prior permission was sought from the responsible authorities at these institutions; some of it was given explicitly in writing while some was in verbal form. The authorities were also provided enough time to have the research proposal for their consideration.
1.10. DISSERTATION STRUCTURE

This dissertation consists of five (5) chapters and each chapter shall start with an introduction and end with a summary.

**Chapter 1** gives the background of the problem under study as well as the research questions and the objectives. This is followed by the scope of the research and then a detailed methodology. It also details the justification of the study and significance of the study.

**Chapter 2** is a literature review; it looks at the works of other authorities and researchers. It gives a perspective of the subject under study including what has been done before. It also details the theoretical framework on which the research is based.

**Chapter 3** looks at the research methodology adopted and its justification. It also addresses data collection and analysis techniques employed. It will give a justification the selection of the data collection tools used, analysis, and point out any ethical issues that were considered.

**Chapter 4** provides a detailed analysis of the research results and provides the researcher a platform to express personal opinions of the subject under study.

**Chapter 5** gives the conclusions and recommendations derived from undertaking the research.
CHAPTER TWO

2.0. INTRODUCTION

This chapter gives a review of literature relevant to the study. It comprises of the contribution of health to the economy, use of technologies in improving health, theory of diffusion of technology and taxonomies of technologies in health as well as benefits of adopting technologies in health. The literature was developed in line with the objectives as well as the justification of the study.

2.1. HEALTH AS AN ECONOMIC ENGINE

It has long been recognised that improved national wealth is associated with good health, however of late many researchers and authors have found evidence that the contrary is also true; improved health leads to better economic development (Mirvis, Chang, & Cosby, 2008; (Suhrcke, Mckee, Arce, Tsolova, & Mortensen, 2005)). The quality and duration of life directly affects an individual’s ability to generate income. Emphasising the importance of the health sector, the Commission on Macroeconomics and Health report of 2001 as cited in Suhrcke M, Mckee, Arce, Tsolova, & Mortensen (2005) put forward that health is a key determinant of economic development and poverty reduction. The report further says that this has led to the inclusion of health in national development strategies and policy framework particularly in emerging markets.

The access, affordability and responsiveness (to local needs) of public health therefore are critical for the nation's economic competitiveness. Health is even central towards the attainment of the Millennium Development Goals (MDGs).

According to Suhrcke, Mckee, Arce, Tsolova, & Mortensen (2005), there is considerable evidence that significant economic benefits can be driven by improving health not only in developing countries but in developed countries as well. Mirvis, Chang, & Cosby (2008) support this assertion when they state that better health leads to economic development which impacts on micro and macro-economic factors. It is widely acknowledged in business that labour or human capital contributes immensely to economic growth—even inspiring location decisions for firms and competitiveness for nations. Health is a huge component of human capital hence health matters to economic growth (Suhrcke et al, 2005). These assertions
offer an argument on why it is beneficial to study this subject at this point in time as it will facilitate for the improvement of health services in Zimbabwe which will in turn drive productivity and grow the economy for the betterment of the populace of the nation. According to the Mexican Commission on Macroeconomics and Health (2004), cross country macroeconomic studies suggest that an increase of 40% in life expectancy would lead to a 1.4% increase in economic growth. Further a 10% decrease in malaria translates to a .3% annual GDP growth. On the other hand, malnutrition causes a decrease in the annual growth GDP per capita worldwide of between .23 and 4.7%.

From another perspective, absence of ill health means finances that would otherwise have been channelled towards treatment of ill health can be used for other developmental purposes (ACOEM, 2009). According to Muhammad (2009), the views on health-income relationship have critical policy implications. If causation is seen to be income-to-health, policies will most likely be made inclined to help the poor, fight poverty and redistribute income. However if as is being advocated in this research, causation is seen as running from health-to-earnings then policy implementation will be towards prioritisation of investment in public health; it will be to insure income against poor health (disability insurance and sickness benefits), so that sick people do not get poor and ultimately the nation at large does not get poor.

2.1.1. Health as an employer

The health sector serves as a job creator in any economy. According to Doeksen, Johnson, & Willoughby (1997), in a study that was carried out in the US using historical trends from 1984 to 1990, the health sector employed about 11% of total employment. In fact the sector employs the second largest number of people in rural areas, the first being schools (the education system) (Doeksen & Schott, 2003). In the European Union, the number of people employed in the health sector grew from 13 to 15 million between 1995 and 2000, that’s an increase from 9% to 9.5% of total employment (Tamsma & Berman, 2004).

2.1.2. How health affects business

It has since been established that human capital is a critical component of businesses; a healthy individual is a productive individual and hence adds to the competitiveness and profitability of an organisation (Suhrcke, Rocco, & Mckee,
2007). Ill health leads to missed working days and reduced productivity (Mirvis, Chang, & Cosby, 2008). According to Shasty and Weil as cited in Mirvis, Chang, & Cosby, (2008) mild to moderate anaemia in women reduces personal productivity by 24%. Illness can also affect businesses by increasing employee health benefits costs and employee turnover rates(Suhrcke, Rocco, & Mckee,2007).

2.1.3. Health in adults

The quality and duration of life directly impact a person’s ability to generate income. Illnesses and deaths are the new causes of increasing poverty. (World Bank, 2006). Illnesses also lead to personal debt. On the flipside improved health prolongs working years, promotes income growth, increases productivity and raises economic output.

2.1.4. Health in children

In children, poor health has both current and future economic consequences that may span generations(Mbarika & Okoli, 2003). First, parents miss work when their child is sick to care for them. Secondly, poor child health can inhibit educational attainment hence limit the child’s future economic productivity. Common childhood conditions like severe iron deficiency anaemia and poorly controlled diabetes among others reduce cognitive functions later in life(Mirvis, Chang, & Cosby, 2008). Good health promotes higher educational attainment; more educate individuals are more productive.

The Mexican Commission for Macroeconomics (2004) sums up the importance of health to the economy when it says: “If health is an asset, it is important to not only create incentives and implement policies to invest in health, but also to avoid, or at least minimise, its deterioration in adverse situations.” (pg. 20)

2.2. THE CONTRIBUTION OF TECHNOLOGIES TO HEALTH

The use of technologies is not unique to health alone; In business, almost all industries now take advantage of the many benefits that are associated with using technologies like efficiency in business transactions, lower costs of doing business, a faster way of reaching out to a wider audience, just in time delivery, agile decision making and many more. Technologies have taken international trade to new heights; Mbarika and Okoli (2003), put forward that the internet (which is a type of Information
Technology) has been hailed by development researchers as a “great equaliser” in that it breaks down geographical barriers making the world a global economy. In such a globalising economy, innovations are key to be competitive (Porter, 1990). Innovations take place in the context of a system and are the result of interactions by which knowledge diffuses between the actors of the innovation system. Knowledge diffusion is essential for innovations while innovations contribute to economic growth and social wealth (Rogers, 1995).

Just as much as other businesses and industries strive to use technologies to reengineer their way of doing business, the health sector worldwide has also endeavoured to take advantage of advances in technology to reform the health industry. According to Chetley, Davies, Trude, McConnel, Ramirez, Shields, Drury, Kumekawa, Louw, faraday, and Nyamai-Kisia (2006) technologies can improve access and quality of service while at the same time minimising costs. This assertion by Chetley et al sums up the many benefits of using technologies in health which include security of patient data, data storage, accurate and fast transactions in terms of tracking patient records and other clerical and administrative work, artificial intelligence and decision support systems (Asabere, 2012), and equitable health access by bridging the rural-urban divide (Ruxwana, Herselman, & Conradie, 2010). Despite the numerous benefits cited above, some authors argue that the major benefit in the use of technologies in health is safety (Dr Chaiken, 2001). He puts forward that technologies can safeguard against medical errors which can be drug errors due to lack of patient history or due to lack of drug knowledge, errors due to forgetfulness perhaps on the part of the patience in adherence to drug times, errors of misdiagnosis due to lack of knowledge or judgement (fatigue). According to the Institute of Medicine America report, *To Err is Human* (1999), between 44000 and 98000 people die in hospitals every year due to medical errors that could have been prevented.

Understanding how technology can improve health systems helps to guide decisions and policies about current and future initiatives. According to Kabanda (2011) if technologies are implemented properly and carefully, they could bridge the rich-poor divide as well as the powerfull-marginalised gap. Infact the use of technology in health can help to achieve equitable health for all.
2.3. THE DIFFUSION AND ADOPTION OF TECHNOLOGIES AND INNOVATIONS

Health care service innovations are pivotal in improving efficiency as well as responding effectively to health care needs (Barnett, Vaseleiou, Djemil, Brooks, & Young, 2011). An innovation is an idea, behaviour, or object that is perceived as new by its audience (Robinson, 2009). There are a number of theoretical frameworks which describe the process of adopting new technologies; the most popular model is Rogers’s Diffusion of Innovation Theory (Sahin, 2006). The theory was developed in 1962; it originated in communication to explain how, over time, an idea or product gains momentum and diffuses through a specific population or social system (Greiver, Barnsley, Glazier, Moineddin, & Harvey, 2011).

Adoption of an innovation is not a simultaneous event; rather it is a process that takes time and where some people are more apt to adopt the innovation than others (Bortha & Atkins, 2005). A number of studies on the adoption and diffusion of new technology suggest that stakeholders’ perceptions about a new innovation and the extent to which they see it as a relative advantage are central to the rate of diffusion and adoption (George, Hamilton, & Baker, 2012). There are a number of theoretical frameworks that look at the adoption and diffusion of innovations among them the technology acceptance model (TAM), theory of planned behaviour (TPB), unified theory of acceptance and use of technology (UTAUT) and Rogers’s diffusion of innovations theory (DOI). Rogers’s DOI theory will be adopted here as it looks at the firm level; the TAM, TPB and UTAUT are at the individual level.

In Roger’s studies and findings he identified 5 stages in what he termed the innovation-decision process. The following discussion looks at these stages in the context of an individual; the adoption of innovations in organisations is mostly based on the decisions of management. Figure 2.1 summarises the innovation-decision process as given by Rogers.
2.4.1. Knowledge

The innovation-decision process begins with the knowledge stage. At this stage, an individual becomes aware of an innovation (Rogers, 1995). The innovation could be new hardware, software, or tools. The main activity at this stage is cognitive (Bortha & Atkins, 2005). As indicated in figure 2.1 the knowledge about an innovation could come through various communication channels from advertising, media, training or education (Emani, et al., 2012).

2.4.2. Persuasion

This stage involves forming an opinion about the innovation; an opinion of which could be favourable or unfavourable (Greiver, Barnsley, Glazier, Moineddin, & Harvey, 2011). The main activity at this stage is affective. Before the development of an opinion, an individual or team seeks for information about the innovation.

2.4.3. Decision

At this stage, a decision is made on whether to accept or reject an innovation (Rogers, 1995). The process involves looking at the benefits, costs, advantages or
disadvantages of using the innovation. Once a decision is taken to adopt the innovation, an individual or organisation begins to use and integrate the technology into their daily activities. According to Rogers, this process of deciding occurs silently and invisibly to the outside researcher and one can rarely capture the exact moment of decision. Instead, a researcher can only access the adopter's reflections and retrospectives of the decision to adopt months or years later.

2.4.4. Implementation

This involves incorporating the innovation into regular use (Sahin, 2006); usually it takes a lot of time. It involves careful change management in terms of the people who will be using the innovation as it means a change to their usual habits and practices (Robinson, 2009). During implementation, evaluation of the innovation also takes place to see whether or not it meets expectations. More information may also be sought in order to improve its applicability, and to reap maximum benefits from the adoption of the new innovation (Barnett, Vaseleiou, Djemil, Brooks, & Young, 2011). Re-invention of the innovation may occur; this refers to the process where a user or an organisation modifies the technology to improve its overall performance to better meet their needs (Rogers, 1995).

2.4.5. Confirmation

This is when a final decision is reached on whether or not to continue using the technology or to discontinue its use altogether. Adoption means a user decides to use the technology fully while rejection is a decision to reverse the original decision of using the technology.

After confirmation some researchers have suggested there is a sixth stage which they call discontinuance. The reasons for discontinuance are numerous, among them obsolescence, replacement, or dissatisfaction with the technology (Rogers, 1995).

At firm level Rogers puts forward that the innovativeness of an organisation will largely depend on individual (leader) characteristics, internal organisational structural characteristics and the external characteristics of an organisation (Oliveira & Martins, 2011). Individual characteristics describe a leader's attitude towards change; this attitude is explained by Rogers's five stages of innovation adoption at individual level.
discussed above that is, knowledge, persuasion, decision, implementation and confirmation. Internal organisational structural characteristics include systems like centralisation, complexity, formalisation, interconnectedness, organisational slack and the size of the organisation. External characteristics of the organisation refer to the organisation’s openness. Figure 2.2. Summarises this illustration:

**Organisational innovativeness**

**Individual (Leader) Characteristics**
- Attitude towards change.

**Internal characteristics of organisational structure**
- Centralisation
- Complexity
- Formalisation
- Interconnectedness
- Organisational slack
- Size

**External characteristics of the organisation**
- System openness

*Figure 2.2: Rogers’s Diffusion of Innovations at firm level*

In his extensive work on diffusion of innovations, Rogers further identified five general attributes that he argued are factors that influence adoption. He defined these factors as:
Relative advantage
This is the degree to which an innovation is perceived as being better than its precursor.

Comparability
This is the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters.

Complexity
This is the degree to which an innovation is perceived as being difficult to use.

Observability
This is the degree to which the results of an innovation are observable to others.

Trialability
This is the degree to which an innovation may be experimented with before adoption.

These five drivers of adoption point to the fact that innovation adoption can be accelerated when all stakeholders in an organisation are involved, and can see the long term benefits of using the technology or innovation. Users also need to be persuaded technically; this gives the users positive attitudes and experiences with the technology and helps to create change agents to further allow a technology or innovation to proliferate.

The very first stage of technology adoption in Rogers’s theory points to knowledge as the basis for driving diffusion and adoption of a technology. Knowledge about a technology can be obtained through research, interacting with others who may be using the technology already, through studying and even through advertising. In the context of understanding technologies and innovations in healthcare, some researchers have suggested that there must be a responsible unit within an organisation that is involved in research and development (R&D) in order to keep policy and decision makers informed on available innovations and technologies and their relative advantages (Baron & Graham, 2007). Following is literature on some of the types and taxonomies of technology in health.
2.4. TAXONOMIES OF HEALTHCARE TECHNOLOGIES

Taxonomy is a practice and science pertaining to classification. Taxonomies provide schemas for classifying entities and defining the relationships between them. A taxonomy helps with coming up with a catalogue that helps with analysis and research as well as information retrieval. The development of a good taxonomy takes into account the importance of separating elements of a group into subgroups that are mutually exclusive (Gremy & Degoulet, 1993). Health technology is a complex issue; infact technology itself is a term that can have different meanings. Traditionally technology used to be associated with “things”; equipment, instruments, gadgets, computers but today the term also includes software, procedures and techniques (Barnett, Vaseleiou, Djemil, Brooks, & Young, 2011). Technology in health may be divided according to purpose of their use: cure, rehabilitation, administration and so on (Fisher, Shell, & Troiano, 2004). This implies that it is vital to understand the various technologies that are used globally in healthcare as a way of coming up with an informed classification of these technologies. Understanding the types of technologies that can improve health is the first step towards making informed policies and decisions to the improvement of health using technologies (Asabere, 2012).

Fisher, Shell and Troiano also suggest another way of classifying health technologies which is according to objects of application: individuals, communities and the environment. According to Interactive Research and Development (IRD); partner of the stop TB partnership for the world Health Organisation (WHO), (2012) there are apparently countless technologies that are in use in healthcare and some are bespoke technologies, however there are some common technologies in health that can be one of the following applications: health information systems (HIS), mobile health applications (mHealth), electronic health technologies (eHealth), teleHealth and medical expert systems among others.

2.4.1. Health information systems (HIS)

According to the Health Information Technology for Economic and Clinical Health (HITECH) Act, a provision of the American Recovery and Reinvestment Act of 2009 (ARRA) as cited in Reynolds, Sharp, & Zeng (2009), HIS refers to “hardware, software, integrated technologies or related licenses, intellectual property, upgrades,
or packaged solutions sold as services that are designed for or support the use by healthcare entities or patients for the electronic creation, maintenance, access, or exchange of health information."

It is basically the use of devices and applications for the management of information in order to ensure that it is available to the right person at the right time (World Health Organisation, n.d).

There is a lot of literature on the perceived benefits of the use of HIS in healthcare but there is a lack of real practical, research based evidence on this (Herrick, Gorman, & Godman, 2010). According to Fisher, Shell, & Troiano (2004) it is difficult to quantify the benefits of HIS in financial terms and go further to suggest the use of value on investment as a measure instead of the typical return on investment (ROI). In Zimbabwe there is no known study that was carried out to evaluate the benefits that HIS has brought to the sector since they were first implemented.

The ultimate goal for HIS must be to improve quality, increase efficiency and add convenience to healthcare provision (Lippeveld, n.d). the World Health Organisation (WHO) (2011) also puts across that if health information is gathered efficiently and shared across populations, then it will lead to better decisions and better spending. HIS has the potential to provide high quality data on health situations which gives decision makers the capacity to make informed decisions to deal with potential health issues (Reynolds, Sharp, & Zeng, 2009).

Fisher, Shell, & Troiano (2004) emphasise that the use of HIS can increase competitive advantage and help health care organisations to retain patients, block new market players and satisfy stakeholders.

### 2.4.2. Mobile health (mHealth)

Mobile health (mHealth) refers to the use of mobile technology in health applications (BCG, 2012). Technologies used for mHealth include mobile phones, patient monitoring devices, personal digital assistants (PDAs) and other wireless devices. Mobile technology, unlike the internet for example, has managed to penetrate even resource-poor settings (IRD, 2012). According to the Post and Telecommunications Regulation Authority (POTRAZ), Zimbabwe’s mobile density as at January 2013 was 100%. This coverage by mobile technology presents the health system with new
possibilities to address issues of accessibility, effectiveness, efficiency and cost in health care (IRD, 2012).

mHealth enables clients of health services to make and receive calls or messages pertaining to health issues like health education, adherence to treatment, organising transport or ambulance services or contacting health workers (Broderick, 2013). Health care workers can also use mobile services to consult with their colleagues thus improving safety in health, to communicate timely with their clients, enhance their skills through the access of bedside internet consultancy as well as research using mobile internet (BCG, 2012).

Researchers also take advantage of mHealth by using mobile technology to capture multiple sources of health data, such as in-depth information about the environment for genome-wide association studies. They can also collect detailed information about subjects’ physical activity, location and physiological responses (through the use of sensors attached to the body and connected wirelessly to the telecommunications network) and activities (through text message surveys) over extended periods of time (NIH, 2013).

2.4.3. eHealth

EHealth is not very different from HIS in that it also includes the electronic sharing of health information using such technologies as the internet. However it goes further to encompass the delivery of health services over the same technologies (Eysenbach, 2001). eHealth is a relatively new term that was barely used before 1999 (Rodrigues, 2008), Intel as cited by Rodrigues (2008) refer to eHealth as “a concerted effort undertaken by leaders in health care and hi-tech industries to fully harness the benefits available through convergence of internet and health care. The World Health Organisation, as cited in NEHTA (2013) define eHealth as “the combined use of electronic communication and information technology in the health sector”.

The benefits of eHealth to consumers is that they can receive faster, safer and more accessile healthcare. They can get more accurate health information as well as access remote health care services. It increases client participation (NEHTA, 2013). Rodrigues (2008) reiterates the importance of eHealth by stressing that eHealth strengetherns health systems for greater equity, solidarity, quality of life and
health and contributes to the Millenium Development Goals (MDGs) of poverty reduction.

A study carried out by the European Union (EU) as cited in Stroetmann, Jones, Dobrev, & Stroetmann (2006), summarises the benefits of using eHealth in terms of quality: safety, timeliness, effectiveness and information that is designed to streamline healthcare process; access: standardiation of healthcare due to availability of information; efficiency: improved productivity, optimum utilistion and reduced costs.

2.4.4. Electronic Health Records (EHR)

EHR are defined as longitudinal electronic records of patients’ health information generated by one or more encounters in any healthcare delivery system(Menachemi & Collum, 2011). The basic benefit of EHR is making access to patient information easily and electronically, doing away with the incoveniences associated with using files, paper and pen which in turn improves the quality of health care. There are three basic functions of EHR : Clinical Decision Support (CDS), Computerised Physician Order Entry (CPOE) and Health Information Exchange (HIE).

Clinical decision support (CDS)

This provides clinicians staff and patients with patient specific information that is intelligently filtered at appropriate times to support healthcare. It includes tools such as computerised alerts and reminders for caregivers and patients, clinical guidelines, condition-specific sets focussed patient data reports and diagnostic support. With more use of these systems, healthcare delivery can be expected to be much safer and more efficient(Azlan, Yusof, & Razali, 2012).

Computerised physician order entry (CPOE)

It is a process of entering medication orders or other physician instructions electronically without using the traditional paper. These systems allow physicians to enter orders for drugs, lab tests, occupational therapy and many other health related procedures (Menachemi & Collum, 2011). The use of CPOE can help to reduce errors that are related to bad handwriting or even recording of medication orders.
Although they have such valuable use, their uptake has been slow due to the high costs associated with their implementation. However, according to studies carried out by the Massachusetts Technology Collaborative and the New England Healthcare Institute, CPOE systems could save hospitals up to $2.7 million a year compared to a cost of $2.1 million for setting them up and an associated $435,000 annual maintenance cost (Eastwood, 2010).

**Health information exchange (HIE)**

HIE facilitates for the process of sharing patient information between different organisations (Menachemi & Collum, 2011). This has the potential to lower health costs by doing away with repeat tests because one provider can not access results of tests that were carried out by another provider. Davies (2006) puts forward that the use of HIE means clinical data about a patient stored at a particular location can be shared in real time thereby increasing efficiency. Traditionally such information was shared by post or fax, thereby delaying care.

**2.4.5. TeleHealth**

The word teleHealth was coined by Thomas Bird in the early 1970s; it refers to the use of telephony technologies to deliver remote healthcare to distant patients (Mbarika & Okoli, 2003). Mbarika (2004) suggests that teleHealth could become the panacea for sub-Saharan Africa’s medical woes. Being able to offer remote healthcare takes care of shortfalls such as shortage of staff, cost and the inconvenience of travelling long distances to seek medical help. According to the World Health Organisation (WHO) as cited in the virtual doctors (n.d), there are millions of people who die every year from treatable diseases. The deaths are attributed to delayed diagnosis and subsequent treatment, and poor disease management. TeleHealth can go a long way in reducing unnecessary deaths. Perhaps the biggest challenge in using telemedicine particularly in Africa is cost.

TeleHealth can also be used in medical education by enabling students and junior doctors to consult with experts on complex issues from remote locations. With a teledensity of 100%, a nation like Zimbabwe could exploit the digital expansion by introducing teleHealth in rural areas where access to medical care is a nightmare.

TeleHealth services are delivered in 3 main ways:
**Video conferencing:** used mainly for real-time patient-provider consultations, provider-provider consultations and language translation services.

**Remote patient monitoring:** where electronic devices are used to transmit patient health information to health care providers.

**Store and forward technologies:** where prerecorded videos and images such as X-Rays, Scans, photos are transmitted between primary health givers and medical experts.

### 2.4.6. Medical expert systems

A medical expert system can be defined as software that simulates human expertise in a specific field (Asabere, 2012); expert systems are derived from that branch of computer science called artificial intelligence (Mateo, Lee, & Gerardo, 2008). A medical expert system helps practitioners to carry out speedy diagnosis and to verify their own diagnosis. Mobile expert systems have also been used for patients to manage chronic illnesses without having to visit a health center each time they have a problem (Celler, Lovell, & Basilakis, 2006). With advances in technology medical expert systems are now used in more roles that include disease prevention, therapy, and rehabilitation after therapy. They can also be used to train students (Khan, Maqbool, Irfan, & Zia, 2008).

South Africa has used expert systems to help HIV patients to self-manage HIV symptoms from home (Mburu & Dr Mbohgo, 2012). Medical expert systems are also used at the point of care to verify diagnosis or to obtain more drug information.

Medical expert systems as well as all the other technologies discussed above thrive on the availability and effective use of enablers like the internet, ICT equipment and mobile devices. Users and organizations alike must adopt technologies into their daily activities in order to improve their efficiency and effectiveness.

### 2.5. INTERNET PENETRATION AS A DRIVER OF TECHNOLOGY USE

Despite the significant growth in the use of the internet globally, few studies have been done to explore the level of internet access and ICT training among health care personnel particularly in Southern Africa (Ajuwon & Rhine, 2008). However the internet presents a profound change that will enable or even force significant
changes in organisational form and processes (Gibbs, 2008). The internet brings access to information, and communication on an unprecedented level (Komolafe-Opadeji, 2009). Its capability to empower consumers and support dynamic information change among organisations will result in new business models, and management mechanisms. The internet has increasingly become the main source for health information and advice (Kituyi-Kwake & Adigun, 2008). The use of the internet encompasses such services as the use of email to relay patient information or to make a doctor’s appointment, telemedicine, and expert systems.

Internet penetration in developing countries, particularly Sub-Saharan Africa, is still very limited due to high costs and poor last mile connectivity technologies. According to the Internet World Stats, a website on international internet usage and statistics Africa’s Internet penetration as of 30 June 2012 stood at 15.6% versus 34.3% world average. For the rest of the world (minus Africa), the penetration rate stood at 37.7%. Simply put, internet penetration refers to the percentage of the population using the internet (Kituyi-Kwake & Adigun, 2008). Figure 2.2. shows the steady rise in internet penetration in Zimbabwe since 2000. The major setbacks in the spread of internet usage in Zimbabwe are high costs and poor infrastructure particularly in terms of last mile connectivity. Although wireless technology has managed to expedite the reach of the internet to remote areas in Zimbabwe, the high cost of computers, laptops and other last mile devices continue to be out of the reach of many Zimbabweans. Broadband costs are also unsustainably high; Econet wireless charges an average of US$1 for 1 Megabyte data bundle. Such a bundle will last less than a few minutes for heavy downloads. Africom charges US$25/month for 1 Gigabyte of data while Powertel charges US$50/month for uncapped internet. Such exorbitant costs have seen most people using the internet for simple things like email, chat, and other data-light applications instead of using the internet for developmental researches and business applications.
2.6. EFFECTIVE UTILISATION OF TECHNOLOGIES

The introduction of new technologies will always be with some challenges, among them the users' inability and resistance to effectively use of the new technology. Even the best technology can fail to bring results if users cannot use it efficiently and effectively (Kevin, 2004). It is easier to integrate new innovations if users are prepared and feel supported and are confident that they are prepared for the change. Implementing and supporting technology supported applications in health will require skills that have not been part of the medical practice. Physicians and other users alike have to make significant changes to their workflow to make time to learn how to use the new technologies (MEDPAC, 2004). Some medical practitioners may view the use of technology as an interruption to the patient-physician relationship by drawing away from personal interaction. Also during initial implementation new systems may add an extra load to users instead of alleviating the work load. Effective change management is called for here (McCarthy & Douglas, 2010); “the overarching purpose of change management is to accelerate the speed at which people move successfully through the change process so that anticipated benefits are achieved faster” (pp. 5).
People ordinarily do not like change (Kevin, 2004), and when it comes to evolving technology it is suicidal to ignore people’s acceptance of the new technology. For successful adoption of any new technology, users must accept that the new technology is necessary and that it will improve their work. Secondly the users must then be proficient in the use of the new technology (McCarthy & Douglas, 2010). Technology may appear simple and uncomplicated but it should not be taken for granted that users will be comfortable with the use of the new technology; overlooking even the smallest detail can lead to catastrophic results (Kevin, 2004). Health professionals must also develop proficiency in information management, internet search, downloading and evaluation of internet-based health information resources (Ajuwon & Rhine, 2008). Without proper training and education, available ICT resources will be underutilised. According to Trivedi (2008) as cited in Komolafe-Opadeji (2009) the nature of medical knowledge and technology requires all personnel in the healthcare sector to have computer skills.

Computer literacy does not imply that a user must know everything; it implies a certain level of self-learning in as far as the use of computers and computer related software and applications are concerned (Gibbs, 2008). Gibbs further suggests that today’s young generation may seem more comfortable with the digital world but, they are actually no more prepared than previous generations as far as having the requisite skills for optimum use of computers for education and in the workplace.

Computer literacy goes beyond just being able to type and go on the internet; it involves how to use search engines, how to exercise safe browsing, word processing and spread sheets, using different browsers, viruses and malware awareness and scanning, cyber-crime awareness, hardware terminology and basic networking (Williams, 2003).

It is important to note though at this juncture that determining an individual’s level of computer literacy is not an easy task as individuals have the tendency to overrate themselves (Komolafe-Opadeji, 2009). Usually there is a strong relationship between the frequency of use and the rating a user will give themselves; if a user uses an application frequently they will tend to overrate themselves on literacy for that particular application (Gibbs, 2008).
2.7. PERCEIVED BENEFITS OF TECHNOLOGIES IN HEALTHCARE

According to Leung et al (2003) as cited in Ambrose, Braithwaite, & Wilson (2011), little is known about perceived benefits and attitudes to the use of technologies in healthcare. However Ambrose, Brainewaite and Wilson go on to suggest that a knowledge of these attitudes as well as perceived benefits will help in the development of plans for the improvement and implementation of new technologies.

Some of the benefits of technologies in healthcare include improved quality, decreased costs, provision of self-care information to the public, online training and learning for healthcare personnel, increased communication, prevention of loss to patient data, reduction in medical errors and decreased workload among others (Al-Harbi, 2011; Shozi, Pottas, & Mostert-Phipps, 2013).

2.7.1. Improved quality

Systems like Health Effectiveness Life Planning (HELP) combine the use of computers for storing and transferring information with using the computers to give advice to physicians on solving clinical problems. Databases can also be used to compare clinical results with expected results thereby improving the quality of healthcare for patients (Al-Harbi, 2011). Electronic health records (EHR) is also hailed as one of the most promising manifestations of technology in health (DePhillips III, 2007). Included in electronic health records are patient demographics, problems, progress, medical history, immunisations, laboratory data, radiology reports and vital signs (Menachemi & Collum, 2011). HER is expected to help reduce medical errors thereby improving healthcare quality and to streamline operational efficiencies. According to DePhillips (2007) most medical errors that occur at the bedside can be attributed to insufficient and/or inaccurate patient data. He argues that if physicians are provided with adequate information pertaining to a patient’s medical history, previous tests done, physicians seen before, allergies and medication received before, then they will make better decisions with better results.

2.7.2. Decreased costs

Using technologies has been known to reduce the costs associated with the multiple handling of paperwork, costs of sending data or health information over traditional postal services or using conventional transportation; instead health information can
be send by just a click of a mouse button (Azlan, Yusof, & Razali, 2012). As championed before, technologies such as electronic health records can reduce the costs of healthcare by doing away with duplicate and unnecessary testing of patients.

2.7.3. Provision of self-care information to the public

Selfcare can be described as the administering of care by the patient to themselves in the form of self-medication or self-checks (BCG, 2012). Through the use of the internet, a number of online systems like expert systems or clinical databases have been developed to assist patients in selfcare procedures as well as self-diagnosis (Marrow 2005 as cited in Azlan, Yusof, & Razali, (2012)). What this means is technology has taken patient care from hospitals to the comfort of the homes by eliminating lengthy hospital stays. Some can argue that a patient will recover faster if they are in the comfort of their own home surrounded by loving friends and family (Fex, 2010).

2.7.4. Online training and learning for healthcare personnel

Again the internet has opened doors to the world of online learning; healthcare professionals can improve their knowledge and skills by making use of the various online learning sites and databases (Ambrose, Braithwaite, & Wilson, 2011). They can also use the internet to consult with colleagues which itself is a learning curve. Mobile technology and other handheld devices also enable them to use these learning tools at convenient times and convenient places including the bedside (Azlan, Yusof, & Razali, 2012).

2.7.5. Increased communication

Effective communication between patient and caregiver is important for improving client satisfaction, compliance and health outcomes; patients in turn understand their illnesses better and believe their caregiver cares for their well-being and as a result they are more likely to stick to their treatment regimes (de Negri, Brown, Hernandez, Rosenbaum, & Roter, n.d).

Communication can also include information availability to decision and policy-makers. The delivery of care depends on information made available to both the
caregiver and the executives. The more accurate and timely the data is, the better the decision-making process, and therefore the better operational challenges and clinical outcomes can be achieved.

2.7.6. Prevention of loss of patient data

Instead of medical personnel using paper-filed patient records, Technologies have allowed patient records to be electronically captured and stored in secure databases with reliable backup facilities. Databases reduce the risk of loss of data due to misplacement, natural disasters like fire or simply due to the difficulty in managing large volumes of data over very long periods (Shozi, Pottas, & Mostert-Phipps, 2013).

2.7.7 Extending healthcare beyond hospitals

The use of technology enabled solutions allows healthcare to be extended to marginalised communities. This maximises on healthcare resources and increases the preventive component of healthcare, the result is that the population is kept as healthy as possible and are less dependent on curative care (Suwinski, 2010).

This can be achieved through more interactive communication channels with healthcare givers through the use of monitoring devices, sensors, and analytics tools. The drive is to move towards managing health rather than monitoring illness.
CHAPTER 3

3.0. INTRODUCTION

This chapter details the methodology as well as the methods that were used to collect data, select participants, analyse the data, and validate the results and ethical considerations that were incorporated into the research. According to Saunders, Lewis, and Thornhill (1997), this chapter is supposed to provide the reader with sufficient information on the setting of the research, the participants, the materials used for data collection, as well as the procedures used.

This research was aimed at providing a critical analysis of the diffusion and adoption of technologies in healthcare delivery in the public health sector in Zimbabwe with a view to enable policy and decision makers to make rightly informed decisions. This was after it was noted that a knowledge gap existed into what efforts were being undertaken at public health institutions in improving health services using technologies.

The specific research objectives were:

6. To identify the taxonomy of Technologies which are currently in use in Zimbabwe’s public health sector.
7. To assess the internet penetration rate and mobile density at public health institutions.
8. To determine the level of computer literacy and effective utilisation therefore of technologies at public health institutions.
9. To find out the perceived benefits which have been brought about by the adoption of technologies in medicine and health in Zimbabwe.
10. To recommend on strategies for adoption, application and value-adding contribution of Technologies in health.

3.1. METHODOLOGY

A research methodology is a path to obtaining answers to the research questions. Methodology describes the design of the study, research methods to be used, target population, sampling procedures and sample size of the study, the data collection methods and issues pertaining validity and reliability of data (Saunders, Lewis, & Thornhill, 1997). The aim of a research methodology is to give a work plan. A methodology seeks to answer the following questions:
Why is a particular research study undertaken?
How did one formulate a research problem?
What types of data were collected?
What particular method has been used?
Why was a particular technique of analysis of data used?

It is different from methods in that methods are the various procedures, algorithms and ways used in research. Methodology is a study of the methods by which knowledge is gained (Rajasekar, Philominathan, & Chinnathambi, 2006). The following sections illustrate the methodology that was adopted in this research in terms of the research design, approach, data collection and analysis methods.

3.2. RESEARCH DESIGN

A research design can be loosely defined as the plan, structure and strategy of investigation to obtain answers to research questions. “The function of a research design is to ensure that the evidence obtained enables us to answer the initial question as unambiguously as possible.” (What is Research Design?, n.d., p. 9). The whole process of researching entails the identification, sourcing, gathering and processing of data to generate information that will enable the researchers to make informed decisions, conclusions and recommendations.

In research there are often two broad methods of reasoning which are deductive and inductive. The deductive approach involves working from more general to more specific reasoning; it a top-down approach. It starts with knowledge of theory, then hypothesis, observation and then confirmation of the hypothesis. The inductive approach involves the opposite that is working from specific observations to broader generalisations. It is the bottom-up approach.

In this study the inductive approach was used as the research is mainly qualitative.

3.3. SAMPLING FRAME

The research attempted to get information from all the different departments and units at selected public health institutions in Zimbabwe. It targeted doctors, nurses, specialists, administrators and other staff at the selected public hospitals and clinics.
3.4. SAMPLE SIZE AND SAMPLE PROCEDURE

It was not feasible to get the actual numbers of employees at each of these institutions; the information could not be released for technical reasons by the responsible authorities at these health institutions. However the researcher was able to obtain information on the number and classifications of various units and departments in the institutions. Using this information the target was to interview one key informant from each of the units. This led to the selection of ten key informants who were interviewed from various departments of the selected public institutions.

Two Central hospitals were used, as well as one urban clinic and one rural clinic. Questionnaires were distributed to doctors, nurses and staff at these institutions pro rata. However, the clinics had as little as 5 members of staff at any given time who could not all participate in the survey due to their busy schedules.

Fifty questionnaires were then distributed to other members of staff from doctors, specialists, pharmacists, and administrative staff.

3.5. RESEARCH DESIGN AND STRATEGY

Research design refers to the framework, plan or structure for study, used to guide in collecting and analyzing data.(Eysenck, 2004). Rajasekar, Philominathan, & Chinnathambi(2006) add that research design is used to obtain evidence to answer research questions. It aims at providing the most valid accurate answer possible to research questions. Of critical importance is the matching of the design with the questions. Researchers use triangulation, according to Greener(2008)which is the cross validation among data sources, data collection strategies, time periods and theoretical schemes. To find regularities in the data, the researcher compares different sources, situations, methods to see whether the same pattern keeps recurring. Other researchers concur that, research study is created through a combination of quantitative and qualitative study,(Saunders, Lewis, & Thornhill, 1997).

3.5.1. Qualitative methods

The qualitative study was employed in this study to assess the views and recommendations from interviews with the senior management of the institutions selected. It was also used to solicit the views from the selected participants within
the public health sector on the use and applications of technologies in healthcare and also the effective utilization of technology at the institutions. Qualitative research is informed by and is embedded in interpretivist philosophy; it is a process of interpretation that is social reality is constructed through interpretation of the actors. These methods are considered to be mostly descriptive in nature and this supports this study peripherally. It is an enquiry process of understanding based on distinct methodological traditions of enquiry that explore social and human problems hence the peripheral incline in this study. It uses inductive reasoning; that is possible explanation is arrived at after collection of data by the researcher. Qualitative research is however besotted with reliability problems caused by researcher’s subjectivity. If qualitative research is adopted, it is time consuming and one is likely to run the risk of collecting meaningless information. It has problems of representativeness and generalisability of findings.

3.5.2. Sources of data

According to Greener (2008) data can either be primary or secondary. She defined primary data as raw data that is gathered through interviews and questionnaires whilst secondary data is that data that can be obtained from published material. In this research the researcher used both.

3.5.3. Primary data sources

Primary data sources include focus group, questionnaire and interviews. Primary data is original data collected from source. It has been collected by the writer to make the foundations of the empirical research study examples of primary data can be personal interviews, and surveys (Saunders, Lewis, & Thornhill, 1997). Secondary data are data that already exist and have been gathered for purposes other than the writer’s thesis. These are normally used under what is commonly called desktop evaluation.

This research study made use of both primary and secondary data sources although mostly primary. The primary data was collected through the use of questionnaires and interviews.
3.5.4. Secondary data sources
Secondary data can be derived from documents such as annual reports, published books and published statistics (Eysenck, 2004). This type of data is collected mainly for purposes other than the completion of the research.

In this research study, the secondary data comprised document analysis from data sources obtained from the MOHCW strategy documents, health institutions’ organizational structure documents and IT brochures. This data was collected to give the researcher an insight into the research problem.

3.5.2.2. Demerits of secondary data
Secondary data is not without its disadvantages which are as follows;

i) Validity – secondary data normally has bias and can be interpreted differently by different people sometimes to suit the researcher’s need hence objectivity is compromised.

ii) Historical – because secondary data is historical it may not be the best denominator for predicting the future.

iii) Accessibility – information is highly guarded by those that generate it and use it hence in situations where the entity is not registered publicly it would be difficult to access the information. One way to circumvent this disadvantage is the ability or closeness of researcher to the principals of the various entities because information in these entities is considered confidential and may be difficult to override this principle when accessing secondary data.

3.6. QUESTIONNAIRE DESIGN
A questionnaire is a document containing lists of pertinent questions used to gather primary data directly from elements of the population and selected sample (Greener, 2008). Questionnaires are a good way of collecting certain types of information quickly and relatively cheap. However the response rate may be low.

A questionnaire was designed to cover the research questions so as to solicit views from hospital and clinic staff. It was designed in a way that enabled respondents to choose their own responses and express their opinions. It is argued that such a design enables the researcher to get more in-depth responses (Greener, 2008). Most
of the questions were open-ended while a few of the questions were closed questions—closed questions are considered quicker and easier for respondents (Rajasekar, Philominathan, & Chinnathambi, 2006).

The approach was to then be able to analyse the responses qualitatively and quantitatively, interpreting the responses with the help of the theory.

3.7. COMPONENTS OF THE QUESTIONNAIRE

Unnecessary demographics were omitted from the questionnaire as they had no value-addition to addressing the research objectives and questions. The only demographics included were the gender and the duration of employment at the institution. The duration of employment was meant as an assessment tool into the validity of a participant’s views particularly when it came to identifying benefits that have been brought about as a result of technology adoption. The other questions addressed the issue of use of Technologies in health, perceived benefits and computer skills level. Finally respondents were asked what they think can be done to increase the use of Technologies in health, like what areas of health Technologies can be applied more. Responses to these questions assisted in coming up with recommended strategies that can be adopted by decision makers. The questionnaire is included in the appendix.

In coming up with the best questions the following guidelines given by Eysenck (2004) were considered:

- **Avoiding leading words or questions**

  Leading questions bias the respondent towards a certain answer or way of thinking and in coming up with questions for this questionnaire, the researcher tried as much as possible to avoid any leading questions.

- **Misplaced questions**

  In this regard a funnel approach is encouraged where general questions are asked first followed by more specific questions. In the questionnaire for this research this was taken into consideration when asking respondents about how they are adopting and using technologies. In order to make the question less direct and attacking, they
were asked to comment generally on the usage of technology in the industry in general before talking about their specific institution.

The recommendation is also to conclude with more easier questions to answer like demographics. In this research, not a lot of demographics was asked since it did not add any value to the research objectives, also the questionnaire had to be as short as possible following recommendations from the pre-test exercise.

❖ Mutually non-exclusive responses

This concept encourages the use of multiple choice answers that are mutually exclusive and clear to facilitate for respondents to make clear choices. Most of the multiple choice questions used in this research employed the yes-no choices which are very clear and not confusing at all. On the Linkert scale for rating ICT literacy the scale was clearly explained with simple terms (good, very god, average, poor and very poor). Although a linkert scale is generally not an easy tool, this scaling was perceived to be clear and not confusing for the respondents.

❖ Non-specific questions

An example of a non specific question would be what do you think about an apple? There are many aspects to an apple, some might talk about its texture, some its taste and some its cost while some its other uses in cooking besides its use as a fruit. This recommendation was taken into particular consideration in the questionnaire for other employees where they were asked to state any recommendations to “improve” on the “effective utilisation” of technologies in public health. The two verbs “improve” and “effective utilisation” were deemed to be very specific and allow for the researcher to get exactly the answers they were looking for.

❖ Confusing terms (jargon)

Complicated words can confuse people and sometimes they may fail to answer to a question. The researcher tried as much as possible to use simple english. Where a technical term like “technology” had to be used, it was pre-explained at the beginning of the questionnaire to give respondents a clear meaning of the term in the context of the research.
Non-directed questions

These questions are similar to non-specific questions. They are wide and a respondent may go astray and talk about other things that are not related to what the researcher is looking for.

However in this questionnaire, the researcher decided to take advantage of these non-directed questions at the beginning of the questionnaire when respondents were asked to give their views on the use of technology in industry. The researcher intended to get more insight into how widely respondents knew about technology and business in general. They were more of a warm-up and not meant to get answers to specific research questions.

Double-barelled questions

These are questions that ask two things at the same time like “what is the cheapest and fastest transport to the city?” this question implies that the cheapest is also the fastest which is not necessarily the case. The research questions asked in this study were as much as possible single-barelled and clear.

Long questions

Long questions discourage respondents from responding to all the questions as some might just find it tiring to read through a winding question. Some may lose the actual meaning of the question in its meandering. In this study all the questions were kept as short as possible without losing the thrust of what they sought to uncover.

3.8. PRE-TEST OF THE QUESTIONNAIRE

The questionnaire was pretested at Parirenyatwa hospital, the largest referral hospital in Zimbabwe, also a teaching hospital where the University Of Zimbabwe College Of Health Sciences is located. Individuals who participated in the pre-tested suggested that the questionnaire be significantly shortened as their profession was a very busy and involving profession and a lengthy questionnaire would discourage a number of people from completing it. Thereafter the questionnaire was be modified accordingly- the number of questions were reduced almost by half; mostly those questions that were directly relevant to addressing the research objectives were asked. After that the questionnaire was sent out to the respondents.
3.9. DATA COLLECTION

3.9.1. Questionnaires

Once the final version of the questionnaire was completed, the questionnaires were then distributed to the respondents. Of the various method of questionnaire distribution, envelops were used to send the questionnaires and were addressed by hand with signed cover letters, to make the questionnaire more personal. This can have the benefit of a high response rate (Greener, 2008).

Interviews were also conducted with key informants using face-to-face interviews.

3.9.2. Face to face interview

Face to face interview had the following advantages;

i) Respondents were interviewed within their own offices hence information could be verified easily because respondents were in familiar territory therefore at ease and comfortable to respond to questions;

ii) Interviews also have the advantage of verifying facts especially in a technical setting as was in this research study and

iii) It offered an opportunity to receive feedback from respondents and the opportunity to the interviewer to explain and clarify some issues necessary to improve the quality of information obtained.

However, the following were challenges encountered in using interviews;

i) Some possible interviewees were not available although having agreed to an appointment. Some of the executives could not be reached because of the time when the research was done some were either on international business trips or on holiday; in such cases the interviewees delegated for replacement candidates to be interviewed.

ii) Covering all possible interviewees was associated with high cost of fuel, time and budget.

3.10. VALIDITY OF DATA

Validity relates to the extent to which a measure, indicator or method of data collection possesses the quality of being sound or true as far as can be judged
The questionnaire method has its own share of advantages and disadvantages—the advantages are:

a. Quality Responses. Questionnaires permit respondents time to consider their responses carefully.
b. Cost Effective. It is possible to provide questionnaires to large numbers of people simultaneously.
c. Questionnaires can address a large number of issues and questions of concern in a relatively efficient way, with the possibility of a high response rate.
d. Uniformity. Each respondent receives the identical set of questions. With closed-form questions, responses are standardised, which can assist in interpreting from large numbers of respondents.

The disadvantages are:

a. Response Rate. It may be difficult to obtain a good response rate as often there is no strong motivation for respondents to respond.
b. Complexity. Questionnaires are complex instruments to use in research and, if badly designed, or not effectively distributed may not be responded to.
c. Questionnaires are an unsuitable method of evaluation if probing is required – there is usually no real possibility for follow-up on answers.
d. Questionnaires are time consuming for respondents, more costly and more labor intensive than other methods, such as personal interviews.
e. Questionnaires can be misused – a mistake is to try to read too much into questionnaire results.

Validity is often difficult to measure in qualitative research and much easier in quantitative research. In order to ensure as much reliability as possible from the research, the questions asked to the response were drawing as much as possible from the research questions and objectives. During the pre-test of the questionnaire, the researcher enlisted the help of research statisticians within the University of Zimbabwe College of Health sciences’ research unit to come up with the best questionnaire to address the research objectives.
3.11. DATA ANALYSIS

Data processing begins with data editing and coding (Eysenck, 2004). Data analysis is a process of inspecting, cleaning, transforming, and modelling data with the goal of highlighting useful information, suggesting conclusions, and supporting decision making. Once the questionnaires are picked they will be screened for anomalies. The questionnaires will then be coded with numbers assigned to each.

The data was processed by using online survey software called eSurv. Presentation of data was done using brief narratives on tables, graphs and charts as depicted throughout this research study. The data analysis and presentation will be as brief as possible without losing meaning.

The procedure for analysis of data involved the following:

- Coding (grouping together of similar responses and assigning of codes) of open ended or unstructured questions
- Data capturing and cleaning
- Program development
- Program running to produce statistical tables.

The reasons why eSurv was chosen are that it is a free tool that is easily obtained and accessible online; it is also quite easy to use. It is not only a data analysis tool but also a survey tool that is used to design survey questionnaires. It was also advantageous in that the questionnaires and the results could be conveniently shared by other researchers online to enlist their help and input.

3.12. ETHICAL CONSIDERATION

The research was in line with ethical guidelines in that participation was voluntary and confidential. The employees were free to participate or not to. The responses will be kept as confidential as possible and no names were asked for the respondents to avoid intimidation of employees. Departments where the respondents work in were also not asked to safeguard anonymity.

Further to that authority was sought well in advance from management at the institutions to carry out the research and it was given in form of written
communication and some verbally. This was after the proposal had gone through the ethics committees at the respective institutions to determine its suitability.
CHAPTER FOUR

4.0. RESEARCH FINDINGS, ANALYSIS AND DISCUSSIONS

4.1. INTRODUCTION

The focus of this chapter is to present the results of the research, to analyse the results and discuss the findings in an effort to determine how such findings address the research objectives. In answering the objectives there will be a presentation and analysis of the data obtained through the use of interviews and questionnaires. The results will be analysed based on some of the concepts discussed in the literature review. The author will make use of descriptive statistics in the form of tables, pie charts, and bar graphs to present the data.

4.2. RESPONSE RATE

Fifty questionnaires were administered and sent to staff and management at public health care institutions. Of those, thirty-three were successfully returned representing a response rate of 66%. This response rate is large enough to render the research findings valid and reliable.

On top of the questionnaires, interviews were held with managers and heads of various departments to address some of the research information which could not be obtained from junior staff.

4.3. GENERAL INFORMATION

4.3.1. The positions assumed by participants

Figure 4.1 reveals the positions which the participants assume in their respective institutions: There were ten interviews with various heads of departments including IT. Questionnaires were then distributed to healthcare givers (doctors, nurses and midwives) and to other staff (pharmacists, administrative, radiographers). The idea was to get a fair analysis of the uses and benefits of technologies in the various supporting departments in healthcare apart from bedside patient care.
4.3.2. Total number of years employed in the health sector

This question was meant to offer an idea of how long the participants have been employed in the health sector as a way to guide on their appreciation of the changes that the use of technologies have brought to the sector over the years. There was no selection criteria of the participants based on the years of service in the industry.
4.4. TAXONOMY OF TECHNOLOGIES IN PUBLIC HEALTH CARE IN ZIMBABWE

Taxonomy represents an attempt to establish an explicit classification according to presumed relationships among similar elements or between the elements and other phenomena of interest (Bashshur, Shannon, Krupinski, & Grigsby, 2011). In this context taxonomy attempts to group systems, technologies and applications pertaining to public health delivery from bedside care, administration, drug dispensing to patient management.

Indications from the research are that public health institutions in Zimbabwe do not have a standard taxonomy for their technologies and it all varies from institution to institution mostly at the discretion of the head of IT. This lack of a uniform taxonomy is apparent in that ICT adoption efforts at these institutions are also not uniform and again are discretionary, depending largely on how much each institution can afford to implement and the disposition of decision makers in as far as purchasing and implementation of new innovations are concerned and how much the decision makers know about technologies at each respective institution.

However, according to information obtained from major hospitals, technologies at public health institutions can be classified into Financial, Clinical, Resource Management and Life Sciences.

4.4.1. Financial

Technologies in this class include accounting and financial systems like pastel, enterprise resource planning (ERPs) like SAP, billing software systems, and other financial applications. In more resource rich settings, financial technologies can include a lot more systems and applications such as General Ledger system (GL), purchase order system (PO) among others.

4.4.2. Clinical

Technologies in this class include pharmaceutical and dispensing systems, electronic health records (EHR) decision support systems, Up-to-date clinical database and outpatient systems like PS6, Lab information systems (LIS). The adoption here falls below what literature seems to suggest and management pointed largely to lack of financial resources as the main impediment to this. Eastwood (2010)
points out that according to studies carried out by the Massachusetts Technology Collaborative and the New England Healthcare Institute, technology systems such as computerised physician order entry (CPOE) could save hospitals up to $2.7 million a year compared to a cost of $2.1 million for setting them up and an associated $435 000 annual maintenance cost. In as much as the use of technology has long-term cost benefits, Zimbabwe is a resource-poor nation and often fails to meet the initial set-up costs required for such technologies.

Despite the high cost of some of these systems, there are other fairly inexpensive systems that can be easily adopted using mobile phone technologies. Systems like self-care management systems do not require a lot of start-up capita. Mobile penetration for Zimbabwe is conveniently at 100% and this can be used to penetrate rural locations and other marginalised communities by introducing simple bespoke applications for patient management. The advantage with bespoke applications is that they will be designed with the local conditions in mind and hence will serve more the needs of the people as well as be suited to the local conditions.

4.4.3. Resource management

Technologies in this class include enterprise resource planning systems (ERP) which is cross-cutting business management software, HR systems like Belina payroll system, and inventory systems for stock control and management. It evident from interviews with management and heads of departments that the adoption of these technologies has brought very visible results in terms of cost management and overall business management...

4.4.4. Teaching and research

It emerged from the research that most hospitals are also teaching hospitals which mean they have teaching departments in fields like general nursing, midwifery and some even medicine and other health professions affiliated to the University of Zimbabwe’s College of Health Sciences. Technologies used in these departments constitute the teaching and research grouping and include bio-informatics, library information systems, and research databases like epi-info as well as gene-sequencing systems among others.

4.4.5. General comments
The ICT systems and technologies in use in Zimbabwe’s public health care sector are still very few as compared to resource-rich nations. The issues of funding remains the greatest hindrance to the adoption of a lot of emerging health ICT innovations as alluded to by management at these institutions. There are a number of clinical Technologies like telemedicine, expert systems that are extremely helpful in addressing shortages of staff and increasing safety of healthcare that are used in a number of countries including South Africa and Zambia but are yet to be introduced in Zimbabwe. However with the limited resources tremendous effort has been made to do as much as possible in improving healthcare delivery and management using Technologies.

4.5. MOBILE DENSITY AT PUBLIC HEALTH INSTITUTIONS

In order to determine the mobile density at public health institutions, participants in the survey were asked whether they owned a phone (smart phone or otherwise). All the respondents indicated that they owned a mobile phone as depicted in the diagram below. The 100% mobile density tallies with statistics released by POTRAZ in January 2013 for Zimbabwe’s teledensity. However at Parirenyatwa Hospital, mobile network connectivity is heavily affected by the complex design of the hospital building walls and the large number of radio emitting equipment used. However, mobile telecommunications companies are making efforts to improve connectivity by installing booster stations at the site.

![Figure 4.3. Mobile penetration figures.](image)
Along the question on ownership of a mobile phone, respondents were also asked what they use their mobile phones for besides calling and texting. A majority of the responses indicate that they also use their phones for internet and research, social networking as well as emails. This question was meant to ascertain how effectively mobile technologies are used to improve healthcare. It emerged that they do use their mobiles for research into medical trends and developments, to communicate with colleagues in the same industry in order to share work related knowledge and information as well as for timely communication. A few also indicated that they are involved in research data capture using a mobile application to collect patient information from rural Zimbabwe and send the data to a central server at Parirenyatwa Hospital University of Zimbabwe College of Health Sciences Campus for collation and analysis.

4.6. INTERNET PENETRATION RATE

The internet penetration rate can be referred to as the percentage number of internet users in the population. It was found that the internet penetration rate at public healthcare institution varies from institution to institution. Each institution makes individual efforts that are guided by their respective leadership and not by any standard requirement neither by the concerned ministry, the Ministry of Health and Child Welfare nor by any regional or international governing body. At some of the institutions broadband internet was non-existent and at some it was relatively better. It all depended on the financial capacity of the respective institutions. Some are well funded by donor funds while some rely mainly on internally generated income.

According to the data obtained in this research, there are two dimensions of looking at this aspect; mobile internet users and broadband users (on laptops, desktops or tablets).

4.6.1. Mobile internet penetration

For mobile internet the diagram below indicates the proportion of users who attested to using their mobile phones for internet.
The 93.9% however is not truly indicative of users who use the internet for healthcare or work related business. Results suggest that that the majority use the mobile internet for social networking more than they do for research. They argued that the mobile screen is too small and not friendly for viewing large documents or files. Besides most of the files will be in formats like PDF which require special software like Acrobat reader to open; such software is not available for most mobile applications. Some complained of the high costs of data bundles which limit their use of mobile internet to only bandwidth-light applications like Whatapp and Viber chat services. This agrees with the assertion by Loza (2013), who argues that a mobile phone does not offer the best web browsing experience due to its small size; the text appears smaller than on a computer. By zooming you can increase the size but then it adds the inconvenience of scrolling up and down countless times. A small screen also increases chances of making typographical errors when typing which adds on to the frustrations of using a mobile phone for internet (Loza, 2013).

4.6.2. Broadband internet penetration

Broadband internet generally refers to high speed internet connectivity where transmission speeds allow users to open many web pages at the same time. The term broadband technically means that there are a wide range of frequencies for the transmission of data through a medium which therefore increases the speed. There
is no hard and fast rule as to what speed is termed broadband but generally accepted industry standards refer to broadband speeds as that equal to or above 500kbps.

In this study, indications are that public health institutions have broadband internet penetration rates of as low as 10% and as high as 35%. This is according to estimates figures that were provided by various IT heads of institutions.

The main reason cited for the poor penetration rate was the high cost of bandwidth in the country. These institutions argued that they cannot afford the monthly bills that are associated with broadband internet. The cheapest rate for 1Mbps is around US$900/month at a wholesale price and US$1500 at a retail price. Another reason for the low rate is the cost of procuring and maintaining computers for all departments and users within the institutions.

The result is that only a few selected departments and individuals have the privilege to have access to broadband internet at work with the rest resorting to mobile internet.

4.7. LEVEL OF COMPUTER LITERACY AND EFFECTIVE UTILISATION OF TECHNOLOGIES

Participants were asked whether they had received any formal training in any computer related qualification. IT heads were also asked whether they offer any basic ICT training to their ICT users or if they intend to do it in future. The following diagram illustrates the proportion of users who have attended some training which is ICT related.
The results indicate that about 58% of healthcare workers have undergone at least one training or attended a course in basic ICT literacy. All of the respondents who were surveyed and interviewed did this as personal initiatives. Management interviewed expressed a desire to send their staff for ICT literacy trainings but bemoaned inadequate funds to carry out the exercise. However they expressed optimism that they are slowly moving towards implementing such an arrangement.

Respondents were also asked to rate themselves using a likert scale on their competencies in using a number of computer applications and programs that are commonly used. Table 4.1 summarises the results that were obtained.
Table 4.1. Summary of ICT literacy ratings among respondents.

<table>
<thead>
<tr>
<th></th>
<th>VeryGood</th>
<th>Good</th>
<th>Average</th>
<th>Poor</th>
<th>VeryPoor</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft word</td>
<td>15.15%</td>
<td>45.45%</td>
<td>24.24%</td>
<td>12.12%</td>
<td>3.03%</td>
<td>33</td>
</tr>
<tr>
<td>Microsoft excel</td>
<td>9.09%</td>
<td>33.33%</td>
<td>27.27%</td>
<td>24.24%</td>
<td>6.06%</td>
<td>33</td>
</tr>
<tr>
<td>Microsoft PowerPoint</td>
<td>12.12%</td>
<td>39.39%</td>
<td>21.21%</td>
<td>21.21%</td>
<td>6.06%</td>
<td>33</td>
</tr>
<tr>
<td>Microsoft outlook</td>
<td>3.03%</td>
<td>33.33%</td>
<td>15.15%</td>
<td>30.30%</td>
<td>18.18%</td>
<td>33</td>
</tr>
<tr>
<td>The keyboard</td>
<td>21.21%</td>
<td>42.42%</td>
<td>30.30%</td>
<td>6.06%</td>
<td>0%</td>
<td>33</td>
</tr>
<tr>
<td>Internetwebbrowser</td>
<td>36.36%</td>
<td>33.33%</td>
<td>21.21%</td>
<td>9.09%</td>
<td>0%</td>
<td>33</td>
</tr>
<tr>
<td>Searchengines</td>
<td>12.12%</td>
<td>36.36%</td>
<td>15.15%</td>
<td>21.21%</td>
<td>15.15%</td>
<td>33</td>
</tr>
<tr>
<td>Databases</td>
<td>6.06%</td>
<td>33.33%</td>
<td>24.24%</td>
<td>24.24%</td>
<td>12.12%</td>
<td>33</td>
</tr>
<tr>
<td>E-mail</td>
<td>42.42%</td>
<td>27.27%</td>
<td>30.30%</td>
<td>0%</td>
<td>0%</td>
<td>33</td>
</tr>
<tr>
<td>Chat</td>
<td>32.35%</td>
<td>32.35%</td>
<td>23.53%</td>
<td>5.88%</td>
<td>5.88%</td>
<td>34</td>
</tr>
<tr>
<td>Computerviruses</td>
<td>9.09%</td>
<td>12.12%</td>
<td>39.39%</td>
<td>15.15%</td>
<td>24.24%</td>
<td>33</td>
</tr>
<tr>
<td>Computerantivirus es</td>
<td>6.06%</td>
<td>15.15%</td>
<td>27.27%</td>
<td>24.24%</td>
<td>27.27%</td>
<td>33</td>
</tr>
<tr>
<td>Computerdatafiling</td>
<td>11.76%</td>
<td>20.59%</td>
<td>26.47%</td>
<td>17.65%</td>
<td>23.53%</td>
<td>34</td>
</tr>
<tr>
<td>Smartphone</td>
<td>27.27%</td>
<td>42.42%</td>
<td>27.27%</td>
<td>3.03%</td>
<td>0%</td>
<td>33</td>
</tr>
<tr>
<td>Touchscreen</td>
<td>39.39%</td>
<td>33.33%</td>
<td>21.21%</td>
<td>3.03%</td>
<td>3.03%</td>
<td>33</td>
</tr>
</tbody>
</table>

The results indicate that the respondents are most comfortable with internet browsing, chat and smart phones. They are least confident with computer data filing, antiviruses and Microsoft Outlook.
4.8. PERCEIVED BENEFITS OF TECHNOLOGIES IN HEALTHCARE

From the study, some of the public health care personnel indicated that they do not have the privilege of using computers or other ICT technologies due to lack of financial capacity by the institutions to incorporate Technologies at full scale. Despite this drawback the respondents were able to identify benefits that are apparent in healthcare provision due to Technologies adoption.

Table 4.2. Summary of perceived benefits

<table>
<thead>
<tr>
<th>Code</th>
<th>Category</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Improved Research</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>Effective communication</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Improved diagnosis</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Increased efficiency</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>Better patient management</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Better management of records (electronic records)</td>
<td>7</td>
</tr>
</tbody>
</table>

Figure 4.6. Summary of perceived benefits.
The results show that 39.4% of respondents said that Technologies have helped them to improve research in their field of work thereby increasing their knowledge and improving their work. Twenty seven percent (27.3%) expressed that there was increased efficiency at work due to the adoption of Technologies. They cited speedy completion of tasks, the ease with which certain tasks were completed as compared to traditional manual methods and the general orderly organisation of their work. In terms of communication, 27.2% pointed out the improvement in communication using mobile technology and the internet. This is espoused by Komolafe-Opadeji(2009) when he said that the internet brings access and communication to an unprecedented level. The benefits that respondents are witnessing agree with what literature outlines as some of the benefits of Technologies in healthcare.

The other benefits cited are better management of patient records, better patient management and improved diagnosis.

4.8.1. Key informants: heads of departments

Information obtained from key informants regarding the benefits of using Technologies in healthcare included the ones mentioned above and, in addition, cited the following benefits:

- Accounting system has made debtors’ follow-up efficient such that there are less bad debtors.
- Efficient management and control of stock due to electronic dispensing systems.
- Payment of contract workers can now be done timely, with reduced errors and at a minimum cost than before.
- Statistical analysis of hospital/clinic data can now be done with fewer errors.
- More accurate and timely management reporting due to the use of management information systems.
- Easier and effective management of institution ICT network through the use of network management software and applications for central management of the network.
4.9. STRATEGIES FOR ADOPTION, APPLICATION AND VALUE-ADDING CONTRIBUTION OF TECHNOLOGIES IN HEALTHCARE.

The following results indicate what the respondents felt needed to be done to improve on adoption of Technologies in Zimbabwe’s public healthcare sector.

Table 4.3. Strategies for adoption of technologies in public health

<table>
<thead>
<tr>
<th>Code</th>
<th>Category</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Offer basic IT training to all employees.</td>
<td>27</td>
<td>81.8</td>
</tr>
<tr>
<td>2</td>
<td>Improve on internet accessibility.</td>
<td>6</td>
<td>18.2</td>
</tr>
<tr>
<td>3</td>
<td>Avail computers to all wards and all departments in health centres.</td>
<td>4</td>
<td>12.1</td>
</tr>
<tr>
<td>4</td>
<td>Get buy-in to increase acceptance of new technologies.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Installation of backup power to avoid power disruptions</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>
The strategies point mainly to training in the use of technologies as the main factor respondents felt needed to be done in order to promote adoption of Technologies in healthcare. This agrees with Rogers’s five stage innovation adoption model where at the very beginning is knowledge. Training is one of the ways through which knowledge is acquired and once users have knowledge on available technologies and are confident in using them, change management with regards adoption will be expedited. However it was also gathered from interviews with key informants that their main consideration in technology adoption was the apparent financial cost or benefit associated with the adoption. The diffusion of innovations theory (DOI) again clearly states that among the five qualities that determine the success of an innovation, simplicity and ease of use of a technology is one of them. This implies the degree to which an innovation is perceived as difficult to understand and use. Diffusion scholars, among them Rogers (1995) put forward that training and awareness campaigns for users is one of the basic steps towards getting the buy-in of users in the adoption of new innovations at firm level.
Another quality that determines the success of innovation adoption is observable results; the easier it is for users to see results of an innovation, the more likely they are to adopt it (Robinson, 2009). The key informants who were interviewed in this study expressed their awe at the positive results they have witnessed with the introduction of Technologies to healthcare and exhibited a willingness to look for funding in order to scale up the use of Technologies at their institutions to keep up with developed nations’ health systems.

4.10. CHAPTER CONCLUSION

This chapter gave an analysis and discussion of the research findings which were further explained by the literature review. The discussions were aligned to the objectives of the study. The next chapter, chapter 5 contains conclusions and recommendations of the research.
CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The present chapter presents the conclusions and recommendations of the study. The conclusions made in this research were found to be valid because of the composition of respondents who were selected for the study. Respondents came from a variety of departments within public health institutions and have enough experience in the sector to give valid conclusions. The conclusions were derived from chapter four and most of the recommendations were derived from suggestions by respondents. An area of further study will be provided also in this chapter.

5.2 CONCLUSION

Public health institutions in Zimbabwe do not have a standard taxonomy for their technologies and it all varies from institution to institution mostly at the discretion of the head of IT. It was again found that the internet penetration rate at public healthcare institution varies from institution to institution. Each institution makes individual efforts that are guided by their respective leadership and not by any standard requirement neither by the concerned ministry, the Ministry of Health and Child Welfare nor by any regional or international governing body.

There is 100% mobile density at all institutions. This agrees with the statistics that were released in January 2013 by the Post and Telecommunications governing body POTRAZ. The level of computer literacy at all institutions is not very good. The research found that none of the institutions offer any basic ICT training to their employees. It also emerged that the 100% mobile penetration is not being fully taken advantage of at these institutions.

As for the perceived benefits, the research clearly shows that heath personnel fully appreciate the benefits that they have witnessed as a result of the adoption and diffusion of technologies in healthcare. The benefits that respondents are witnessing agree with what literature outlines as some of the benefits of Technologies in healthcare.
In conclusion there is reasonable use of Technologies in health delivery in Zimbabwe’s public health sector compared to other resource-poor nations although there is still a very wide gap with what literature entails in terms of the capabilities of technologies in healthcare. A lot of technology health applications that are apparent in literature like telemedicine, expert systems, and m-health applications are not being implemented in Zimbabwe. It appears that knowledge is the biggest determinant of what technologies and innovations are adopted in Zimbabwe’s public healthcare sector, this agrees with the Diffusion of Innovations theory which cites knowledge as the first step towards adopting an innovation. However, the knowledge may be limited as there is no department that is dedicated to doing research and development into innovations and technologies that are available globally in health care. As a result, the health sector has not taken advantage of the range of technology opportunities as effectively as other social sectors.

5.3 RECOMMENDATIONS
The following are the recommendations that arise from this study:

5.3.1. There is need for taxonomy.

The MOHCW must come up with a standard nomenclature for technologies used in public health care. This will help all stakeholders to communicate at the same level and using the same language. It also ensures uniformity in health care management which in turn will ensure equitable health for all citizens.

ICT is a multidimensional field and it can be quite confusing to a number of people. According to Davies (2006) there are a variety of terminology differences in the health sector which poses a challenge. ICT terminology can at times mean different things to different people depending on the context it is used as well as a number of other factors. This becomes problematic in the context of policy making, health care provision, and research.

Policy making

Policy makers require certain information when coming up with policies; such information can be benefits of using a certain technology like cost/effectiveness, or
even return on investment. With health innovations there might be need to provide details on expected improvements in health and wellbeing for the public. In order to explain these relationships a clear clarification is required and that is derived from a well-defined taxonomy.

**Health care provision**

The success of an innovation depends on the cooperation of the users of the technology. In health innovations are used by health care givers as well as the patients. For a patient to agree to use a technology for their health management, they require full knowledge of the nature, content and effect of the technology probably in comparison with a traditional method. Proper taxonomy helps with where to look for information for a particular innovation.

**Research**

Again a clear nomenclature of an innovation is essential to guide researchers measuring the impact of that innovation on health care. A clear nomenclature and classification of an innovation allows for a valid, accurate and complete research into that technology.

**5.3.2. Governance issues**

Governance issues that must be addressed include infrastructural issues, needs and priorities. There is need for national policies and regulatory framework that is aimed at implementing standards and assisting with organisational change required for adoption of Technologies. The Government must lay a framework for the management of the use of technologies in healthcare by developing strategies that address issues of standardisation, training, and security of data.

**5.3.2. Leverage on mHealth**

POTRAZ announced in January 2013 that the mobile density for Zimbabwe stands at 100%. Public health institutions must take advantage of this and introduce a variety of mobile applications aimed at improving access to health care for those
marginalised communities throughout the country. Applications like telemedicine are fairly inexpensive to implement and can go a long way in providing equitable healthcare for all Zimbabweans. Patient management for those who are chronically ill and need to take medication daily is another area where m-health can be applied. Simple mobile applications to remind patients to take their medication at prescribed times can be implemented at minimum costs given that every person owns a mobile phone.

5.3.3. Training in basic ICT skills

In the research findings, 80% of respondents alluded to the fact that basic ICT training was required for all health professionals. They bemoaned the high levels of computer illiteracy at health institutions. In this regard it is recommended that starting with the health institutions’ management, effort must be made to train all current employees in basic ICT skills and to offer refresher courses as necessary. At policy level, it is encouraged that the ministries of Health and Child Welfare (MOHCW) and Higher and Tertiary Education (MOHTE), work in collaboration to make ICT training a basic part of the curriculum for all health professionals from nurses, mid-wives, doctors, pharmacists, and other specialists.

A number of hospitals are already in collaboration with the University Of Zimbabwe College Of Health Sciences for clinical teaching experience for students. It is suggested that health institutions can take advantage of this already existing relationship to enlist the services of the college library to offer information literacy training to their employees in areas such as online information retrieval, analysis and selection. They can also be educated on proper referencing for research purposes and general knowledge on available online resources to increase their healthcare knowledge.

5.3.4 Security and privacy

Since the study is driving towards the extensive use of electronic records and community access to personal information. It is recommended that the government and concerned authorities look into the issues of security and privacy of data proactively rather than reactively. There is need to address issues like data corruption, accidental damage, theft and unauthorised use among others well ahead
of time. The government and these public health institutions must engage the private sector to develop applications for data security and integrity.

5.3.5. Investment and sustainability

Indications from the research are that financial resources are the main hindrance to the uptake of innovations. A joint investment with government, technological and financial institutions is seen as necessary. The telecommunications industry in Zimbabwe is doing quite well in terms of technological advancement and forming partnerships with these organisations might go a long way in driving solutions to fast track the adoption of technologies in public health. It also acts as a sustainability solution.

5.4.5. Invest in R&D

Research and development is an area where investment is called for in public health. There are a number of technology-based systems and applications that are fairly inexpensive to implement but would go a long way in improving the sector; these technologies are mostly unknown by the management who are the ones who make buying decisions. If a R&D division is implemented in these institutions then information on such technologies would be readily available and more informed decisions and policies can be made.

5.5. AREA OF FURTHER STUDY

It was discovered that IT departments at public health institutions have no IT managers; instead they are headed by Finance managers. It appears IT as a department is not getting the recognition it should get in light of the fact that the world is now being taken over by technologies. The fact that the IT department plays second fiddle to the finance department raises questions of how then the IT strategy for these institutions is aligned with their business strategies or if they have an IT strategy at all.

A further study is necessary to carry out an analysis or gap analysis of the alignment between IT strategy and business strategy in these public health institutions.
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APPENDICES

QUESTIONNAIRE 1: QUESTIONNAIRE TO GENERAL STAFF.

An analysis of the diffusion and adoption of Technologies and Innovations in Medical care in Zimbabwe’s Public Health Sector

Please may you kindly complete the survey below, which is for academic research. Completing the questionnaire should not take more than 30 minutes. No names of participants are required and all the information you provide will be treated in the strictest confidence.

Technology is defined as any system or application that assists in the collection, management and processing of information to support healthcare and healthcare delivery.

Thank you

1. How long have you been employed in the health sector?
   - more than 10 years
   - 5-10 years
   - 1-5 years

2. What is your view on the growing use of technology in various industries?
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

3. Do you use a computer in your line of work?
   - Yes
   - No

4. Besides the computer, what other health technologies do you use? (e.g. X-ray machines, electronic medical records, databases, expert systems, up-to-date etc)
5. Have you formally studied any computing course, basic or otherwise?

Yes ☐
No ☐

6. How do you rate your level of confidence in the use of the following using the provided scale of 1-5?

5-Very good     4-Good     3-Average     2-Poor     1-Very poor

<table>
<thead>
<tr>
<th>Application</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft word</td>
<td></td>
</tr>
<tr>
<td>Microsoft excel</td>
<td></td>
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<tr>
<td>Microsoft</td>
<td></td>
</tr>
<tr>
<td>powerpoint</td>
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<tr>
<td>Microsoft outlook</td>
<td></td>
</tr>
<tr>
<td>The keyboard</td>
<td></td>
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<td>Internet web</td>
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<td>browser</td>
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<td>Search engines</td>
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<td>Chat</td>
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<td>Computer viruses</td>
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<td>Computer antiviruses</td>
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<td>Computer data filing</td>
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</tr>
<tr>
<td>Smart phone</td>
<td></td>
</tr>
<tr>
<td>Touch screen</td>
<td></td>
</tr>
</tbody>
</table>

7. Do you own a mobile phone?

Yes ☐
No ☐
8. If your answer to question 8 above is yes, what else do you use your phone for besides calling and texting?

   9. Please state any benefits that the use of technologies have brought about to the public health care sector.

   10. What are some of the challenges you face in the adoption and use of technologies at work?

   11. What do you suggest can be done to improve on effective utilisation of technologies in healthcare?

   12. What is your gender?

      Male  
      Female

Thank you for taking this survey

QUESTIONNAIRE 2: FOR INTERVIEWS WITH KEY INFORMANTS.

An analysis of the diffusion and adoption of Technologies and Innovati
onsin Medicalcare in Zimbabwe's Public Health Sector.

Thank you for agreeing to this interview.

For the purposes of this research and this interview, technology shall be defined as any system or application that assists in the collection, management, and processing of information to support healthcare delivery.

Section A: Demographical questions.

1. What is your position at work?

-----------------------------------------------

2. For how long have you been working in that organisation?
Less than 5 years ☐
Between 5-10 years ☐
Above 10 years ☐

Section B: Key Aspects on the use of technology in the public healthcare sector.

3. What is your comment on the use of technology in today's industry?

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4. In your view what do you think generally about the rate of uptake of technologies in the public health sector as a whole?
5. As a hospital/Clinic what can you say has been the rate of uptake of health technologies and innovations at your institution?

5.1. What is involved in the decision-making process for your organisation on which and when technologies are implemented?

6. Can you give me some of the technologies that are currently in use at your institution.

7. Is there a classification of these technologies that is being used by your institution?

8. Do you have broadband internet connection at the institution?

9. Do all hospital/clinic departments have access to the internet? If not what are the reasons?
10. Does the institution ever provide basic ICT training to its employees?

11. Can you provide a reason for your answer?

12. What benefits have you realised at your institution that are attributable to the use of technologies?

13. What recommendations can you give that would see an increase in the adoption as well as effective utilisation of technologies at public healthcare institutions?

Once again thank you for your time.