Teleconsultation perspective for cardiovascular patients in Saudi Arabia

A Thesis submitted for the degree of Doctor of Philosophy

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Abstract

This research of teleconsultation services aims to improve the quality of diagnosis and treatment for rural cardiovascular patients through utilizing distant medical expertise. Equitable access to expert healthcare as well as improved medical management for these patients can assist in modifying cardiovascular disease (CVD) risk and reduce morbidity and mortality in Saudi Arabia. The objectives were to design and develop a new care pathway for cardiovascular disease patients by utilizing teleconsultation technology, investigate factors and issues that might act as barriers to its adoption, and then evaluate the impact of this model on the stakeholders. A small scale pilot project was used to determine the issues of technology, processes and human resources required to deliver an effective service with the context of the research setting. Four primary healthcare centres, two regional hospitals, fifteen patients and sixty other participant stakeholders were included in this study. An approach using (PCP) patient care pathways was used to introduce the teleconsultation technology and integrate it within the healthcare delivery system.

Compared to the traditional PCP, the modified PCP utilising teleconsultation technology improved the quality of healthcare through:

- Improved access to medical care and quality of diagnosis by obtaining the expertise of a distant specialist.
- More efficient medical evaluation and management.
- Enhanced role of primary healthcare centres and participating hospitals by providing all levels of health services for patients.
- Evidence-based referral (reduced waiting time, reduced burden on outpatient clinics).

The telconsultation adoption barriers included:

- ❖ Inadequacy of finance
- ❖ Limited infrastructure
- ❖ Legal and regularity difficulties.
- ❖ Organization issues.
- ❖ Literacy on technology.

This study recommends the following for telemedicine implementation in the country:

- Promote perception and readiness for ICT services with the healthcare community.
- Enhance structural readiness including appropriate infrastructure and adequate funding, human resources and equipment.
- Proactive policies to encourage growth of the telecommunication sector and to address concerns regarding privacy and security.

DEDICATION

I dedicate this thesis to

My Parents and My wife

Acknowledgement

I would to thank Allah, my Lord, for giving me the strength to get through my course of study; without His support and guidance, it would have much more difficult to accomplish this.

I would like also to thank my country, the Kingdom of Saudi Arabia, for its encouragement and support and for giving me the opportunity to pursue my degree in higher education.

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GLOSSARY

CVD	Cardiovascular Disease
ICT	Information and Communication technology
GP	General Practitioner
CHF	Congestive Heart Failure
COPD	Chronic Obstructive Pulmonary Disease
PCP	Patient Care Pathway
IT	Information Technology
PHC	Primary Health Care
MOH	Ministry of Health
WHO	World Health Organisation
ATA	American Telemedicine Association
JPEG	Joint Photographic Expert Group
DICOM	Digital Imaging and Communications in Medicine

CHAPTER 0NE – INTRODUCTION

1 Introduction

Saudi Arabia is located in the southwest corner of Asia (see figure 1); it is a vast country and the largest Arab country of the Middle East. It covers 2,150,000 square kilometres, which is about a quarter of the size of the US. The total estimated population of Saudi Arabia in 2009 was around 28 million with an annual growth rate of 2.28%.

Figure 1: Map of Saudi Arabia

In 2002, the United Nations Development Programme (UNDP) report on annual global human development still classed Saudi Arabia among countries of medium-term development (WHO, 2006). In the past 30 years, however, an enormous improvement in socioeconomic development, with excellent progress in education, health, environment and housing, has been achieved in the country. The health sector has been identified as a major priority in all development plans and the Saudi Arabian government has devoted to healthcare a significant annual allocation from the total government budget and this has been distributed to all health service providers. The financial appropriations to the Ministry of Health (MoH), which provides therapeutic services to 60% of Saudi citizens, reached approximately $ 127000000 in 2010. The Ministry of Health has thus expanded its coverage, and developed and improved the quality of healthcare. Health services have

been decentralization in order to improve performance with19 health regions each led by a Regional Director General of Health Services. The mission of the Ministry of Health and its directorates are: 'the provision of comprehensive health care comprising preventative, curative and rehabilitative [services]' (Ministry of Health, 2002). According to the MoH there has been an increase in life expectancy in recent years and life expectancy for males/females in 2009 was (72.2/74.3) (MOH, 2009). 'With increasing longevity and changes in lifestyle, there has been a consequent change in patterns of disease with a marked increase in illnesses related to non communicable diseases, in particular cardiovascular disease' (WHO, 2006, p.18). Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in Saudi Arabia (MOH, 2009). There are urgent needs to adopt new health strategies and management programs that can assist in modifying the CVD risk and the care of those with the disease. One approach is the use of information and communication technology (ICT). Benefits can be obtained by utilizing telemedicine to tackle the CVD problem.

1.1 Problem Statement

Cardiovascular disease has been the major cause of death in Saudi Arabia in the last five years according to statistics from the Ministry of Health. Much of the population lives in rural and remote areas. The shortage of cardiovascular specialists and appropriate medical equipment in most of rural primary healthcare centres and some of regional hospitals has contributed significantly to the delay of diagnosis and treatment for patients. In additional the poor referral system within all areas of healthcare has allowed serious cardiovascular event to occur and incidence of CVD to rise. Moreover, the absence of evidence-based referral between primary care and district hospitals as well as tertiary hospitals has increased the burden on hospital outpatient clinics and results on many occasions to referral of unsuitable candidates. Furthermore, there are low rates of feedback from hospitals to primary care which can result in incomplete and inadequate follow-up treatment. Hospital location adds to the problem. Many secondary and tertiary hospitals are located in places which require many patients to travel large distances for treatment. Burdens such as travel cost and separation from family prevent healthcare services being delivered equally and comfortably.

1.2 Aim

The aim of this pilot study is to design and develop a new care pathway for cardiovascular disease patients by utilizing telemedicine technology, investigate factors and issues that might act as barriers to its adoption, and then evaluate the impact of this model with stakeholders.

1.3 Objectives

- Develop a cardiovascular teleconsultation model supported by modifying patient care pathway.
- Adaptation of the model to available communication infrastructure.
- Evaluation of the impact of the model on and benefits for cardiovascular patients as well as the healthcare system.
- Investigation of national health policies, strategies and readiness to determine how the MOH may support the adoption of teleconsultation and where appropriate changes should be made.

1.4 Motivation

Information and communication technology (ICT) has become very important in developed countries. It is beneficial in many fields such as finance, education and health. Telemedicine is one aspect of this technology, and is seen to have an important role in the future of the health service. However, although attempts have been made in Saudi Arabia to utilise telemedicine, progress lags behind developed countries. Hence, the motivation of the present study is to contribute to determining how bring such technology to the country. This might help reduce health services costs, employ resources more effectively and provide equal access to good healthcare to all citizens. This will be achieved by collecting data on the viability of telemedicine in Saudi Arabia and determining its acceptability by citizens. Cardiovascular patients in especial need of high quality healthcare services wherever they are, as CVD is often the cause of mortality and disability. Specialist doctors can use telemedicine to provide fast and accurate diagnosis and to manage patients efficiently. Thus, this pilot project is concerned with how advanced technology can be integrated into the healthcare delivery system.

1.5 Expected contribution

This thesis will benefit both cardiovascular patients and the healthcare delivery system in Saudi Arabia. It redesigns the care pathways of cardiovascular patients, which will assist in the fight against CVD. Early diagnosis of such illnesses can save lives and prevent disabilities. This project exploits teleconsultation to improve the quality of care through:

- Improved access to medical care, enabling a general physician (GP) to obtain an evaluation of the test results of a patient from a specialist.
- Improved quality of diagnosis by obtaining the expertise of a distant specialist.
- More efficient medical evaluation and management.
- Avoiding unnecessary travel.

Furthermore, this research will demonstrate how telemedicine can enhance the healthcare delivery system. The following can be achieved:

- Improved access to healthcare services and care delivery especially for patients in rural and remote communities.
- Enhanced role of primary care and participating hospitals in the health system by providing all levels of health services for patients.
- Improved relationship between primary care and hospitals for the benefit of patient management.
- Evidence-based referral (reduced waiting time and reduced burden on outpatient clinics in hospitals)**.**

Finally, this study can provide significant data for future application of telemedicine in Saudi Arabia, as it will identify potential obstacles to its implementation.

CHAPTER TWO - OVERVIEW

2 Overview of research topic

2.1 Telemedicine

2.1.1 Definition

Telemedicine refers generally to the use of advanced information and communication technologies (ICTs) in delivering and supporting healthcare services. It is a broad term and is described worldwide in many other terms such as telecare, telehealth, health telematics, e-health, on-line health, medical informatics and mobile health (m-Health) (Beijnum, Pawar, Dulawan, & Hermens, 2009). Over the past few years, it has been defined and described in several ways. The term "telemedicine", which was first introduced by Thomas Bird in the 1970s, can be defined simply as medicine at a distance (Greek *tele* = at a distance) (Wootton, Craig, & Patterson, 2006). The American Telemedicine Association defined telemedicine as 'the use of medical information exchanged from one site to another via electronic communications to improve patients' health status' (ATA, 2010). However, the term telemedicine has a much broader meaning for many researchers. It encompasses the whole range of medical applications and services including prevention of disease, diagnosis and treatment, continuing education of healthcare providers and consumers and allows patient access to expert advice and information no matter where the patient or relevant information is located (Wootton, Craig, & Patterson, 2006).

2.1.2 History

The concept is quite old; early examples of telemedicine are telephone and telegraph. The telephone was invented in the late nineteenth century and has been used as a valuable tool for delivering health services between patient and physician. In the middle of the twentieth century, modern telemedicine has been facilitated by many technological inventions. In 1964, microwaves established telemedicine as a two-way video conferencing link between the state mental hospital and the University of Medical School, 112 miles away (Bauer & Ringel, 1999). Then, in 1967, a television link between patients and physicians was set up between Logan International Airport Medical Station and Massachusetts General Hospital to provide health care to passengers and airport

employees 24 hours a day (Wootton, Craig, & Patterson, 2006). Television was also utilized by telemedicine specialists in the 1970s and 1980s to transmit medical images. In the 1990s telemedicine began to take off with the rapid growth of computer and information technology. The internet and innovations in technology has allowed telemedicine to grow into a more complex and feature-rich technology: for example, the first transatlantic robotic operation was performed in 2001 on a patient in Strasbourg by a surgeon in New York (Marescaux, et al., 2001).

2.1.3 Types

Telemedicine can be divided according to its modes of operation into three main categories (Hoyt, 2007):

- **Store and forward** (asynchronous communication). Medical data such as images or videos can be saved and then transmitted to a physician or medical specialist for assessment. Unlike traditional in-person patient meetings and actual physical examination, this method of telemedicine does not require the presence of doctor and patient at the same time. Pathology, dermatology and radiology are common specialties that use this process.
- **Real time** (synchronous communication). This division of telemedicine services involves real-time interactions between patient and healthcare provider through two-way television or phone conversations. Many traditional physical examination activities that are performed in face-to-face visits can be performed in this way. This approach requires advanced equipment and medical devices to send and receive real-time medical data and employs video conferencing.
- **Remote monitoring** (self-monitoring/testing). This method enables the clinician to monitor and measure patient health data and information remotely by using various devices. It has been used together with advanced communication equipment, for managing chronic diseases such as congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), diabetes, and asthma or to achieve earlier and proactive interventions in disease. Sensors such as blood pressure (BP), weight, pulse oximetry, glucose and ECG can be utilized for remote monitoring of patients.

CHAPTER TWO - OVERVIEW

Telemedicine applications have been characterized into four separate types (Norris, 2002):

- **Teleconsultation.** This uses telecommunication and information technology (ICT) to obtain the opinion of a healthcare provider who is distant from the patient and/or their primary healthcare provider, regarding the diagnosis and treatment of the patient. This type of patient/ doctor communication can take place in real time (live consultation) via a videoconferencing link. Data consultation or store-and-forward process is the other form of teleconsultation which is effected by acquiring the patient's medical information and then sending it to the consultant to give his/her opinion at same time later.
- **Telemonitoring** (biotelemetry). This is defined as the use of audio, video and other telecommunication and information technology to monitor the status of a patient at a distance (Meystre, 2005). It has been used to transmit the physiological and biological data of patients from one location, such as the home, office and primary clinic to another for data analysis and decision-making. Recently, this method has spread across the world as it has prove to be an effective tool in follow-up treatment and chronic disease management, especially in communities that have rising elderly populations. It has also been adopted as a response to the rising needs for home care (Meystre, 2005).
- **Telesurgery** (remote surgery). It involves the manipulation of the surgical instruments by a surgeon with the assistance of advanced medical devices and telecommunication technology at a site remote from the patient (Kumar & Marescaux, 2008). A robotic system controlled by a remote surgeon directly implements all surgical tasks in real time through an interface and is as precise as traditional surgery.
- **Teleeducation** (telelearning). It has been used for many years to deliver continuing education programmes to rural healthcare professionals or those with poor access such as in developing countries (Curran, 2006). It has three basic modes which are video, audio and computer. Distant learning can be used in either synchronous or asynchronous modes. Video conferencing and

interactive television are examples of synchronous video learning and offer live visual and verbal interaction between instructors and learners. The transmission of the spoken word (voice) can be considered as synchronous audio learning (Curran, 2006). Recently, computer aided learning has become common in distant learning in many forms such as the Internet, World Wide Web and email.

Telemedicine is further classified according to its clinical subspecialty such as: teledermatology, teleradiology, telecardiology, teleneurology, telepathology, telepharmacy, telepathology, teleophthalmology, telepsychiatry, telepaediatrics, etc.

2.1.4 Benefits

The use of telemedicine has offered many benefits to the economy of the country, patients, society, healthcare system and healthcare providers. The following can be considered as the common benefits which have led to the spread of this technology around the world (Wootton, Craig, & Patterson, 2006).

- Cost reduction in overall healthcare expenses.
- Improved efficiency and resource utilization.
- Improved access to healthcare services and care delivery especially for people in rural and remote communities.
- Development of communication between healthcare provider and consumer.
- Reduced number of unnecessary hospitalizations (hospital load).
- Availability of specialized services to underserved areas.
- Increased patient satisfaction and expectation.
- Increased medical knowledge sharing, professional education and continuous training.
- Enable remote physicians to participate in meetings.

2.1.5 Challenges and barriers

There are a number of challenges and barriers in telemedicine development and implementation that may reduce its effective use and potential benefits. These challenges

and barriers affect all nations and people regardless of their location, religion or ethnic group (Latifi, 2008).

They may be described as follows:

- Limited access to definite care.
- Limited communication technology and infrastructure.
- Limited diagnostics, treatment and pharmaceuticals.
- Language and religion.
- Cultural diversity.
- Medical norms.
- Autonomy.
- Extreme environmental conditions.
- Financial.
- Legislative – policy.
- Bureaucratic / political.
- Technology and resources available.
- Physician and health staff unfamiliarity.
- Consumerism.

2.2 Teleconsultation

2.2.1 Definition

Teleconsultation is an advanced telemedicine application which has spread considerably, especially in the developed countries, in recent years. Teleconsultation has been defined in many ways. Essentially, consultation means seeking advice or information from somebody. Thus, teleconsultation means seeking medical advice or information from a person at a distance (Wootton, Craig, & Patterson, 2006). This process may take place between healthcare professionals or between patient and physician. Teleconsultation is also defined according to the applied mechanism between health service providers and consumers as it ‘is the consultation of one (or more) distant health care professional(s) by a locally present health care professional about a patient’s case, diagnosis and treatment using telecommunication and information technology to bridge the spatial distance

between two (or more) participants' (Nerlich & Schaechinger, 2003, p.3). Others have defined the teleconsultation concept in terms of its main purpose of providing medical expertise or treatment to places where there are shortages in expertise by leveraging electronic communications (Khoury, 2008). The clinical aims of teleconsultation are as below (Darkins & Cary, 2000):

- To help make a diagnosis on the basis of clinical history, clinical examination, and investigation.
- To ask the best way to treat a patient and what that treatment should consist of.
- To obtain advice about technical aspects of care or treatment.
- To ask for corroborative opinion in relation to a recommended action for a patient.
- To obtain advice if a patient needs to transfer elsewhere for treatment and how this transfer can be done safely.

2.2.2 Types

Teleconsultation can be distinguished into two main categories:

- **Synchronous** (real-time consultation). It involves real-time face-to-face contact (image and voice) via video-conferencing equipment such as television, digital camera, webcam or videophone to connect medical experts and clients, who are separated geographically, simultaneously (Verhoeven, Tanja-Dijkstra, Nijland, Eysenbach, & Gemert-Pijnen, 2010). It simulates the traditional physical face-to-face consultation and parties can interact about their concerns without any delay in time or data transmission. There is evidence that on-line-consultation has proved effective in treating chronic and severe disease. Compared with asynchronous teleconsultation, this method is expensive as it requires more advanced equipment and medical devices to send and receive real-time medical images and data and to make video link.
- **Asynchronous** (store and forward consultation). In this approach all the clinical information of the patient (medical record, video and audio recordings) and medical images are captured, processed and analysed and sent to consultant(s) in other locations for a medical opinion. This process does not require the patient

and consultant to be present at the same time or face-to-face. Subsequently, the decision is transmitted by the consultant. Recently asynchronous consultation has been divided into message, storage and discussion systems. The message system utilizes email to enable doctors to send questions directly to other specialists and receive replies. Storage systems are including Web or picture archive communication systems (PACS) which are used in teleradiology. Discussion systems implement the functionality of a typical Web-based bulletin-board system (including messaging, discussions, image storage, etc.) and typically are open to all participants (Luk, Ho, & Aoki, 2008).

Telephone is the early form of teleconsultation and is still popular in medical care. It is the cheapest of the teleconsultation methods and can be utilized within communities that are less advanced in telecommunication and information technology or not able to afford the cost of real-time interaction.

2.2.3 teleconsultation for healthcare services

Teleconsultation has proven its value in healthcare delivery system and being applied across many medical practices. Healthcare professionals and patients benefit from teleconsultation and being more efficient with their time. Substituting conventional face to face contact with video consultation becomes irresistible, particularly over large geographies, with hard to access communities or care groups, where clinical expertise is scarce and distributed. The circumstances where access to high speed broadband is becoming available in domestic and communal environments should make this technology widespread over the next few years.

Teleconsultation is, at its core, a way to deliver two important changes to healthcare (Rice, 2011):

- **Removes distance instantly.** Healthcare professionals and patients are brought together through teleconsultation without having to be in the same location. This avoiding unnecessary travel and reduced cost. It allows delivering greater levels of productivity and flexibility to healthcare providers. A patient and nurse can attend a hospital outpatient consultation “virtually” from a GP surgery through

this technology. Teleconsultation can provide great benefit especially where expertise is limited and an instantaneous informed input from that expert can materially affect the treatment plan and thus the outcome for the patient.

- **Increased choices as to how services are accessed.** Healthcare providers and patients will have a wider menu of effectiveness and convenience options to work. Teleconsultation can be best for the change from one physical channel for accessing services to a choice of channels of coordination between healthcare professionals, their patients and care teams.

Other advantages of teleconsultation can be summarized as follows:

- Improved quality of diagnosis and treatment through utilizing medical expertise and hence improving the quality of health care. (Nerlich & Schaechinger, 2003).
- Reduced diagnostic errors.
- Equality of access to specialists.
- Improved follow-up treatment to manage chronic disease.
- Enhanced patient self-care.
- Improved patient confidence in diagnosis and treatment.
- Reduced cost for patient by avoiding unnecessary travel and for health system by eliminating waste of resources.
- Increased access to care and reduced burden on hospitals.
- Increased medical education.

To obtain the maximum benefits from the telemedicine consultation process, there are a number of factors to be considered (Norris, 2002):

- Agree on the aim of the teleconsultation. (diagnosis or treatment or education)
- Establish the process and content of the teleconsultation. Irrelevancies, discontinuities and distractions in health care issues should be avoided in the consultation process.
- Ensure practitioners are familiar with the equipment and trained in its operation.

- Formalize the delegation of clinical responsibilities in the teleconsultation process. A physician who participates in a telemedical consultation must be satisfied with the healthcare provider who attends with the patient at the other end of the teleconsultation link.
- Documentation of all procedures and outcomes of teleconsultation process to be kept in patient's medical record.

2.3 Cardiovascular diseases

According to Defelice (2005, p.1), 'Cardio refers to the heart and vascular to entire arterial blood vessel system within the body including the brain, neck, chest, abdomen and legs'. Cardiovascular disease or heart disease term refers to the group of diseases that affects the cardiovascular system which involves heart and blood vessels (Arteries & veins). These diseases have been classified in six major forms (WHO, 2009):

- Coronary heart disease – disease of the blood vessels supplying the heart muscle.
- Cerebrovascular disease - disease of the blood vessels supplying the brain.
- Peripheral vascular disease – disease of blood vessels supplying the arms and legs.
- Rheumatic heart disease – damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria.
- Deep vein thrombosis and pulmonary embolism – blood clots in the leg veins, which can dislodge and move to the heart and lungs.
- Congenital heart disease - malformations of heart structure existing at birth.

3 Literature Review

3.1 Development of Teleconsultation

The simplest and oldest example of teleconsultation is a telephone conversation between two physicians or between patient and physician to obtain a second opinion (Norris, 2002). This method is as old as the telephone. Around the middle of the last century, the era of telemedicine consultation by utilizing microwave technology started. One of the first teleconsultation applications reported in the scientific literature was probably the psychiatric care project. In 1959, the University of Nebraska Medical School accomplished the first audio-visual interactive system with the use of microwave technology to open a link to the state mental hospital. In April 1968, a microwave video link was set up between Logan International Airport Medical Station and Massachusetts General Hospital. This program was aimed at providing health care to passengers and airport employees 24h a day without the need for a physician to be assigned to the airport permanently. It was successful in avoiding the medical delay owing to patient/doctor travel (Kim, 2004). The INTERACT program that started in December 1968 between Dartmouth Medical College and the University of Vermont can be considered as the first network of telemedicine consultation to support rural clinics. It was launched to provide medical consultation and education services to ten rural clinics in New Hampshire and Vermont by establishing a network assisted by a microwave system (Kim, 2004). It showed an improvement in access to medical care and education in the rural areas but ended in 1985 owing to financial difficulties. In 1971, the National Library of Medicine's Lister Hill National Centre for Biomedical Communication chose 26 sites in Alaska to determine the potential impacts of using satellite video consultation on the quality of health care in Alaska's rural sites. This project, later known as Alaska ATS-6 Satellite Biomedical Demonstration, proved that a satellite system could improve village health care and be used effectively in providing health assistance for any medical problem except emergency care (Kim, 2004). The National Aeronautic and Space Technology Administration (NASA) was interested in this technology since its inception and devised several programs to take advantage of it. During 1975, NASA and SCI systems of Houston executed a study to investigate the minimal requirements for television systems to do accurate telediagnosis. An actual

medical examination was conducted and taped between a nurse and a physician by use of closed-circuit television. After the results of this application were analysed, the pictorial and diagnostic limitations as a function of technical video characteristics were defined (Davis, 1974). Also, in 1989, the first international telemedical consultation program was conducted by NASA, Space Bridge to Armenia/Ufa, following a massive earthquake in the Soviet Republic of Armenia in December 1988. By using one-way video, voice and facsimile and under the supervision of the U.S./U.S.S.R Joint Working Group on Space Biology, medical consultations were performed between a medical centre in Yerevan, Armenia, the site of the disaster, and four medical centres in the U.S. This project, which was established over a satellite network, proved that medical consultation could be carried out across political, cultural, social, and economic borders (Kim, 2004). Since the mid-1990s, teleconsultation applications have grown significantly owing to the shift from analogue to digital information and communication technology and the accompanying role of computers (Khan, 2000). It is worth noting that about 35% of the usage of telemedicine networks is accounted for by teleconsultation. It has invaded most clinical specialties and the number of medical consultations is accelerating considerably. For example, in 1998, the total number of telemedicine consultations performed in the USA was nearly 40000 in more than 35 different specialties (Norris, 2002). Approximately 70% of these consultations were synchronous interactions using live video, and the rest used pre-recorded or non-video interactions. In the following year in the USA, the number of telemedical consultations almost doubled and reached around 75000 consultations. The top three clinical subspecialists that use teleconsultation services are psychiatry, dermatology and cardiology services (Kim, 2004). This increase in teleconsultation use is attributed to the following causes (Norris, 2002):

- The development of computing and information technology.
- The improvement in network and telecommunication infrastructure.
- The rise of interest in the internet.
- The reduction in telecommunication costs compared with satellite used previously.

3.2 Teleconsultation worldwide

In most developed countries the average cost of healthcare amounts to 10% to 12% of Gross Domestic Product (GDP) and in the US healthcare cost accounted for 15% of GDP (WHO, 2006). According to World Health Organization guidelines, however, healthcare service spending should not exceed 5% of GDP (WHO, 2006). As a result, most countries have made very robust attempts to reduce their healthcare costs by improving their strategies and adopting the latest technologies. The teleconsultation concept created in the developed countries has become an attractive option and an important tool of modern health technology because it provides a valuable approach to health cost savings. Healthcare services have improved significantly at both personal and community levels wherever the teleconsultation strategy has been adopted. It has been utilized in all clinical subspecialties including cardiology, dermatology, psychiatry, ophthalmology, and paediatrics, but to varying degrees. In surveys of teleconsultation, psychiatry, dermatology and cardiology are the clinical fields with most use through both synchronous and asynchronous methods (Zimlichman, 2005). These was a similar finding in the survey conducted during 2001 within the United States, which is the leader in terms of this technology (Kim, 2004). A teleconsultation initiative are primarly among the developed countries and thus has allowed them to gain considerable experience in this domain. Chronic diseases such as cardiovascular disease, cancer and diabetes that have risen in the last years in developed nations owing to an increased number of elderly people and changed lifestyles have been detected earlier and treated better than previously, especially in areas which are medically underserved. Also, teleconsultation avoided unnecessary hospitalization and outpatient clinics visit and this can contribute significantly in infectious diseases decline. Countries such as the USA, UK, Germany, Australia, Japan, and Canada were the first developed countries to realize the potential advantages of teleconsultation. Therefore they have spent a great deal of effort, time and money in developing technology and numerous pilot projects have been established to ensure efficient and effective implementation of teleconsultation.

3.3 Key areas for achieving success with teleconsultation

In order for teleconsultation to be implemented effectively in a healthcare system, we need to identify the basic points that maximize the likelihood of success. These essential factors include:

- Determining the goal of teleconsultation by addressing patient needs along with the agreement and involvement of the stakeholders. Successful implementation of telemedicine has consistently presented its objectives as well as a clear vision of how the telemedicine contributes to the overall goal. Delivering care in remote locations or to populations for which care is unavailable to them due to geography or limited resources can be a motivating factor. It is helpful for patients and healthcare providers to contribute effectively and pursue the use of teleconsultation.
- Defining a project plan. Following a pragmatic approach while responding to real needs and gradual advancement are a key to successful implementation. A good project plan has reasonable expectations.
- Monitoring the implementation and the definition of key points (milestones) for evaluation are important to ensure that everything is working properly.
- Identifying a financial strategy. Financial considerations remain critical. Programmes that start with solid financial justification and meet the measurements of the plan capture support and success more easily (Vanderwerf, 2004). Clear short and long term financial plans for the creation and operation of teleconsultation are an important issue. If a strategic goal of teleconsultation is cost saving, methods to measure the saving should be clearly identified. Failing to do so can hinder long-term sustainability and end the teleconsultation services.
- Deploying teleconsultation in the health care system with minimal disruption. Teleconsultation should not replace the existing channels to health services; instead, it adds new channels and choices for patients and professionals (Rice, 2011). The more change that must be adopted the higher the likelihood of failure (Vanderwerf, 2004). A big change in the standard protocol will increase the difficulty for teleconsultation to be accepted and succeed. A high level of

utilization can be achieved only if telemedicine can be made part of the normal care process. Without utilization, the programme will decline. Teleconsultation needs to be integrated into care pathways, work flows and professional practice. This makes securing its adoption a significant change management challenge that must be considered within the overall strategy for a healthcare system (Rice, 2011).

- Creating a convenient work environment and plans for technical problems. Health-care providers' acceptance of teleconsultation can be achieved by creating a motivating work environment. Easy-to-use technological tools and less need for training can remove the fear of technology and the resistance to change. Technology is never 100% reliable, as a variety of problems can arise. For this scenario, procedures need to be thought through. Rescheduling the teleconsultation session is not always the best solution. Where time is critical, another channel plans for its implementation will be needed (Rice, 2011). Proven good quality equipment that delivers excellent performance is important in providing technology satisfactorily.
- Assure effective training. Training has a major impact on utilization and can be a major factor in sustaining the use of teleconsultation. Training helps users to become more comfortable so that they can more readily include and accept new methods of healthcare and technology. The basic foundation for training should include the following (Vanderwerf, 2004):
    - Communication technology.
    - Clinical technology.
    - Diagnostic device user training for both send and receive sites.
    - Workflow and protocols of care and procedures for the use of devices.
    - Documentation.
    - Trouble shooting and access to product and technical support.

As teleconsultation is still relatively new and has just started to emerge in developing countries, implementing Internet based telemedicine applications in rural areas is not easy. This is due to the limited development in the field of telecommunications; as such

the rural areas of some developing nations are even deprived of basic telephone lines. Hence, achieving widespread use and maintaining sustainability of telemedicine in developing countries constitute challenging task (Shrestha, 2011). An effective teleconsultation project is one that can manage change and obtain stakeholders' confidence.

3.4 Teleconsultation barriers

The implementation of telemedicine applications is affected by several challenges and barriers. Our survey of the most common categorization of teleconsultation barriers includes the following.

3.4.1 Technical barriers

Standard issues. Teleconsultaion is a telecommunication link between a patient and a remote healthcare provider and this link is an electronic highway. It is created for different purposes such as video and audio transmission for visual collaboration between a patient and his/her doctor or interchanges the diagnostic images or medical data between medical experts. The lack of standards or protocols blocks the transmitted data from being received or makes them unintelligible at the receiving station. The lack of clinical and technical standards for transmitting data is a major inhibitor to networking information systems within and across managed care organizations and for other players in the health care system (OTA, 1995). These standards relate to data definitions, coding or content, and transmission of diagnostic images (e.g., speed, resolution, and image size). Today, several national organizations and government agencies are involved in healthcare information standards development process for all telemedicine applications. Working on standardization has become a key factor in telemedicine practice.

Technology and equipment incompatibility. ‘Compatibility is the degree to which using technology is perceived as being consistent with the existing values, and past experiences of the potential adopter’ (Al-Qirim, 2003, p.503). One of the most important challenges today for both public and private sectors is technology limitations, as well as equipment incompatibility. For successful implementation of telemedicine, interconnectivity and interoperability within the framework of the national information

infrastructure need to be ensured (OTA, 1995). In the field of teleconsultation, compatibility problems have impeded many telemedical communications and as a result many appointments with patients have been cancelled (Burg, 2003). Since 1998, three telemedicine networks have existed in Ontario providing, via video teleconferencing, remote patient consultations with a specialist. Each network is successful in its own right, but, owing to compatibility problems, the three networks were not capable of performing a complete teleconsultation task between them; it sometimes delayed care or required users to switch locations (Cisco, 2007). Keeping abreast of developments and acquiring high technology is laudable provided that it serves essential clinical and healthcare needs. The emphasis placed on high-level technology without attention to specific clinical and healthcare requirements and infrastructure capabilities in each setting has generated a poor fit between teleconsultation system design and end-user needs (OTA, 1995).

3.4.2 Legal and regulatory barriers

Confidentiality and privacy. Confidentiality and privacy are potential significant human factors barrier (Kenyon & Sessions, 2003). The public concern regarding the privacy and security of medical data can be significant barrier to the widespread use of telemedicine applications and the development of computer-based patient record systems. Transmission of medical information through the telecommunication network and the usage of computer-based patient record systems represent the basis of success in most telemedicine applications at present. Their integration in health information systems has become a necessity since it provides significant benefits in terms of health services and improving healthcare quality. For example, the telemedicine domain allows medical providers to have instantaneous access to a patient's medical record and offers the ability to exchange this information within the healthcare institution or over distance. These confidential medical record databases, which contain information about all patients, become jeopardized if left unprotected (Khan, Qurashi, & Hayee, 2007). The need for proper handling of medical records and guaranteed data protection during transmission has prompted governmental institutions and the private sector in many countries to create policies to address these issues. Confidentiality and security laws need to be enacted in

line with country privacy practices. At present, teleconsultation sessions cannot be held until permission has been received from the patient.

3.4.3 Financial barriers

Using limited financial and human resources to provide high-quality care efficiently for an increasing number of patients is a major challenge to many healthcare systems worldwide (Wartena, 2009). Even when financial issues are not the main objective of telemedicine programmes, they remain critical. Telemedicine programmes more easily capture future funding and support when they start with a solid financial justification and meet the measurements of the plan (Latifi, 2004). The implementation and sustainability of telemedicine systems depend mainly on the availability of financial resources. Different countries have different policies in this context. Telemedicine services will be a part of the overall healthcare system in countries with national health care system; in insurance-based countries, where services are reimbursed on a fee-for-services basis, new rules will have to be established; in countries with a market-driven healthcare system the prices need to be adapted to market prices driven by healthcare consumers (Latifi, 2008). Today, the most important barrier to telemedicine for many countries and especially developing countries is the cost of technology and communication. It is too high and unfeasible. The financial cost of installing network infrastructure, facilities and equipment in rural areas is significant, and continued availability of national support to initiate such systems is uncertain. Moreover, the ability to provide financial support to maintain such telemedicine systems once established is also uncertain (Khan, Qurashi, & Hayee, 2007). The telemedicine service also has other cost implications. A new telemedicine service needs to recruit more technical and medical staff as well as clerical staff and office managers to support the running and development of the service. Furthermore, there are financial requirements to train the doctors, specialists and nurses who are willing to work in this new system.

3.4.4 Cultural barriers

User acceptance. The teleconsltation model depends largely on acceptance by healthcare providers (physicians, nurse practitioners, and physician assistants) (McConnochie,et al., 2010). We should recognize that user acceptance is important, but physician acceptance

is critical (Latifi, 2008). Physicians are the most important users of telemedicine technology and their acceptance and satisfaction will play a crucial role in further acceptance of telemedicine (Frey & Bratton, 2002). Of the many obstructions facing telemedicine, proponents pick out "people issues" most often (OTA, 1995). Teleconsultation may be identified to physicians and other healthcare workers as a threat to their conventional role and status or as carrying with it the potential of increasing their current workload (Bellazzi, et al., 2001). Lack of physicians' technology acceptance has caused many telemedicine programs to fail. Physicians may vary noticeably from culture to culture in technology assessment and attitude formation (Hu, et al., 1999). Doctors are wary if they have to use new technology which interferes with the routines that to which they are accustomed (Buck, 2009). The reluctance of physicians to use teleconsultation services may be influenced by their attitudes to quality, convenience, control of patient care and referral relationships, skills that they need to interact with the application, and fear that urban medical centres will steal rural patients. For example, some uninterested physicians reported inability to actually examine patients, scheduling difficulties, and unfamiliarity with the technology as reasons that have prevented them from participating in telemedicine activities. Telemedicine technologies, however, may need to adapt to the needs of physicians and patients in order to succeed and gain user acceptance. The most significant factor affecting doctors' acceptance of telemedicine technology is "perceived usefulness". Perceived usefulness is even more important than ease of use. It is an incentive which makes users wants to work with the telemedicine application (Buck, 2009). The US Medical Association's policy recommends that designers of clinical information systems involve physicians in all stages of system design and select technologies that are easily mastered, flexible, and acceptable to physician users. Training was also cited as a crucial component of any successful telemedicine system to help doctors with limited experience and familiarize them with computers (OTA, 1995).

Patient satisfaction. 'Satisfaction is an accepted indicator of the performance of a health-care service. It reflects patients' values and expectations regarding various aspects of a health service' (Yip, et al., 2003, p.46). Patients are satisfied when there is a match between the care expected and that received. It is essential that consumer demand for

telemedicine services is increased and patients' acceptance and adoption promoted (Purdue University, 2006). Patient acceptance of teleconsultation services may be less of a barrier than physician acceptance. A patient satisfaction survey found that the convenience of not needing to drive hundreds of miles to an appointment with a specialist outweighs any disappointment at not seeing that specialist face to face especially when the appointment is just a follow-up visit (OTA, 1995). Literature on the topic supports the view that the general patient population readily accepts telemedicine services. In 2003, a study conducted in Oklahoma concluded that improvement in the quality of care, patient satisfaction, increased productivity, and healthcare delivery cost savings were facilitated by the application of health information technology and, in this particular case, telemedicine (Whitacre, Hartman, & Boggs, 2007). Other study concluded that 'telemedicine is an acceptable method to patients to improve access to specialty expertise, and compares favourably with face-to face care' (Brown-Connolly, 2002, p.7).

3.4.5 Operational barriers

Teleconsultation has a number of operational limitations, the most important are:

Poor relationships between patient and healthcare provider. The patient-healthcare provider relationship is considered vital in patient care. Traditional healthcare usually takes place in a closed-door examination room as a face-to-face encounter between provider and patient. Teleconsultation utilizes technology to bring people who are physically separated by distance together in real time. A most important issue focuses on how technology and distance affect the relationship of patient and healthcare provider during a telemedicine visit. Technology may impact adversely on the patient and healthcare provider interaction process. It can be a kind of parasitism as well as a source of contention, particularly if the electronic devices require constant adjustment or if they break down. On the other hand, the involvement of a second healthcare worker such as a physician's assistant or technical devices can also enhance the patient-healthcare provider relationship (Khan, Qurashi, & Hayee, 2007). Typically a patient will need to overcome their concerns regarding their ability to interact effectively and build a successful relationship with their physician, the confidentiality of the consultation and the suitability of the equipment (Khan, Qurashi, & Hayee, 2007). The key issue in developing

successful patient-provider relationship is improving communication between patient and physician. Bulik suggests the following prescriptive observations that could develop true patient-provider relationship, and overcome technological and environmental filters in a telemedicine encounter (Bulik, et al., 2005).

- Verbal categories: social small talk at the beginning of the teleconsultation encounter provides an opportunity to develop a conversation between patient and provider. Specific attention to verbal interaction such as tone of voice, style of question asked and "wait time" - a meaningful pause allowing the patient to respond - are approaches to enhancing patient-provider relations.
- Non-verbal categories: ensure camera placement allows for patient eye contact even if the provider looks at the monitor to see the patient rather than looking into the camera.
- Relational categories: providers should acknowledge to patients that "I am looking at…" when consulting an off-camera electronic medical record or other patient chart since all behaviour is amplified during a telemedicine encounter.
- Action/transactions categories: conscious attention to the basic characteristics associated with active listening provides a sense of purposeful "being with" essential behaviour for the development of transactional presence and the patient-provider relationship.

Poor relationships between healthcare professionals: in teleconsultation applications, the personal part of the equation is far more complex and difficult than the technology part of the equation. The nature of the relationship between healthcare providers may be a key factor in whether or not a telemedicine system will be fully utilized. Existing relationships between healthcares providers may need to be altered when telemedicine is introduced (OTA, 1995). Also, identifying the incentive necessary for establishing and maintaining these relationships is an important issue (Thompson, 2003). Potential breakdown of professional relationships is the main barrier to success of teleconsultation operations. Telemedicine can represent a threat to preferred practices (Norris, 2002). Most healthcare practitioners diagnose their patients in the privacy of their own office but

during some telemedicine applications such as teleconsultation the specialist may diagnose the patient in the presence of other healthcare staff such as a primary care physician or equipment technician. Sometimes, skilled staff at the remote site perceives that their autonomy is threatened by the use of teleconsultation and they will become no more than technicians acting solely at the command of the remote specialist (Wootton, Patil, Scott, & Ho, 2009). How well the system is organized, managed, and maintained will determine its success in avoiding this trap (OTA, 1995). Also, working on developing trust between healthcare professionals and trying to persuade unconvinced colleagues to use this new method of healthcare can empower relationships between healthcare providers and contribute significantly to establishing viable telemedicine systems.

Under-utilization: until now most installed telemedicine projects have seen disappointingly low utilization rates (Paul, 2006). In the last years the empirical research has concluded that the low utilization of telemedicine implementations is a serious problem and threatens the advantages to be obtained (Monrad, Aas, 2007). This low utilization applies to clinical and non-clinical areas of installed telemedicine projects, even there with abundant equipment and substantial financial commitment (Paul, Pearlson, & McDaniel, 1999). Better access to healthcare and access to better healthcare for rural and under-served populations enabled by use of teleconsultation must always be associated with better resources utilization (Khan, Qurashi, & Hayee, 2007). It is uneconomic to replicate resources and install telemedicine links in several centres which are then unused. Reasons for under-utilization of telemedicine facilities are the non-availability of qualified personnel, increased workload of physicians, system failures, no maintenance support after installation and insufficient training provided for physicians, physicians' assistants, and nurse practitioners (Srinivasan, 2008). Moreover, technological barriers are often cited as a significant cause of frustrating adoption and utilization rates. Technological barriers are perceived as those instances where the use of the technology is not sufficient to perform the tasks or accomplish the objectives for which the technology was initially adopted (Paul, Pearlson, & McDaniel, 1999). They include uncertainty about the capability of a system to support clinical activities, system reliability, ease of use, and

worries about patient confidentiality and privacy in the use of an electronic medium. Reducing technological barriers to telemedicine, however, is in itself unlikely to result in significant increase in telemedicine utilization rates because numerous other barriers such as professional, legal, and financial barriers would still exist (Paul, Pearlson, & McDaniel, 1999). Indeed, one objective of any telemedicine program implementation should be to maximize utilization. High utilization rates will be achieved only if telemedicine can be made part of the normal care process. When, however, telemedicine is presented as a "different way" to deliver medicine with its own workflow and different forms, the higher the likelihood of failure is (Vanderwerf, 2004).

Organizational matters: healthcare organizations are probably more complex than any other organization. The introduction of new technologies and methodologies leads to disruption in many organizations and becomes a source of employee conflict. The introduction of telemedicine often affects the structure of the individual organization, especially in the effect of the extended collaborations with other healthcare organizations (Broens, et al., 2007). For example, in telemedicine remote consultation cooperation often occurs between people from different healthcare organizations with scheduling difficulties. Also, employees from different healthcare organizations may have to work with each other for the first time. The lack of system management is a key reason for insufficient cooperation and consequent telemedicine failure. Telemedicine might require changes in collaboration and (team) roles and clarity about rights and responsibilities. Furthermore, the novel working practices introduced by telemedicine do not always fit with existing traditional working protocols in health care (Broens, et al., 2007). The US Western Governors' Association Telemedicine Action Report lists several reasons for resisting change (Khan, Qurashi, & Hayee, 2007):

• Fear that telemedicine will increase the workload.
• Fear that telemedicine is market- rather than user-driven.
• Fear of technological obsolescence.
• Lack of skills and the need to acquire them.
• Lack of agreed standards.

3.5 Patient care pathways (PCPs)

Teleconsultation needs to be integrated into care pathways, work flow and professional practice. This makes securing its adoption a significant change management challenge that must be considered within the overall strategy for a healthcare system (Rice, 2011). Patient care pathways can be utilized to predict and manage change and can address the concerns of telemedicine over the general lack of project management and the resulting poor integration of telemedicine into the healthcare system.

'Patient pathways are tools that assist in providing general guidelines of care for dealing with individuals and groups of patients suffering from a wide variety of diseases' (Coughlan, Eatock, & Eldabi, 2006, p.138). The clinical pathway concept appeared for the first time in 1985 at the New England Medical Centre Boston, USA and was originated by Karen Zander and Kathleen Bower. It evolved as a result of the adaptation of documents used in industrial quality management, standard operating procedures (SOPs), whose goals are to improve efficiency in the use of resources and finish work in a set time (Wiki, 2010). Later, the use of the patient care pathways expanded too many countries, including Australia, New Zealand, Japan and several European countries. There is a difference of emphasis on the use of patient pathways of care in different countries (Jones, 2009). In the USA, it has been utilized as a tool to control costs whilst maintaining the same level of quality and clinical outcomes (Currie, 2000). In the UK, however, the emphasis is on improving the quality of care, integrating services to make them reflect the patient's journey and acting as a model to ensure best practice and that guidelines are implemented. For example, in the UK, it is used to analyse remote patient monitoring projects to determine the impact of changing work practices. At present, patient care pathways are well recognized and understood by the majority of service providers within the USA and UK healthcare systems and the concept of patient care pathways is internationally understood and accepted (Jones, 2009). The introduction of telemedicine, however, offers a new pathway to care, although the impacts are even less well understood since the majority of studies have focused on traditional patient pathways. The positive reactions and experiences of the patients who received a telemedicine service suggest that telemedicine should be incorporated into a routine pathway of care that includes all the clinical routines or processes (Devine, 2009). The

successful mainstreaming of telemedicine into the standard care process requires delivering care with telemedicine in the same way as delivering care without telemedicine. 'The more different it is, even in minor issues, the more change that has to be accepted. A simple rule to keep in mind is that the more change that must be adopted the higher the likelihood of failure' (Vanderwerf, 2004).

3.5.1 Description and meaning of patient care pathways

PCPs are traditionally used to describe the journey that a patient takes in the course of resolving the presentation of a clinical problem, and would normally represent the clinical processes, decisions and treatment (Jones, 2009). Patient care pathways, which are also known in the literature as clinical pathways, care pathways; critical pathways or care maps generally refer to the route that a patient will take from their first contact with their GP, through referral, to the completion of treatment. It also covers the period from hospital admission to discharge. It may thus be illustrated on a timeline, on which every event relating to treatment can be entered (Rygh & Hjortdahl, 2007). Patient pathways of care have also been presented as a concept and described as an outline or plan of anticipated clinical practice for a group of patients with a particular diagnosis or set of symptoms. It provides a multidisciplinary template of the plan of care, leading each patient towards a desired objective (Middleton, 2000). Patient care pathways could be seen also as a tool to identify the interface between providers, communication paths and give insight into the optimal design for delivery of services. Patient pathways do not physically exist; therefore, they are commonly presented in a linear fashion, similarly to a flow chart, decision tree or process map (Jones, 2009).

3.5.2 Benefits of using patient care pathways approach for evaluating telemedicine

Patient care pathways were adopted in healthcare systems as offering a safe environment that gave an opportunity to increase the chance of successful introduction of projects that improve the processes and performance for delivery of the best quality of care (Jones, 2009). The care pathway is a valuable approach to depicting the existing traditional healthcare delivery system to gain better understanding of healthcare introduction and to develop service efficiency and patient outcome. Patient care pathways have been utilized

to analyse the effect of introducing technology within an existing healthcare system (Bratan, 2007). They allow us to determine how a system will respond to different changes in assumptions and identify the critical factors (Heathfield, 1997). Patient care pathways can be utilized to predict and manage change and can address the concerns of telemedicine over the general lack of project management and the resulting poor integration of telemedicine into the mainstream healthcare delivery system. One of the most important benefits of using patient care pathways is the ability to identify the risks associated with introducing telemedicine and to obtain a partial solution by allowing the telemedicine system to be modelled and used to predict the outcome from actions and developments before making changes to the existing healthcare system (Jones, 2009). This advantage is also emphasized by Ammenwerth in that 'It is clear that the use of patient care pathways can remove some of the fear associated with negative outcomes of a project by pre-empting the challenges before the study is implemented' (Ammenwerth, 2002). Indeed, in the presence of telemedicine, patient pathways of care can be recognized as an application of process management to improve patient healthcare. An additional proven benefit of the patient care pathway is that it allows the trialling of different configurations of service and provides a better understanding of the key issues involved in transfer from a traditional healthcare delivery system to a more sophisticated healthcare system such as telemedicine techniques. Patient care pathways can also be utilized to assess the changes when a telemedicine project is introduced and its alternative designs. Moreover, it forms the basis for modelling the application in order to determine key parameters such as patterns of care and resource usage for different care scenarios without actually modifying or disturbing the system itself. Therefore, patient care pathways allow evaluations to be undertaken of all the possible solutions prior to implementation of any changes in practice or policies. According to Eldabi, the patient care pathway can provide an understanding of the system and the alternative options before we commit to one solution and is essential when we are working with complex systems (Eldabi, 2002).

3.5.3 Patient care pathway model in the context of telemedicine

The protocols used in telemedicine should follow standard protocols as much as possible. It is very difficult to cut a program that is delivering a highly regarded volume of services. 'A consistent characteristic of unsuccessful telemedicine programs is that they saw themselves as somehow separate from the overall organization and had independent objectives. These programs lost support over time or were relegated to a minor and often experimental role in care delivery' (Vanderwerf, 2004). PCPs are used by a multidisciplinary team to provide agreed common protocols that characterize best practice and have a focus on coordination and quality of care (Jones, 2009). In the design of the patient care pathway, careful thought and consideration are needed. Many models have been developed on how clinical pathways could be implemented but there is no one corrects method or means of implementation. A healthcare organization must determine the most suitable approach (Cheah, 2000). Also, patient care pathways should be designed on the basis of real need and clearly illustrate both the patient's journey through the system and also the information flow. Finally, it is worth mentioning that, although the patient pathway of care represents well the technical design of the telemedicine system and identifies technical changes, that can give insight into optimum design of the system, it cannot solve organizational or human issues which are hard to overcome (Jones, 2009).

3.6 Saudi Arabian perspective on ICT

The Kingdom of Saudi Arabia realized years ago the importance of information and communication technology and shares the world orientation toward information and communication technology. Therefore, over the last few years, remarkable progress has been made in different ICT fields including connectivity and access, sector reforms, national IT initiatives and e-Services. The Kingdom has adopted a multi-phase plan to restructure the ICT sector in four phases and strengthened national plans and initiatives through close cooperation with agencies such as the United Nations Development Programme (UNDP, 2006), the Communications and Information Technology Commission (Commission, 2005), and the Economic and Social Commission for Western Asia (ESCWA, 2005) among others (Qurban & Austria, 2008). The national ICT plan includes a long-term vision and a first five-year plan for ICT in the Kingdom. The long-

term vision is to convert the country to an information society, so as to increase effectiveness and efficiency and provide services for all sectors of society. The five-year plan includes projects that cover the main aspects of ICT usage such as e- Government, e-Commerce, e-learning, telemedicine, telework, digital Arabic and Islamic/cultural content (Commission, 2005). The use of ICT in the healthcare sector, however, is still in its infancy, with limited implementation. The Saudi Arabian Ministry of Health, which serves almost 60% of the population, conducted a study to assess the benefits, especially the financial aspect, of using ICT in the health sector. They found that the government would save around 10 to15% of its annual health budget with the implementation of e-health. As a result, the Ministry of Health allocated 4 billion Saudi Riyals (approximately 1.1 billion USD) to the development of e-health programs within the next four consecutive years (2008-2012) in order to elevate the quality of healthcare and service delivery (Qurban & Austria, 2008). Today, the Kingdom of Saudi Arabia is increasingly interested in hosting global ICT conferences such as the Saudi E-Health 2010 Conference to bring together both healthcare providers and information technologists from all over the world to harness their expertise as well as to empower advancements in the delivery, quality, and continuity of health care in Saudi Arabia.

3.6.1 Saudi Arabian readiness for telemedicine

Readiness is an essential and preliminary step in the successful implementation of telemedicine services in existing health systems. It can be measured prior to the implementation of telemedicine. For an innovation in healthcare, the assessment of readiness can decrease the risk of its failure after introduction (Jennett, Gagnon, & Brandstadt, 2005). Organizational readiness is an important factor in ensuring the long-term success of telemedicine programmes and services. Readiness for telemedicine is a versatile concept related to planning and the workplace environment (Jennett, et al., 2003). It is reflected in an organization's beliefs, attitudes, and intentions about the extent to which changes are needed, as well as its capacity to successfully make a change (Susanto, 2008). It is worth mentioning that public perception plays a central role in readiness to shift to telematic health and in evaluating the barriers that could limit deployment of and access to telemedicine services. Public perception is fundamental in

assessing public requirements and acceptance of such services to ensure public accountability (UNPAN, 2007). Previous studies on public perception related to telemedicine and other e-health initiatives in Saudi Arabia are almost non-existent. In 2008, however, Qurban & Austria evaluated public perception of e-government projects such as e-health programs in military hospitals, which serve a limited segment of the population in Saudi Arabia. The findings of this research indicate that e-health acceptance among stakeholders in military hospitals is superficial owing to the lack of awareness of the true nature of e-government and e-health. Also, the apparent digital divide that persists adds to this reality. Hence, information literacy activities such as information dissemination, awareness campaigns, and training initiatives should be undertaken to resolve the lack of knowledge of e-health and other e-government issues, as well as to reduce the rate of digital divide among Saudi nationals (Qurban & Austria, 2008).

3.6.2 Telemedicine initiatives in Saudi Arabia

In 1993, by a royal decree, the e-Health Centre project was established and was named "KFSH&RC". The centre utilizes fibre optics and international video-conferencing via the Saudi Telecom Company, with a view to facilitating access to medical consultations and to disseminating healthcare educational activities (ESCWA, 2005). Health telematics have been used with remarkable success in King Faisal Specialized Hospital as well as a cluster of military hospitals and some private sector hospitals. 'One of the most active parties in telemedicine in Saudi Arabia is the Sultan Bin Abdulaziz Al-Saud Foundation, which has established the Sultan Bin Abdulaziz Medical & Educational Telecommunications Program and the MeduNet Program to promote and support telemedicine in the Kingdom and telemedicine cooperation with top medical centres around the world' (ESCWA, 2005). The Ministry of Defence and Aviation has created development goals to provide comprehensive health services which are free of charge to cover the healthcare needs of military personnel as well as their immediate family members by unifying all of its military hospitals and affiliated clinics through WAN (Qurban & Austria, 2008). Meanwhile, the National Guard Health Affairs has recently installed a clinical informatics system with the aim of streamlining and standardizing all its medical records and documentation, and expediting the system to optimize its

resources and provide modern health care to National Guard employees and their dependents. Most private sector hospitals also have hospital information systems in place. The Ministry of Health has recently launched a project with the intention of building a centralized national electronic health record (EHR) database that connects all hospital information system in the Kingdom to allow the transfer of data and records electronically and create a national electronic healthcare system. The project is being initiated in a major hospital in each of five main regions, with a regional server connected to the Ministry's server, and a smart ID card for access is currently being designed (ESCWA, 2005). The Ministry of Health has also focused on a program to link 25 additional hospitals in major cities and important rural areas in its efforts to further telemedicine services and infrastructure as well as provide international connectivity to these sites (Commission, 2005). Moreover, the Ministry has begun to connect all of its hospitals through a wide area network (WAN) and to utilize health information systems in its hospitals (Qurban & Austria, 2008). The National Telemedicine Network connected sites have increased from five to 20 for remote diagnostics and live casting of operations as well as voice and video-conferencing services. On the other hand, government healthcare providers in Saudi Arabia have been increasing their adoption of advanced ICT systems, but without coordinating efforts to build up to one national network and repository of health records. There are 20 different Health Information Systems deployed separately, especially in the large regional hospitals in Saudi Arabia, without being connected with each other' (ESCWA, 2005, p.13).

4 Research Method

4.1 Introduction

This research has designed and developed a new care pathway model for cardiovascular disease patients by utilizing telemedicine technology. It investigates factors and issues that might act as barriers to its adoption. In addition, it explores the impact of this model on stakeholders. A case-study and small scale pilot approach was used to enrich the study and to present the main work of this project, in order to test the proposed framework of the new cardiovascular disease patient care pathway. Patient care pathways and modification were employed to undertake the analysis. The analyses were carried out based on the empirical material which was collected during all stages of the research. In this research, data was generated as a result of observations and interviews with key stakeholders (physicians, patients, nurses, technicians, and decision-makers), along with some methods of quantitative data gathering. The responses and opinions of stakeholders were the main criteria in the evaluation of this work. As the major objective of this research is to investigate the factors that act as barriers during the implementation process of teleconsultation, a qualitative research methodology approach has been applied. This explores and understands the consequences of information and communication technology on people's health and staff behaviour, by looking carefully at their encounters with each other, as well as their interaction with technology. This research bases its results on numerical data as well as verbal data. Therefore, quantitative research methods were also employed.

In the next section, a brief introduction about the patient care pathway principle is given. Also, quantitative and qualitative research methodologies will be summarized briefly.

4.2 Patient care pathways (PCPs)

PCPs, which are described in detail in section (2.4), have been used to describe the journey that a patient takes in the course of resolving the presentation of a clinical problem and, normally, would represent clinical processes, decisions and treatment (Jones, 2009). Patient Care Pathway has been utilised as a method to design and implement e-health project. Thus, it is adopted in this pilot project to offer a safe

environment that gave the opportunity to increase the successful introduction of projects that improve the processes and performance for delivering the best quality of care (Jones, 2009). The introduction of teleconsultation offers a new pathway for care. Patient care pathways, in the context of telemedicine, can be utilized to predict and manage change, and can address the concerns of telemedicine over the general lack of project management, and the resultant poor integration of telemedicine into the mainstream health-care delivery system. Also, the pathways can be used to identify the risks associated with introducing telemedicine, as well as predict the outcome of actions and developments before making changes to the existing health-care system (Jones, 2009). It is worth mentioning that the new protocols that will be used in the modified patient care pathways in context with teleconsultation applications should follow the standard protocols of traditional patient care pathways as far as possible. It is very difficult to cut a programme that is delivering highly regarded services.

4.3 Research approach

There are different types of research methodologies for researching information systems. Most of these methods fall under the two most commonly used approaches, which are the qualitative (inductive) and quantitative (deductive) paradigms. In addition, there is another research methodology called mixed approach (triangulation). The mixed method is a research method that utilizes both quantitative and qualitative research methods, where both methods complement each other. It also called consequence-oriented, problem-centred, and pluralistic design (Creswell, 2003). This exploratory study requires both qualitative and quantitative research methodologies because our interest is in process stage and outcome. Quantitative research methods just deal with numerical data. So, when used along with qualitative methods, they can help interpret and better understand the complex reality of a given situation, as well as the implications of quantitative data. Kaplan and Maxwell (1994) argue that the goal of understanding a phenomenon, from the point of view of the participants and its particular social and institutional context, is largely lost when textual data is quantified. A multi-method approach delivers a multitude of results and improves the robustness and validity of its results (Kaplan, 1995). Any realistic appraisal of a telemedicine application will need to take into account a range of

both quantitative and qualitative aspects (Ohinmaa, Hailey, & Roine, 1999). An interpretive research method, which is one kind of qualitative research approach, was also adopted to understand how the telemedicine will impact on patients and the health-care system.

4.3.1 Quantitative research methodology

Quantitative research generates numerical data, or data that can be converted into numbers (Deeptee & Roshan, 2008). Quantitative research is about asking people for their opinions in a structured way, in order to produce hard facts and reliable statistical results. It includes methods such as surveys or questionnaires which can be used to measure how many people think, act or feel in a particular way (Rodgers, 2010). In this study, a quantitative research method can be a valuable tool in summarizing data and delivering conclusions in the form of figures and trends. It can assist to evaluating the new patient care pathways, based on quality of service, time efficiency and patient satisfaction.

4.3.2 Qualitative research methodology

The qualitative research type was developed in the field of social sciences to enable researchers to study social and cultural phenomena (Avison & Pries-Heje, 2005). It involves the use of qualitative data, such as documents, interviews and participant observation data, to explain and understand phenomena. It is a common methodology and is used by many researchers in different academic disciplines. Recently, it has been employed widely by researchers in the information system field (Costa, 2008). Qualitative research methods can assist researchers to explore how people experience something which is new to them, and explain a new area where issues are not yet understood (Hancock, Ockleford, & Windridge, 2007). Qualitative research attempts to deepen our understanding of people, situations and organizations in the social and cultural context in which they exist (Myers, 1997). In the health-care domain, Farzanfar's evaluation study concluded that qualitative research methods are valuable tools in determining the usability, effectiveness and user satisfaction in interactive patient-management systems (Farzanfar, Finkelstein, & Friedman, 2003). Thus, a qualitative research methodology is adopted in this thesis to acquire in-depth knowledge about how

new information and communication technology will work in Saudi Arabia. In this study, qualitative data was gathered through observations and interviews with the local population and stakeholders.

4.3.3 Interpretive research paradigm

Interpretive research is one type of qualitative research methodology, and is based on the assumption that access to reality (given or socially constructed) is only obtained through social constructions such as language, consciousness, shared meaning, documents, tools and other artefacts (Klein & Myers, 1999). Interpretive methods of research in information systems are aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context (Walsham, 1995). One common use of interpretive research is to understand phenomena through the meanings that participants assign to them (Klein & Myers, 1999). It attempts to understand issues or particular situations by investigating the viewpoint and behaviour of the people in the circumstances and the perspective within which they act and hence presents the reality as a social phenomenon of multiple facets (Stoop & Berg, 2003). Interpretive methods can aid this study to determine how stakeholders perceive the new patient care pathway, and how likely they are to accept or support the system. Furthermore, it is a valuable tool in revealing the challenges and possibilities of teleconsultation in Saudi Arabia.

4.3.4 Case study research approach

Robson (2002) describes three main approaches or research traditions in qualitative research, that is: case studies, ethnography and grounded theory. Since a case-study approach has been used to evaluate the main work presented in this proposal, the key aspects of it are illustrated here. Yin (2003) defined the case study as ‘an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used’. Case studies are one of the most widely used qualitative research methods in information systems research, and are used extensively in social science research (Orlikowski & Baroudi, 1999). This method has been considered to be a well-established research method which provides deep

understanding of the phenomenon in its natural setting, and employs multiple methods of data collection to gather information from one or more entities, such as people, groups, or organizations (Benbesat, Goldstein, & Mead, 1987). In 1987, Benbesat introduced 11 characteristics that define key aspects of case studies, as shown below:

1. Phenomenon is examined in a natural setting.
2. Data is collected by multiple means.
3. One or few entities are examined.
4. The complexity of the unit is studied intensively.
5. Case studies are most suitable for the exploration, classification and hypothesis development stages of the knowledge building process.
6. No experimental controls or manipulation are involved.
7. The investigator may not specify the set of independent and dependent variables in advance.
8. The results derived depend heavily on the integrative powers of the researcher.
9. Changes in site selection and data collection methods could take place as the researcher develops new hypotheses.
10. Case research is useful in the study of 'why' and 'how' questions.
11. The focus is on contemporary events.

This study employed case-study methodology to investigate factors and issues that might act as barriers to establishing a teleconsultation system, and explored its impact on stakeholders. It is a pilot project with interest for the Saudi Arabian Ministry of Health's health-care services, to develop and manage services for cardiovascular disease patients.

4.3.5 Pilot study

Pilot studies are defined as "small-scale versions of the planned study, trial runs of planned methods/measures, or a miniature version of the anticipated research" (Prescott and Soeken 1989). The use of pilot study to evaluate new technology projects is common in practice. It has been used extensively to understand, investigate and assess the adoption of new technology. It can also be very useful during the gradual roll-out of new technology (Pal, Sengupta and Bose, 2008). A pilot study is important in projects

affecting customers' interactions with the product/service offerings as the perception and/or reaction of customers can be captured and analysed through such studies. For a comprehensive evaluation of such a project, it is critical to analyse the experience gathered in the pilot study and users' feedback on the functionalities offered by the technology. A well-defined structured methodology for using a pilot study to justify new technology is necessary. Hence, skillful design, rigorous evaluation, and careful interpretation of the results are absolutely critical for an effective pilot study (Pal, Sengupta and Bose, 2008).

The main objective of our research is to propose a set of well-structured pilot studies in a systematic fashion and subsequently to analyse the findings from the pilot to assess the viability of teleconsultation in Saudi Arabia. The pilot project is used to gather information about the use of teleconsultation and to help determine how this technology can be implemented and integrated into the healthcare system.

4.4 Data collection methods

In the research study, the 'data generation method is the means by which you produce empirical (field) data or evidence' (Oates, 2006). Various techniques can be used to generate data. Each method has its own strengths and weaknesses, as well as purpose and data form. Collecting research material can be achieved by methods such as questionnaires, interviews, observation, documents and literature analysis. High-quality data collection is essential in research studies to produce strong evidence. The strategy in this study is to employ mixed method data collection techniques. According to (Axinn & Pearce, 2006, p.2):

> 'A systematic consideration of mixed method data collection strategies reveals two key themes. The first is that mixing multiple methods affords opportunities to use the strengths of some methods to counterbalance the weaknesses of other methods. The second theme is that mixing multiple methods is a valuable strategy for producing a comprehensive empirical record about a topic'.

4.4.1 Interview

An interview is a conversation that has a purpose and structure. Usually, it is carried out between two people, where one person (the interviewer) seeks responses for a particular purpose from the other person (the interviewee). The style and form of an interview is determined by its purpose. Research interviews aim to gain information and understanding of issues related to the main objectives and specific questions of a research project (Gillham, 2000). An interview is certainly the most suitable method when the researcher needs to gain insights into things such as people's feelings, opinions, emotions and experiences (Denscombe, 2007). Unlike normal conversation, the interview should be well-designed and scheduled in advance to benefit the study. There are three types of interview: structured interview; semi-structured interview; and unstructured interview (Oates, 2006).

In this study, face-to-face semi-structured interviews were conducted as the data collection method. A semi-structured interview is a flexible method and allows for focused, conversational, two-way communication (Mukherjee, 2004). Unlike a structured interview, it can be used to give and receive information. The semi-structured interview method can be valuable tool to:

- Obtain specific qualitative and quantitative information from a sample of the population.
- Obtain general information relevant to specific issues.
- Gain a range of insights on specific issues (Mukherjee, 2004).

Semi-structured interviews are based mainly on open-ended questions. However, they may also contain some closed questions. This technique provides opportunities for both the researcher and participant to discuss some topics in more detail. Furthermore, it offers the interviewer the freedom to probe the interviewee, to elaborate on their original response or follow a line of inquiry introduced by the interviewee (Mathers, Vox, & Hunn, 1998). The interviewer can ask additional questions if the interviewee raises some interesting points and the interviewer would like to gain more detail about these points.

For this research, a set of questions was prepared in advance to evaluate the modified care pathway for cardiovascular disease patients, utilizing telemedicine technology. It also investigated factors and issues that might act as barriers. Moreover, it intends to explore where appropriate changes should be made.

4.4.2 Stakeholder interviewees

Stakeholders are people or organizations that are invested in the programme, are interested in the results of the evaluation, and have a stake in what will be done with the results of the evaluation (MacDonald, et al., 2001). A health system transformation requires the involvement and alliance of all stakeholders. Evaluation is a necessary and important component of any telemedicine project design, and the evaluation framework should be meaningful to all telemedicine stakeholders (WHO, 2009).

Key stakeholders interviewees for this study fall into the following groups:

- Administration staff and decision-makers;
- Doctors (general physicians, specialists and consultants);
- Assistant medical staff (nurses, technicians);
- Information technology (IT) specialists.

4.4.3 Questionnaires

Questionnaires are one of the most widespread data gathering techniques and are used as part of many of the research methodologies. They are valuable research tools through which people are asked to respond to the same set of questions in a predetermined order (Gray, 2009). ‘A well-designed questionnaire that is used effectively can gather information on both the overall performance of the test system as well as information on specific components of the system’ (Miesenberger, 2002, p.36). Questionnaires have advantages over some other types of surveys in that they often have standardized answers that make it simple to compile and analyse data. Questionnaires can also be carried out with or without the presence of the researcher (Powers, 2007). There are two basic formats for a questionnaire: open-ended and closed-ended. For the purpose of this research, closed-ended questions were prepared to give the respondent a previously chosen set of answers for their consideration. On a closed-ended questionnaire, the questions are usually multiple choices, or some other form of rating scale. The

participants are not able to provide or modify the choices on their own (Powers, 2007). A questionnaire was prepared to assess the impact of a modified model of patient care pathway on patients, and to determine their opinion and attitude towards telemedicine technology. This questionnaire is interesting with regard to answers which related to patients, such as satisfaction, acceptant and concerns as well as work patterns and outcomes of some clinical aspects.

It is important to mention that, in this questionnaire, many guidelines for questionnaires have been reviewed in order to avoid major mistakes such as vague questions and to make the questionnaire free of bias.

4.4.4 Observations

Observations were also a key part of the study as they are a valuable tool in describing and evaluating a person(s), project, or process. The observational research approach has many positive aspects. It is usually a flexible research methodology. Also, observational data gathering is considered to be valid because the researcher is able to collect a wealth of information about a particular behaviour (Powers, 2007). There are two basic types of observation: participant observation, also known as reactive observation, and non-participant, or unobtrusive, observation. Participant observation is one of the most demanding methods; it is also the most common in qualitative data collection. It requires the researcher to become a participant in the culture or context being observed (Powers, 2007). Non-participant observation is differentiated from participant observation in several ways. The non-participant observer does not normally try to become a participant in the context, and attempts to be as unobtrusive as possible. Moreover, the non-participant observer strives to be more detached so as not to bias the observations. Hence, overall, the non-participant researcher watches and observes certain sampled situations or people, rather than taking part or trying to become immersed in the entire context (Powers, 2007). In this study, the researcher was a non-participant observer. Observations yield the best results when conducted by an outsider with considerable inside experience (Forsythe, 1999). During observations, different considerations were taken into account to enrich the study. The researcher made the effort to use all of their senses, not only their

sight. Also, recording was an important issue, so he tried to note and record everything sensory such as sounds, time, and number of participants, as well as non-sensory elements, such as feelings, thinking and impressions. Furthermore, photos of important events and places were also taken. The observation process for this thesis consists of two main parts: the workflow of patients through the traditional patient care pathway, to become better acquainted with the actual process and collect data. After that, observing the process of the modified patient care pathway in the presence of telemedicine technology. This made the study and comparisons more precise, and provided more valuable data for analysis.

4.5 Data analysis

> Analysis of data is a process of inspecting, cleaning, transforming, and modelling data with the goal of highlighting useful information, suggesting conclusions, and supporting decision making. Data analysis has multiple facets and approaches, encompassing diverse techniques under a variety of names, in different business, science, and social science domains (Wikipedia, 2011).

Since this study collects both numerical and textual data, both qualitative and quantitative data analysis tools will be employed.

4.5.1 Qualitative data analysis

'Qualitative modes of data analysis provide ways of discerning, examining, comparing and contrasting, and interpreting meaningful patterns or themes' (Reviere, 1996, p.53). Qualitative results are richly detailed data and mostly originate in this study from interviews and observation methods. Data reduction facilitates the ability to communicate findings simply and efficiently. This filtering process of data is often termed thematic analysis (Bryne, 2001). The use of thematic analysis has become popular among researchers. It is a valuable tool to deal with qualitative data since it aids the researcher to sense themes from raw information (Boyatzis, 1998). This study utilized thematic analysis techniques to process, analyse and interpret the collected raw information. Practically, thematic analysis is the process of coding qualitative information. This process is based on two distinct stages:

- Stage 1. Developing themes and a coding.
- Stage 2. Validating and using the coding (Boyatzis, 1998).

Within the first stage, there are three different approaches to develop themes:

a) Theory-driven.
b) Prior data, or prior research-driven.
c) Inductive, or data-driven.

For the purpose of this study, prior research-driven and data-driven methods have been employed. The prior research-driven approach is a review of the literature and past research findings in order to provide insight into the possible development of a thematic coding (Boyatzis, 1998). This approach helps the researcher to create an initial list of codes to drive themes prior to even reading the data (Ruona, 2009). Also, engagement with the literature can enhance the analysis by sensitizing the researcher to more subtle features of the data (Tuckett, 2005). Building on prior research can be an effective technique and provide elements that help construct the code of themes (Boyatzis, 1998). So, during the prior research driven stage, the researcher will read prior data and research to gain knowledge about telemedicine technology and its constraining factors, as well as its applications, especially the teleconsultation method, which serves our modified patient care pathway. Then the data-driven approach is employed. As mentioned earlier, the coding process using the thematic analysis approach has two main stages: developing themes and a coding, as well as validating and using the coding. Every stage in developing the coding (data-driven approach) has different steps.

The following steps**,** as outlined by Boyatzis **(**1998**),** were followed;

- Stage 1: Developing themes and a coding;
    - Step1: Reducing the raw information. The researcher carefully read and reread the collected raw material looking for ideas, themes, trends and keywords. Also, an outline of paraphrased items and summaries was created. This in-depth review made the researcher more familiar with the data and provided a full picture of the constraint factors of the telemedicine application and its impact on stakeholders.

- Step 2: Identify themes. In this phase, the researcher focused on potential themes that met the research inquiries. This process was carried out by comparing the similarities within each raw information transcript, in order to collect relevant themes.
- Step 3: Comparing themes across subsamples. At this stage of the process, all the themes or items within data transcripts were compared to find similarities. This process aimed to reduce the raw information to make it more manageable, as well as enhancing the ability to interpret it.
- Step 4: Creating a coding. The researcher began a coding process to refine themes. This process was achieved by constructing a set of statements for every theme. It was followed by reviewing all the collated extracts for each theme, and considering whether they appear to form a coherent pattern.
- Step 5: Determining the consistency of judgment of the coders. Candidate themes that might meet the research objectives were discussed with the stakeholders to determine their views.

- Stage 2: Validating and using the coding. At this point, all independent themes produced from Stage 1 were reviewed in relation to the entire data set, to examine their validity. At the end of this stage, the different themes that characterize the research phenomenon are identified and fit together to tell the whole story about the data.

4.5.2 Quantitative data analysis

This empirical research is also designed to generate quantitative date. The statistical package for social science software (SPSS) was used for statistical data analysis and data management. It is one of the most widely used statistical analysis packages for social sciences, health and medicine, academic and industrial fields, globally. The advantage of using the SPSS program is that it enables quantitative data to be analysed easily and quickly, and in many different ways. Also, it provides the opportunity for using complicated statistical techniques without making mistakes (Bryman & Cramer, 2002).

5 Research setting and background

5.1 Introduction

The project was initiated with the aim of developing health services for cardiovascular disease patients within healthcare institutions of the Saudi Arabian Ministry of Health, by using information and communication technology. The following section describes how this idea was initiated and the design and development of the case study. It considers the type of teleconsultation used and outlines the process. Furthermore, information is presented on the location of the case study and the selection criteria for hospitals and primary healthcare centres, as well as patients and medical staff involved in the project.

5.2 Healthcare system in Saudi Arabia: An overview

The Ministry of Health (MOH) is the major government agency entrusted with the provision of health care services including preventive, curative and rehabilitative for the Kingdom's population. It is considered the leading Government agency responsible for the management, planning, financing and regulating of the health care sector. Therefore, the MOH can be viewed as a national health service (NHS) for the entire population (KACST, 2008). With the intention of decentralisation, there are 20 Health Directorates covering all Saudi Arabia regions and provinces. They fully cooperate with the central MOH to provide and supervise health services.

The health system in Saudi Arabia consists of primary, secondary and tertiary care. Primary health care (PHC) is the patient's first point of contact with the national health system. PHC services are provided through a network of health care centres (2,073 in total) throughout the Kingdom (MOH M. o., 2010). Its services are delivered by general practitioners, dentists and other medical staff to local patients. Primary healthcare centres provide services to family members of all age groups within their catchment areas, and they are linked to general and specialist hospitals through a referral and feedback system. The centres provide comprehensive prenatal and postnatal care for mother and child, and they are responsible for child immunisation against infectious diseases. In addition, they pursue prevention of communicable and endemic diseases, and management of chronic

diseases, such as hypertension and diabetes (WHO, 2006). However, the availability of selected services such as dental clinics, laboratories and X-ray equipment varies amongst centres. According to the latest statistics, only 31% of health care centres have X-ray equipment, and 73% of them have laboratory equipment (MOH M. o., 2010).

Secondary health-care services are provided by district general hospitals (medical, surgical, paediatric, obstetric and gynaecological, dental and emergency), following referral from a primary health-care centre (Al-Yousuf, Akerele, & Al-Mazrou, 2002). Today, there are 244 hospitals located in various parts of the country. Tertiary health care delivers sophisticated forms of diagnosis and treatment. Often, the specialist tertiary hospitals are to be found in the major cities. Their patients, who need more advanced facilities for diagnosis and treatment of, for example, cancer, are usually transferred from regional secondary hospitals. Typically, both secondary and tertiary hospitals are the only health-care institutions that have cardiovascular specialists/consultants.

It has been nearly two decades since the referral system was introduced in Saudi Arabia. However, it is still not utilised effectively. Inappropriate referral forms and poor quality hospital discharge reports are still evident. In addition, patient medical records in many primary healthcare centres and hospitals are poorly kept and incomplete. It is also worth mentioning that medical records and referral letters are transferred between the three health-care tiers in paper form, and are usually delivered by patients.

5.3 Cardiovascular diseases in Saudi Arabia: An overview

The prevalence of cardiovascular diseases has risen in the last five years and continues to do so in Saudi Arabia. CVD is now the main cause of death and disability amongst Saudi citizens. According to statistics from the Ministry of Health, in 2009, 4896 cases of morbidity in the country (18%) were caused by CVD (MOH, 2009). It has become a major killer. Chronic diseases were responsible for 413 deaths per 100,000 in 2002; 144 (35%) were due to cardiovascular disease (WHO, 2006). Indeed, coronary heart disease constitutes one of the main health problems in Saudi Arabia with an estimated 4.8% of cases (1,200,000 patients). Moreover, there are inadequate cardiovascular specialists to

care for this increasing number of patients. Approximately, 307 cardiologists work in the Ministry of Health hospitals, which are equivalent to 19 specialists per million citizens (MOH, 2009). Besides, in some regions, only one or two cardiologists serve a large community. More seriously, in some parts, there are no available CV specialists. In all cases, this is below international standards, as the national average of CV specialists should be 55.7 per million. The National Medical and Health Research Strategy planning team (NMHRS) estimates that by 2032, the economic burden arising from Cardiovascular Diseases will be close to $ 21 billion (KACST, 2008).

5.4 Project stages

The project has two main phases: health service delivery pre-teleconsultation and health service delivery in the presence of teleconsultation. The traditional routes of care were observed first in order to see how cardiovascular disease patients moved through all the stages of treatment. Besides measuring the length of time taken by CVD patients to access specialists, several other clinical aspects were evaluated and will be discussed in a separate section. In the second phase, teleconsultation technology is used to improve the delivery of services and to enhance the management of treatment. As in the first phase, all the clinical aspects were observed and their quality of services compared. Moreover, after applying teleconsultation, patients' satisfaction and stakeholders' opinions were measured by conducting interviews and questionnaires.

5.5 Study area

This pilot study was carried out in the healthcare establishments of the Ministry of Health in the Kingdom of Saudi Arabia. Since the country is vast, two different regions were covered, and from these more generalised findings extrapolated. Therefore, regions in the north and centre of the country were chosen. This included:

- Four primary health care centres.
- Two hospitals.

5.6 Study criteria

5.6.1 Selection criteria for primary healthcare centres

Two primary health care centres were chosen in each of the two northern and central regions. They were selected to be as distant from each other as possible within the same region in order to have wide geographical coverage and include different social classes. In the selection of primary healthcare centres, the following criteria were taken into account:

1. Located in an area of high population.
2. Distance from the regional hospital is not less than 100 kilometres.
3. Communication link (internet) available.
4. Laboratory available.
5. Necessary medical equipment (such as X ray, Echo and ECG) available.
6. Medical staff enthusiastic about the application of teleconsultation.

5.6.2 Selection criteria for hospitals

One secondary hospital was chosen in each region. The following criteria were applied by the researcher in the selection of hospitals:

1. Communication link (internet) available.
2. Medical equipment available.
3. Cardiologists available.
4. IT staff.

5.6.3 Selection criteria for patients

This study was designed to determine ways in which cardiovascular patients could have faster and more convenient access to hospital specialists, and quicker treatment with more efficient follow-up (condition management). Therefore, research was restricted to cardiovascular disease patients. Those attending primary healthcare centres exhibiting cardiovascular symptoms or having a history of disease were the subjects of this pilot project. The following criteria were also considered in the choice of patients for the study:

1. Patients able to fulfil all teleconsultation stages.

2. Patient gave consent to participate.
3. Having a history of cardiovascular problems or presenting with one or more cardiovascular disease symptoms.

5.6.4 Traditional versus modified patient care pathway (comparison criteria)

One of the main objectives of this study is to observe and evaluate patient care and teleconsultation versus traditional treatment. The framework for assessing telemedicine by the Institute of Medicine (IOM) has been chosen as evaluation tool. This identifies five dimensions that are important for evaluating telemedicine: quality, access, cost, patient perceptions, and clinician perceptions. These five dimensions may be expandable to define the specific aspects that are addressed in this work.

- Access to specialists.
- Time for diagnosis.
- Access to treatment.
- Waiting list and burden on hospital's outpatients.
- Patient management (follow-up and discharge letter).
- Relationship between primary healthcare centre and hospital relationship.
- Quality of service

Interviews and questionnaires are used to determine patient satisfaction and stakeholder attitudes and opinions.

5.7 CVD patient care pathways

5.7.1 Existing patient care pathway

Patient care pathways reveal the existing health delivery practices. The initial step within the methodology of this research is to design, schematically, the current care pathways of cardiovascular patients and to understand how health care is delivered to that category of patient.

CHAPTER FIVE– RESEARCH SETTING

In addition to researcher's personal experience as an employee in the Saudi Arabia Ministry of Health, the following methods were used to define the existing care pathways of cardiovascular patients:

- Documents and relevant information regarding health-care delivery protocols were reviewed.
- Meetings with health-care employees were undertaken to clarify procedures.
- Patients were interviewed – forming an important source of information on how care was perceived.

Figure 2 shows the existing cardiovascular disease care pathways and how patients move through all areas of health in order to receive treatment.

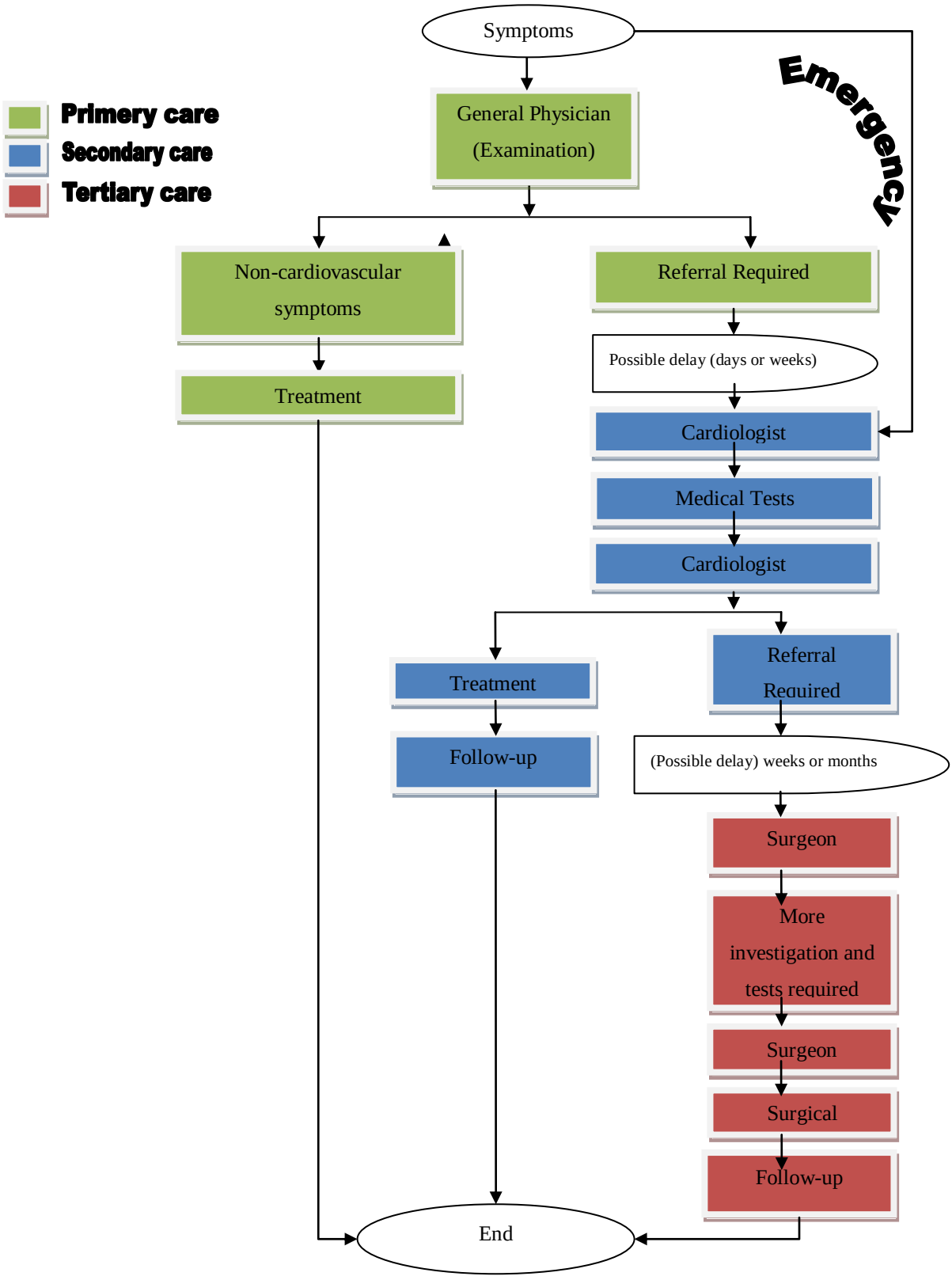

Figure 2: Existing patient care pathway: cardiovascular disease

5.7.2 Modified patient care pathway

The re-modelled patient care pathway has been created based on following premises:

1. The role of primary care should be strengthening.
2. Referral should become evidence based.
3. Greater interaction between all sectors of healthcare to be developed and encouraged.
4. Improved continuity of care between sectors of healthcare.
5. Discharge letter to be routine.
6. ICT to be used to mediate interactions between healthcare sectors wherever possible.
7. Shared role in management of care.
8. Diagnosis and treatment expedited where appropriate.

The modified patient care pathway (see Figure 3) has been redesigned to address the serves and is based on recommendations from cardiologists and general physicians, taking into account facilities and medical equipment that exist in primary healthcare centers. The design of the proposed PCP is based on:

1. Where possible tests are conducted in primary care, including blood tests and resting 12 lead ECG (ideally also exercise test), at earliest opportunity.
2. History, patient information and results of all tests sent to the cardiologist (ideally using pro-forma templates) for initial review and in advance of teleconsultation.
3. Teleconsultation to include consultant, local physician and patient.
4. Teleconsultation to be used primarily for management.
5. If the patient needs surgical intervention, patient information and results of all tests are sent to the surgeon electronically (ideally using pro-forma templates) with priority of referral.

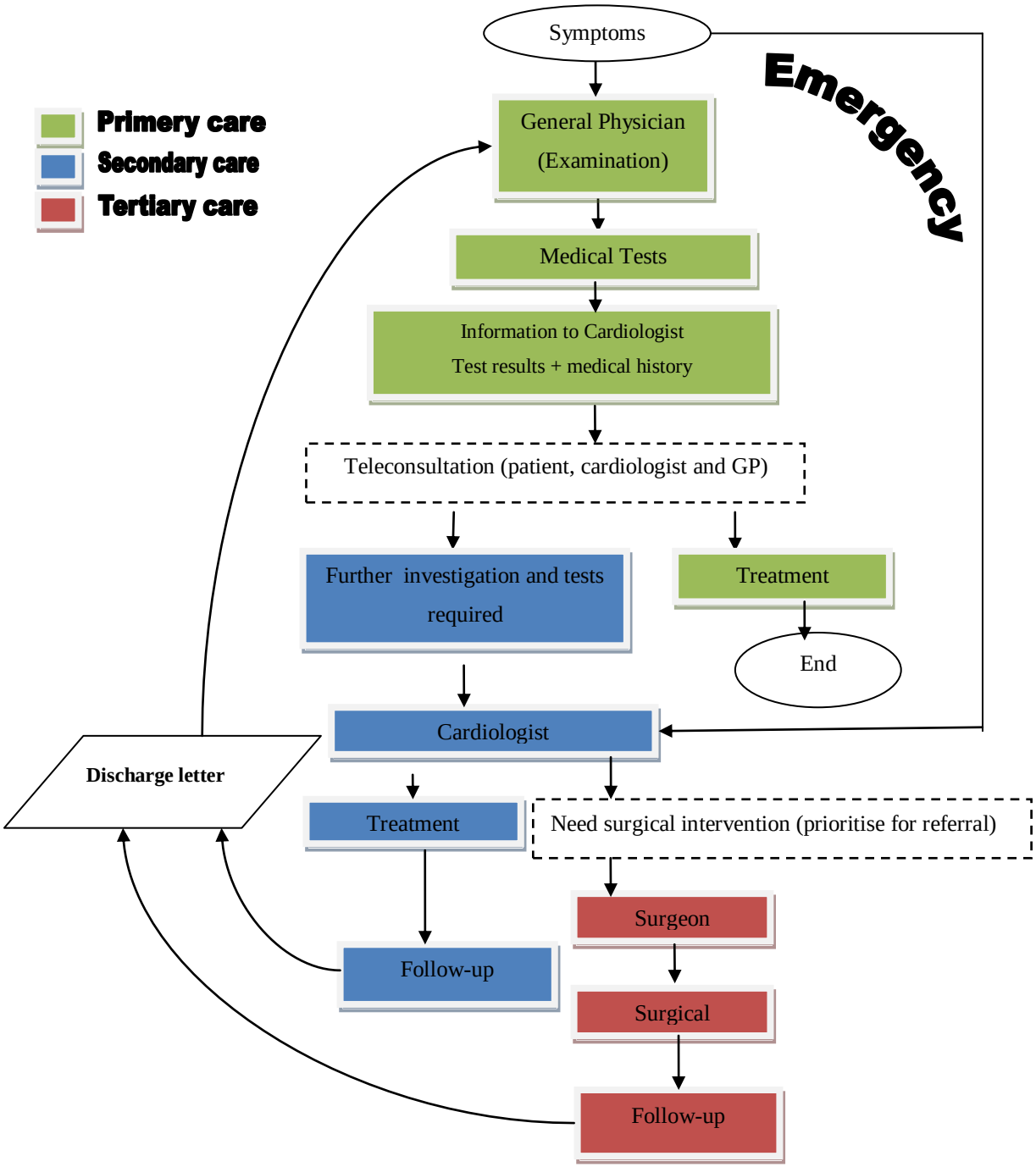

Figure 3: Modified patient care pathway: cardiovascular disease

5.8 Developing the model

5.8.1 Proposed teleconsultation architecture

The purpose of the proposed teleconsultation architecture was to support the patients in the remote primary healthcare centres. For this a hybrid mode of teleconsultation, combining two modalities, is adopted (see Figure 4):

1. Store and forward approach – all clinical information of patients (medical records and medical images) are captured, processed and analysed and then sent to the consultant(s) in other locations.
2. Real-time interactive approach – face-to-face contact (image and voice), via video-conferencing equipment, between patient, local physician and specialist, who are geographically distant.

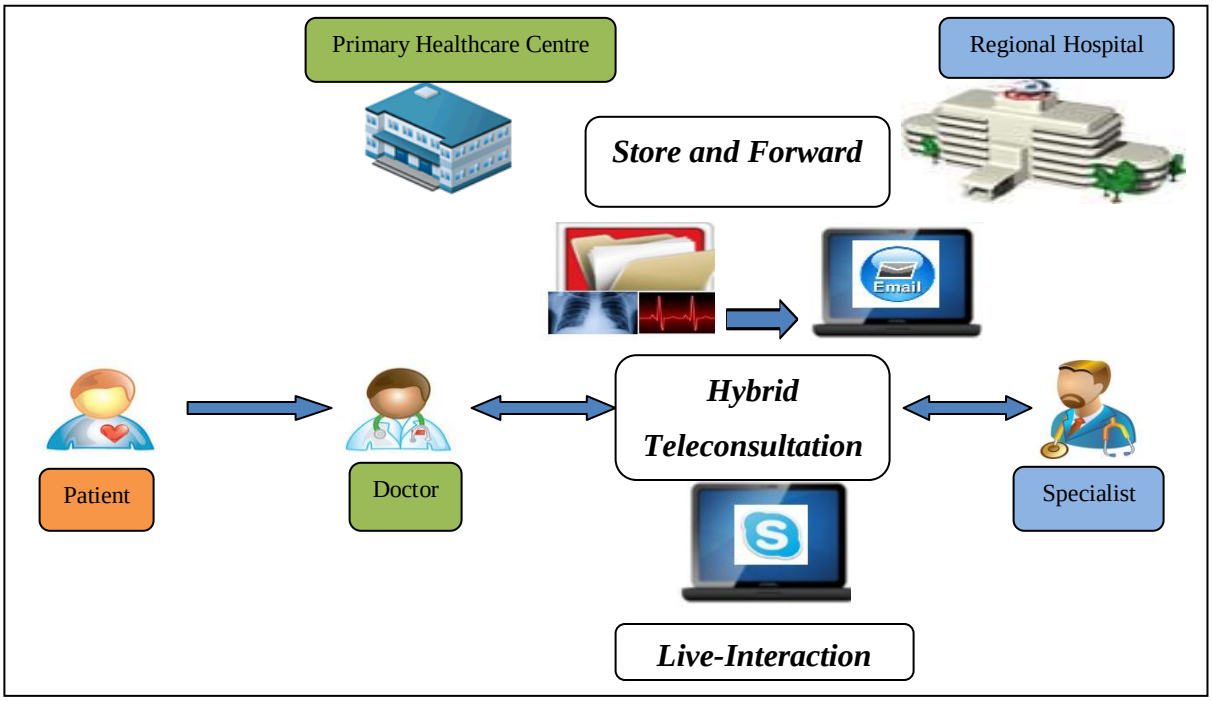

Figure 4: Proposed teleconsultation architecture

According to Whited:

> 'Hybrid models are useful when a combination of store-and-forward and live-interactive approaches are desirable. An advantage of the hybrid

> model is that it combines some features of both types of consult modalities. Physician-patient interaction is maintained. High-quality digital still images are available, thus averting time lost in obtaining high-quality video images. This system also avoids the need for large bandwidth connections since the still images can be forwarded over low bandwidth lines – high-quality video images are not necessary' (Whited, Edison, & Pak, 2008: p. 8).

When sent in advance through the store and forward approach having the results of physical examinations and tests can avoid the limitation of the diagnostic capabilities of the live video-consultation which is best used for management of the care of the patient.

5.8.2 Teleconsultation protocol

The hybrid teleconsultation approach is adopted to support management of patient between primary health care centres and district hospitals.

Proposed approach:

1) General practitioner (GP) at a primary healthcare centre acquires information and records physical examinations, symptoms, and medical tests such as (ECG, X-ray and laboratory tests).
2) All data converted to a form able to be sent electronically to the distant consultant (e.g. X-ray as JPEG).
3) Any related paper forms/reports are scanned, indexed and stored in the patient's electronic record.
4) All information collected to a single "document" and sent electronically to the distant consultant.
5) The cardiologist review the patient information and case to advise on any immediate action, which might include:
    - Emergency admission.
    - Priority referral to hospital.
    - Medical tests in hospital.

- Teleconsultation with cardiologist, GP and patient.
- Referral elsewhere.

5.8.3 The PCP before the introduction of teleconsultation

Before redesign of the patient care pathway, it is necessary to depict the current patient journey. This allows consideration of the alternatives and reaches the eventual choice clearer.

Figure 5 illustrates the cardiovascular patient care pathway through healthcare levels in Saudi Arabia. It is a traditional vertical structure, where services have been organised and planned on the basis of referrals. A patient is referred from primary to secondary care and then to tertiary care in their journey to specialist treatment. Service flow is in one direction and each healthcare tier works independently. The figure also demonstrates how this pyramidal healthcare system can prevent CVD patients from obtaining rapid and fair of access to high quality health service, particularly in remote areas.

A patient is usually referred to tertiary care if surgical intervention is needed. The same process as in the secondary tier has to be repeated. However, the access to a surgeon might take weeks and months.

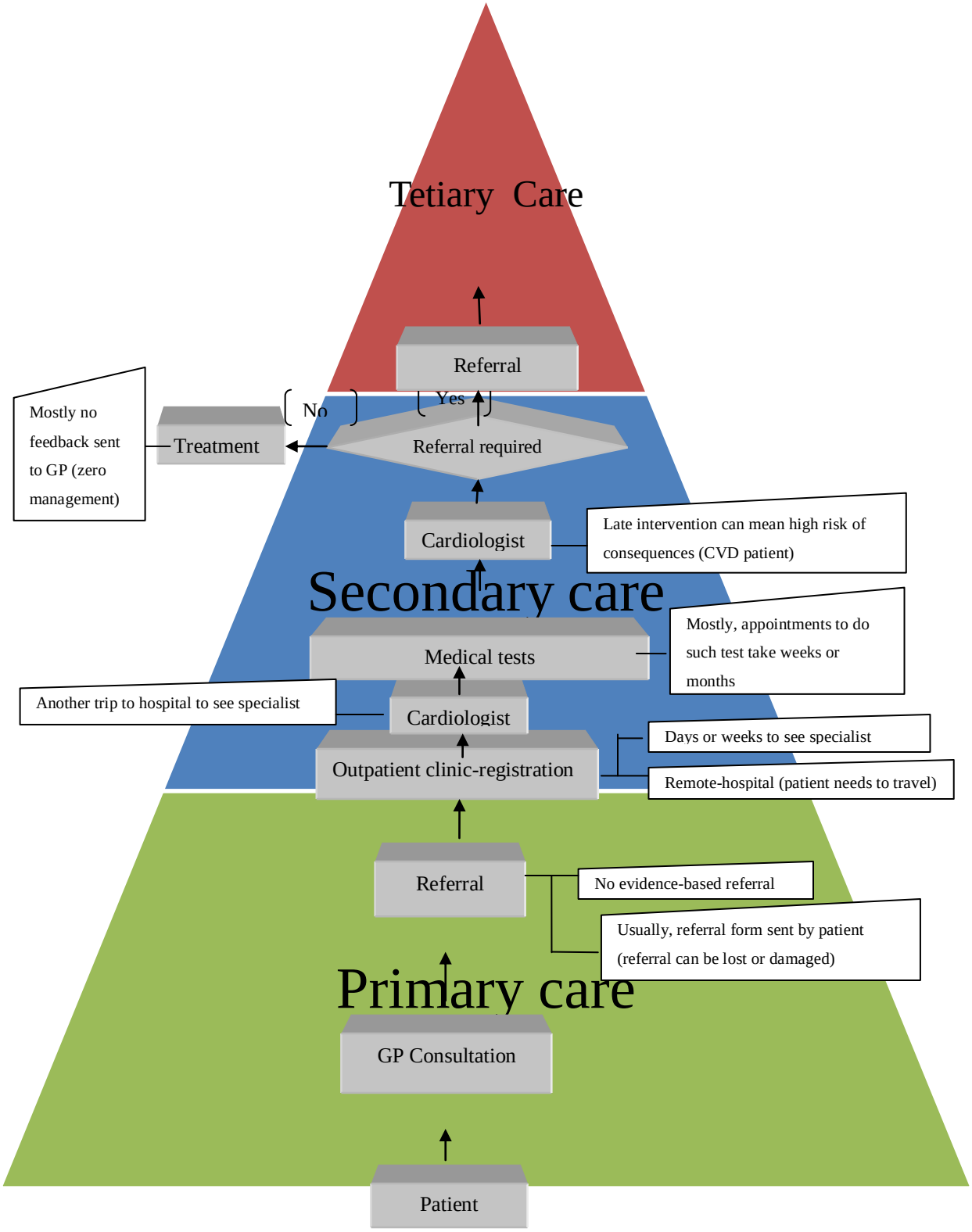

Figure 5: CVD patient flow through the tiers of the healthcare system in Saudi Arabia

5.8.4 The PCP pre-implementation of teleconsultation

Mapping the current PCP allows consideration of where telemedicine (store and forward and teleconsultation) can be introduced in the process. The patient journey within a primary healthcare centre can be seen in Figure 6. In the diagram, the upper boxes and solid lines show the movement of the patient, whilst the lower boxes and the dotted lines represent the flow of patient information and medical data. The lowest purple boxes indicate the points where teleconsultation can be introduced. The approach is to make minimal change to the existing protocol by the teleconsultation introduction. The green lines at the top and bottom of the figure depict everything that occurs in primary care and show that patient journey and the teleconsultation services will be executed in primary healthcare.

Figure 7 shows the patient journey in secondary care after referral from primary care. It involves moving between areas within the hospital, but the time to final decision may take weeks or even months. The purple boxes indicate the points where teleconsultation can be introduced. As is seen in the bottom line, applying teleconsultation services in a primary healthcare centre can eliminate the need for the patient to make unnecessary moves and, more importantly, to travel long distance to a secondary care (hospital).

The next section describes in detail the change to PCP with teleconsultation.

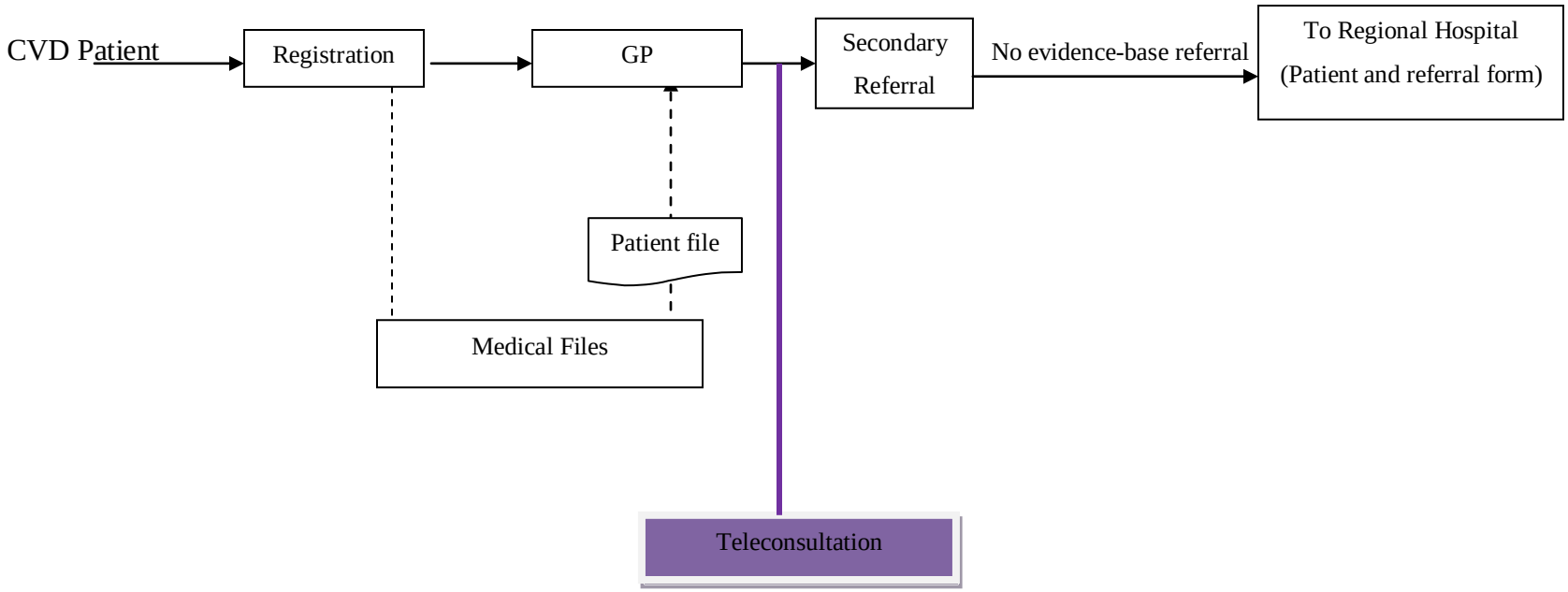

Figure 6: PCP in primary healthcare centre

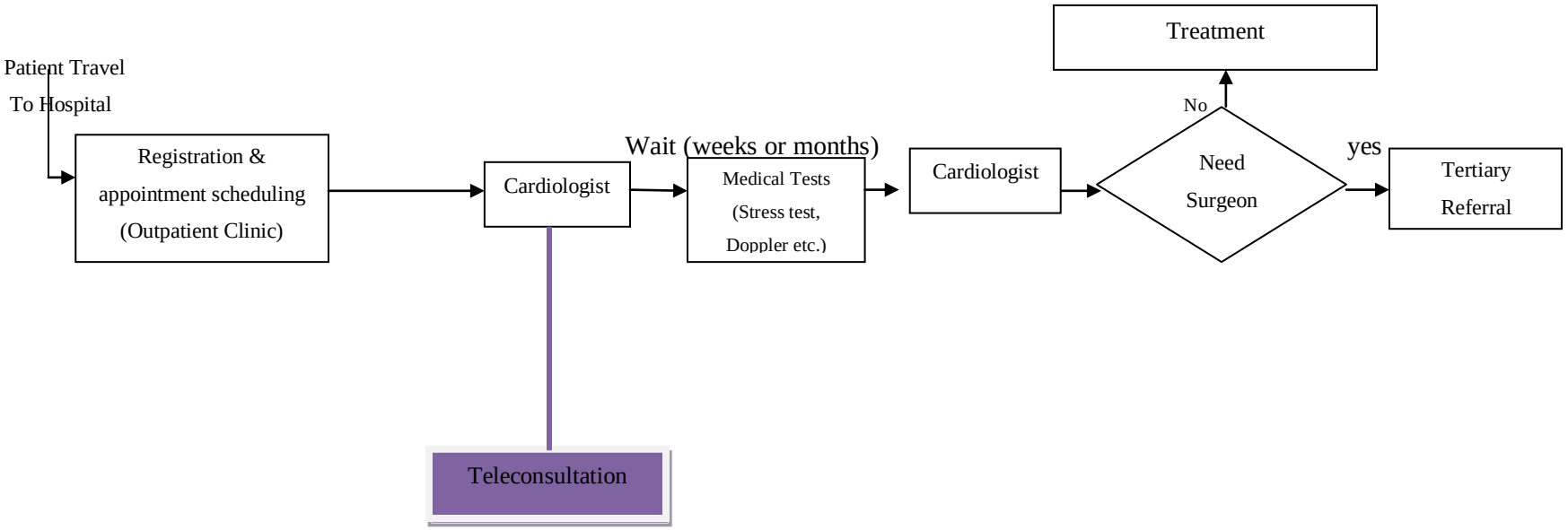

Figure 7: PCP in Secondary care hospital

5.8.5 The PCP during the implementation of teleconsultation

Figure 8 shows how the patient care pathway in a primary healthcare centre has been modified by adding teleconsultation to the process. The underlying traditional PCP remains largely unchanged. However, the patient is given tests much earlier in the process, as soon as symptoms of CVD presented. In this way, the information to make accurate diagnosis is gathered early. Furthermore, as it is captured in digital form, the information can be forwarded to the cardiologist for opinion and advice.

The significant difference between figure 6 and figure 8 is that every patient does not need to go to a regional hospital to seek treatment; only those with evidence of need will travel. Thus, for many unnecessary travels is avoided. Alternatively, those with significant need can receive prioritised referral or immediate admission. In such cases, a teleconsultation can be arranged quickly to review case and discuss and agree management. In this way, the GP will be aware of the patient's health and can commerce treatment immediately without the need for patient to travel to hospital. Consequently, the initial steps of the patient's management process can be initiated effectively. Indeed, the redesign of traditional PCP offers early intervention from cardiologists, which reduces the risk of complications.

Figures 5 and 7 indicate that there are geographical and managerial obstacles to overcome in order to deliver fast and efficient healthcare to CVD patients in hospital. Figure 7 illustrates the current PCP in secondary care hospitals and the points where teleconsultation can overcome delay to access cardiologist. Figure 9 builds on figure 7 and follows the actions that took place in primary healthcare centres (figure 8). The introduction of teleconsultation will reduce the need for travel. In addition both the patient and the GP are aware of the next steps to take based upon the specialist's advice. The patient will travel to hospital when appropriate intervention is indicated, or when investigations with advanced medical equipment are necessary. Priority referral and reduced waiting time to see a cardiologist based on need are further advantages.

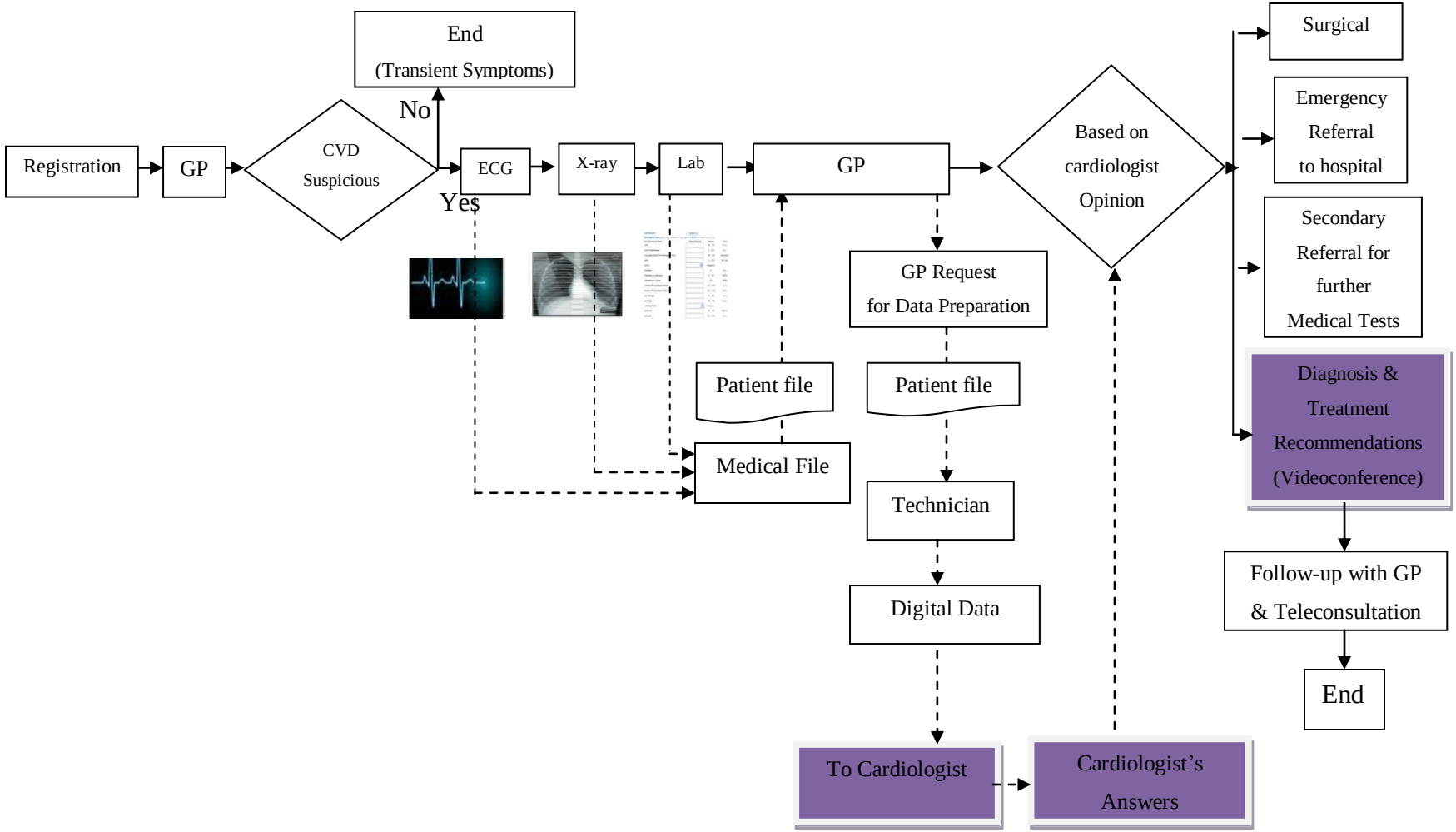

Figure 8: The PCP in a primary health care centre during the implementation of teleconsultation

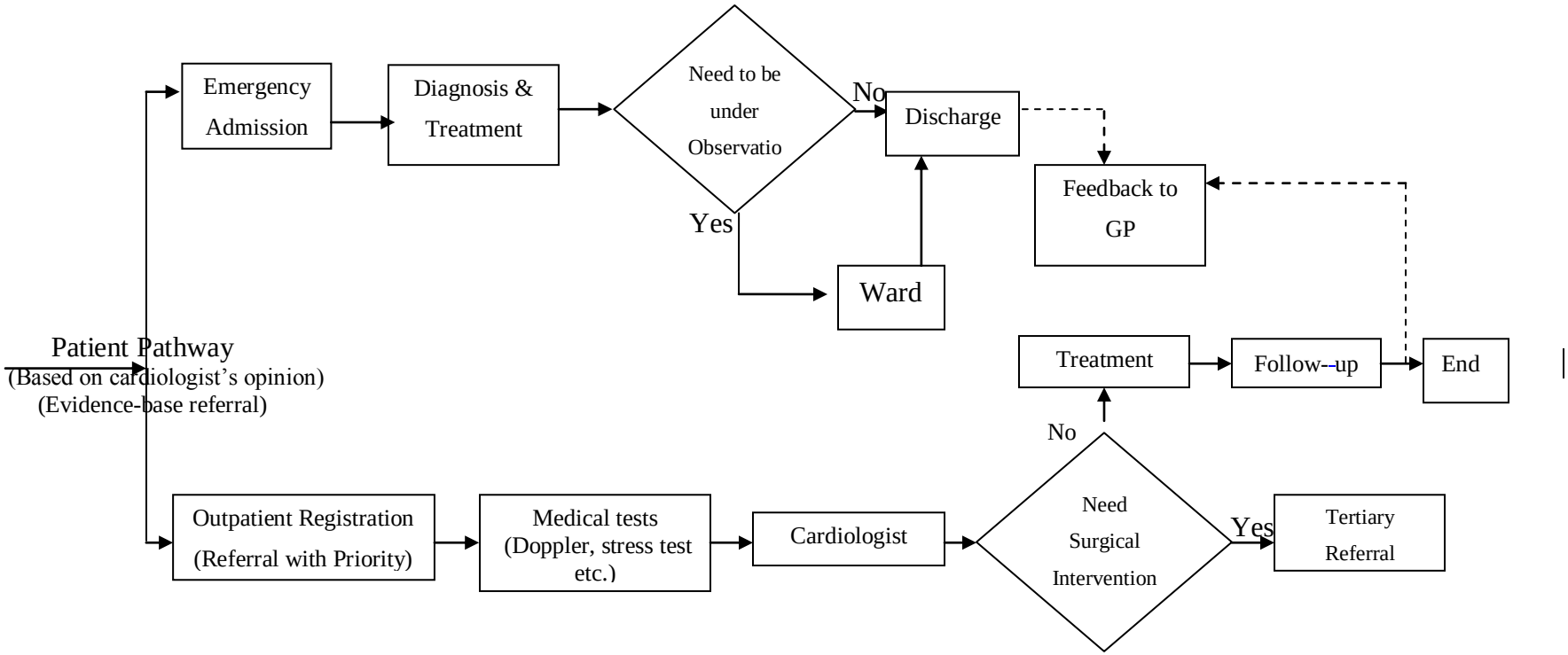

Figure 9: The PCP in a secondary hospital during the implementation of teleconsultation

5.8.6 The PCP post-implementation of teleconsultation

ICT such as teleconsultation will cause the structure of the healthcare delivery system (Figure 10) to be redesigned. In this case, ICT enables a horizontal integration of the patient care pathway between the separate sectors. The communication that was established through teleconsultation removes barriers between healthcare tiers and supports a multi-directional movement of patients and information flow. It strengthens the role of primary healthcare centres by supporting more-effective management with the available specialist skills. This modified PCP model provides the structure to manage the care process of patients more efficiently and to ensure continuity of care.

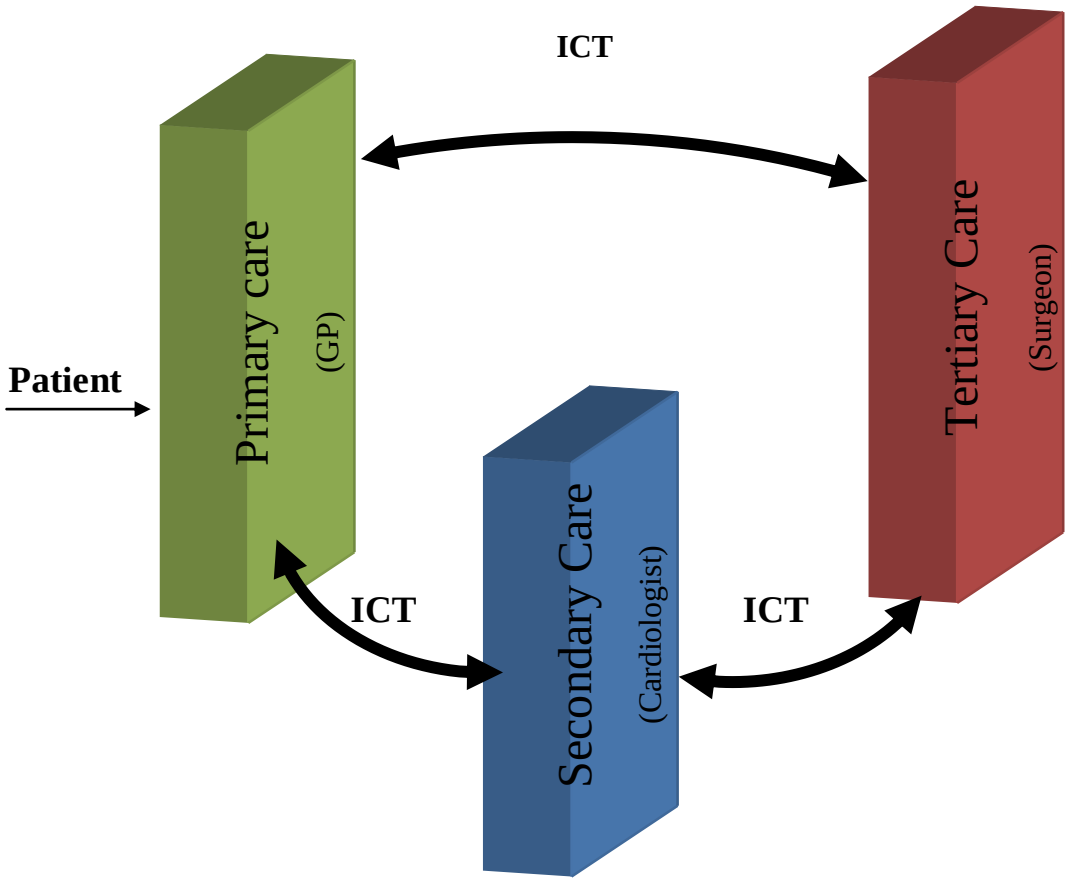

Figure 10: The PCP post-implementation of teleconsultation

6 Implementation of the project

6.1 Introduction

This pilot project has been conducted in medical institutions belonging to the Saudi ministry of health (MOH). For this aspect of the research, the director of information and communication department in the ministry of health has kindly provided all possible support and required access to research resources. The pilot was conducted over the four months from December 2011 until the end of March 2012 in primary health care centres and hospitals belonging to the Ministry of Health to observe traditional and modified patient care pathways as well as conduct interviews and questionnaires with patients, health staff and managers. This activity has been carried out in four primary healthcare centres and two hospitals. Two centres were connected with a district hospital in the north (Tabuk city) of Saudi Arabia and two others were connected to the main hospital in Riyadh, the capital city of Saudi Arabia.

6.2 Procedures undertaken pre-implementation teleconsultation

6.2.1 Ethical consideration

Ethical approval is a legal requirement to protect the rights, safety, dignity and well-being of people participating in research. In this pilot project, permission was sought from both the Brunel University Research Ethics Committee and the Research Ethics Committee of Ministry of Health for conducting the study in Saudi Arabia (Appendix 1). During all stages of conducting the project, the terms of the ethics approval have been considered. All the participants were provided with an ethical approval certificate in advance, informed that they have to read the research information sheet (Appendix 2) and sign the consent form (Appendix 3) before taking part in the study. They were informed that all the information will be anonymised and securely stored to ensure privacy and security. In addition, permission was sought in advance of starting aspects of the pilot from the ministry of health to access medical institutions and conduct the project.

I am grateful for their cooperation and issuance of the approval letter

6.2.2 Identify project's sites

Saudi Arabia is a vast country and so two distant regions were selected for the study. These regions are Tabuk, which is located in the northwest of the country, and Riyadh, located in the centre (Figure 11).

Figure 11: Saudi Arabia. Map of regions

Tabuk was selected because it suffers from a shortage of cardiologists. There are two cardiologists to serve a region with a population of 800,000 inhabitants (MOH, 2010). Riyadh, which is the capital city, was chosen based on the prevalence of cardiovascular disease, which is the highest in the country. The study included two primary healthcare centres and one hospital in each region. The location of these institutions was chosen based on the selection criteria, were in chapter 5. A scoping visit was made to each site before conducting the project to determine available facilities and equipment. Also, the visit was used to meet the stakeholders and to assess their interest in telemedicine and participation in the study.

6.2.2.1 Primary health care centre

Halat Ammar and Bir Ibn Hirmas are the primary healthcare centres that were chosen in the northern region (Figure 12). Both are the only health institutions that serve their inhabitants. Their staffs consists of general physicians (GP), nurses, technicians and administrators. King Khalid hospital, located in Tabuk city (approximately 100 km distant), is the referencing hospital.

Figure 12: Selected primary healthcare centres (Tabuk region)

Al Uyeynah and Sultanah are the primary healthcare centres that were selected in the central region (Figure 13). They also are about 100 km distant away from the nearest regional hospitals. All of these primary healthcare centres were ideal for carrying out the study. They met the selection criteria, most important as an Internet connection was available. Furthermore, each site had the necessary medical equipment (such as ECG, X-ray and laboratories). More importantly the staffs, including GP, nurses, technicians and administrators, were eager to participate in teleconsultation.

Figure 13: Selected primary healthcare centres (Riyadh region)

6.2.2.2 Hospitals

The hospitals in the pilot project were:

- King Khalid Civilian Hospital. It is located in Tabuk city. There are about 300 beds in the hospital. The role of the hospital is to provide diagnostic, preventive and curative services. The hospital also provides comprehensive healthcare services and training to health professionals. The hospital established a video-link with the King Faisal Specialist Hospital to obtain a second opinion for patients in intensive care.
- King Fahad Medical City (kfmc). In Riyadh City – the capital of Saudi Arabia, KFMC is considered the largest and most advanced medical complex in the Middle East with a total capacity of 1095 beds. King Fahad Medical City is a primary referral centre for the region. At all levels of treatment, specialists from many disciplines are brought together. It performs diagnostic tests and treats complicated cases referred by other hospitals and health facilities. The cardiology service consists of outpatient facilities, inpatient provision, a comprehensive range of non-invasive investigational facilities, cardiac catheterisation and angiography, and a range of interventional cardiology procedures.

6.2.3 Patients

Pilot studies are conducted for two main reasons. The first is to test the feasibility and organisational structure of a research project, and the second to establish some figures for population parameters and what the results are likely to be. The sample size required depends on precision that can be achieved (Sattools, 2012). Although level of precision improves with increasing sample size, the relationship is nonlinear one (see figure 14).

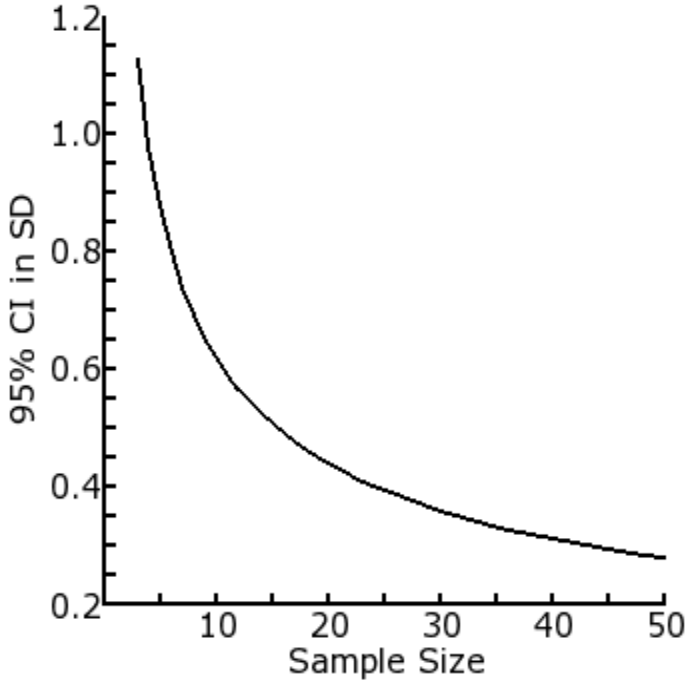

Figure 14: The relationship between confidence interval and sample size

In planning for high precision pilot study the decision in sample size is based on when the sample size/confidence interval curve flattens out, and in most cases this occurs when the sample size is between 10 and 40 cases (Sattools, 2012).

Small sample sizes are common in pilot studies in telemedicine research. It may be impossible to find a suitable patient sample for telemedicine services that are not part of a formal programme, or where populations are widely dispersed and remote (WHO, 2009). Sample of 15 patients were involved in this pilot project.

6.3 Project Requirements

6.3.1 Primary healthcare centre site

- **Personnel requirements**
  - General physician (GP): to introduce the case (patient) to cardiologist, review the medical record and the results of medical tests done to a patient in primary healthcare centres such as ECG, X-ray and lab, as well as implement the management that is recommended by the cardiologist.
  - Technician: to acquire data in electronic form to send to the cardiologist including from DICOM (such as converting X-ray images to JPEG files). Also, scanning any paper records (such as ECG and laboratory results).
  - Information technology specialist (IT): to manage the operation of the videoconference.
  - Administrative: to oversee the team work and operation of the system.
- **Hardware and software requirements**
  - Personal computer
  - High definition (HD) webcam
  - Microphone
  - Speaker
  - Internet access with high speed (upload/download)
  - Scanner
  - Skype software.

6.3.2 Hospital site

- **Personnel requirements**
  - Cardiologist: to provide GP and patient with second opinion on management and treatment options.
  - IT: to manage the operation of videoconference.
  - Administrative: to oversee the operation of the system.

- **Hardware and software requirements**
  - Personal computer
  - High definition (HD) webcam
  - Microphone
  - Speaker
  - Internet access with high speed (upload/download)
  - Skype software.

6.4 Potential benefits of this pilot project

1) Resolve the shortage of cardiologists and cardiology services.
2) Improve access to cardiologist and reduce waiting time (diagnosis delay).
3) Improved quality of diagnosis and treatment.
4) Evidence-based referral.
5) Avoiding unnecessary travel for patient.
6) Promote feedback process (patient management).
7) Enhanced role of primary healthcare centres and participating hospitals in health services delivery.
8) Improve relationship between primary health care centres and hospitals.

6.5 Essential features of the teleconsultation

1) Easy to use.
2) Little training needed.
3) Possible use of lower bandwidth links.
4) Deployed in healthcare system with minimal disruption.

6.6 The Case

6.6.1 Pre-implementation teleconsultation

6.6.1.1 Observation of the conventional patient care pathway

For any redesign of a patient care pathway, it is essential to observe and depict the conventional patient journey. This allows full consideration of all options to implement

the change and their effect and makes the amendments and suggestions in the pathway clearer. The cardiovascular patient should always be at the centre in the study and all the modifications to a patient care pathway should aim to meet their satisfaction and expectations.

The detailed information of the conventional PCP was collected through interviews and observation. Visits were made to the Department of Primary Healthcare in the Saudi Ministry of Health to obtain the protocols of the health services delivery for this type of patient. Decision-makers in the department were consulted in order to review and clarify the procedures that govern these clinical pathways.

The patient movements between primary healthcare centre and hospital were then observed over a period of two months. During this period, meetings with patients, GPs and cardiologist were held.

6.6.2 Teleconsultation implementation

The teleconsultation service was established to connect the rural primary healthcare centre with the regional hospital. It is a two-way interaction that utilise synchronous and asynchronous transmission. Store and forward techniques were used as the bandwidth of telecommunication link available in most of the primary healthcare sites was limited. Accordingly, high-resolution images cannot be show during real-time consultation. Therefore, images such as x-rays and data were sent in advance by the primary healthcare team to the cardiologist as attachments e-mail. Video conference was then arranged depending on severity of the case and availability of the cardiologist. The system was intended to bring together the CVD patient and cardiologist in the shortest time and without the need to travel. Introducing teleconsultation technology into the conventional PCP not only altered the movement of the patient around the healthcare system but also revealed aspects regarding human interaction and organisational dynamics. Significant contributions were provided by stakeholders during all stages of the teleconsultation process.

6.6.2.1 Data collection strategy

The pilot project in Saudi Arabia took three months to set up. A total of 15 patients participated in this study at the different sites. A larger number of patients would have been preferred however the time to conduct primary data collection was limited and the prevalence of referral is low. However analysis has shown that 15 patients was a sufficient number to evaluate the new PCP. All patients were chosen in the primary healthcare centres. The GP selected each patient to be included in the study. Emergency cases were excluded. Prior to participating, patients and medical staff were asked to read the information sheet of project and sign the consent form. Every patient willing to participate was asked to answer a patient satisfaction questionnaire (Appendix 4). Before the start of the video consultation, patients were asked two questions to discover their general knowledge about telemedicine and their feelings about participating in the teleconsultation session. The remaining questions were to determine the acceptance and satisfaction of the service after the video consultation session.

A total of 60 interviews were completed with stakeholders. GPs, cardiologists, nurses, technicians, IT, and decision makers asked to answer 14 questions (Appendix 5). These questions were to investigate factors and issues that might act as barriers to adoption of teleconsultation and where appropriate changes should be made.

6.6.2.2 Training consideration

Prior to the pilot project, a training session was carried out in both the primary healthcare centre and the hospital. This was a one-hour session to give a summary of the project and explain the functions of the participants. It was also aimed at training the participants in how to deal with the project tools.

6.6.2.3 Creating the modified patient care pathway

GPs in four project sites (primary healthcare centres) were asked to deal with CVD patients in place of direct referral to the regional hospital. In the modified PCP, GPs had to record physical examinations, symptoms, and carry out medical tests such as ECGs, X-rays and laboratory tests. The hybrid teleconsultation application was added to the

traditional patient clinical pathway. And the medical report of the patient and associated images were sent to the cardiologist in the regional hospital via e-mail (store and forward).

Two doctors in each hospital agreed to participate in the study. One of them was the primary participant and the other was a back-up. The task of the doctors was to review the medical data and images and provide with GP an initial diagnosis and their availability to join the video consultation. Real-time videoconferencing using SKYPE was established for all patients approximately two weeks after the GP request to bring together the patient, specialist and GP to discuss diagnosis, treatment and answer any patient queries. The workflow of the patient was observed during all steps of the modified PCP. Photos of important events and places were also taken (Figures 15 and 16).

Figure 15: Live teleconsultation between Halat Ammar primary care centre and King Khalid Hospital

Figure 16: Live teleconsultation between Al Uyeynah primary care centre and King Fahad Medical City

7 Empirical investigations and findings

7.1 Introduction

This chapter presents the analysis and the results of the research. In accordance with the design of the study and research objectives, the quantitative results are presented first to assess the impact of introducing teleconsultation. The statistical package for social science software (SPSS version 18) was used for statistical data analysis and data management. The models will be evaluated based on the data (questionnaires and observation) collected in the pilot project. Moreover, the new patient care pathway will be compared with the conventional. Evaluation will be based on the following criteria:

- Access to specialists.
- Diagnosis time.
- Access to treatment.
- Waiting list and burden on hospital's outpatients.
- Patient management (follow-up and feedback report).
- Primary healthcare centre and hospital relationship.
- Quality of service.

The research findings are analysed to determine the barriers for teleconsultation implementation. The attitude of stakeholders towards adding telemedicine to the health delivery system is assessed based on quantitative data, interviews and observations. Thematic analysis was used to process, analyse and interpret the qualitative data. NVIVO computer software (version 9.2) was used to organise and analyse the non-numerical response of the stakeholders' data.

7.2 Features and issues of the conventional patient care pathway

The Department of Primary Healthcare in the Saudi Ministry of Health sets protocols for the transfer of patients between healthcare tiers (primary, secondary and tertiary). It will also identify the responsibilities of stakeholders in primary healthcare centres and hospitals regarding health services delivery and referral system. Cases have been

classified into emergency cases, potentially life-threatening and routine medical conditions (cold cases). Every case has a different referral protocol and starts with the GP in the primary healthcare centre.

The protocols for the cardiovascular patients that govern patient care pathways are similar to any other patient. PHC is the first point of contact for the patient with the national health system. CVD patients must visit their GP to seek treatment. Hospitals do not accept any case without a referral from the primary healthcare centre unless the case is an emergency. Traditional patient care pathways of CVD patients are characterised by the following:

- All CVD patients who arrive at the primary health centre with CVD symptoms or who have a history of CVD are referred directly to the hospital for diagnosis and treatment. The GP does not perform any medical tests, investigations and treatment to this category of patient. Evidence-based referral is nonexistent. According to the GPs at Bir Ibn Hirmas primary healthcare centre: "Any patient who comes to the centre with symptoms of cardiovascular disease is transferred directly to the hospital and without even conducting the necessary tests because of the risk of the possibilities and the lack of experience in this disease treatment."
- The patient is required to travel to hospitals at least 100 km distant for treatment.
- Access to cardiologist for initial diagnosis commonly takes three months. A one-year delay in diagnosis and treatment is usual. Late intervention can cause high-risk consequences for CVD patients.
- One in three patients must travel to hospital for up to one year with final diagnosis for transient symptoms (non-cardiovascular). As a result, this can add undue burden to outpatient clinics and waiting lists.
- The flow of patient information between primary and secondary care is not protocol-based. The only patient data transferred between GP and hospital is the referral letter and it is always sent by the patient itself. Furthermore, there is an absence of hospital feedback reports to primary care, which often cause incomplete and inadequate follow-up treatment. This consequently considerably affects a patient's health management.

In conclusion and based on the study aspects, the traditional PCP can be summarised as follows:

- Access to specialists (up to two months or more).
- Consultation time (20 minutes or more) face-to-face.
- Access to treatment (up to five months).
- Waiting list and burden on hospital outpatients (no evidence-based referral causes an increase in the waiting list for diagnosis and treatment as well as an increased burden on outpatient clinics in hospital).
- Patient management (very poor follow-up and feedback report).
- Primary healthcare centre and hospital relationship (almost not existent).
- Quality of service (inequality of access to highly specialised care for rural citizens).

Indeed, the conventional PCP of CVD for patients living outside the immediate vicinity of the hospital and the organisational barriers is obstructing healthcare services being delivered equitably and conveniently. Delay in treatment and problems in the referral system and feedback reports aggravate health problems for CVD patients and cause a lack of patient healthcare management.

7.3 PCP in the presence of teleconsultation

7.3.1 Sample of pilot project

The pilot project was conducted in four primary healthcare centres and two hospitals. Patients, physicians and healthcare staff were chosen based on the criteria outlined in chapter 5. Fifteen patients participated in the case study. All patients were chosen in primary health centres and in collaboration with primary care physicians. Only potentially life-threatening and routine medical conditions (cold cases) were included in the study. Emergency cases were excluded. However, participants from the health staff were chosen through both primary health centres and hospitals. Sixty health staff, including GPs, cardiologists, nurses, technicians, IT and decision-makers were included

in the pilot study for interview in order to elicit their opinion on teleconsultation and its implementation.

7.3.2 Pilot project findings

7.3.2.1 Observation results

All changes to the PCP during the pilot study were recorded thus provided important information regarding the setup of the clinical criteria to be measured. The quantitative data were analysed by using SPSS software. The pilot results are as follows:

- Access to specialist: teleconsultation implementation, speeding up the process of diagnosis. It allows all participant patients to access a cardiologist for initial diagnosis within two weeks (Mean=13 days, Median=14 days, Standard Deviation=2.3 days, Confidence interval 95%=1.16 days) from first contact with primary healthcare centre. This is done by live video link between hospital and PHC. No CVD patients had to travel to hospital before initial consultation.
- Diagnosis time: This pilot project utilised the store and forward teleconsultation approach to provide the cardiologist with the information on the patient condition in advance before of the telecosultation. The average time for a teleconsult for the 15 patients was 10 minutes (Mean=10.4 minutes, Median=10 minutes, Standard Deviation=1.7 minutes, Confidence interval 95%=0.9 minutes).
- Access to treatment: All of the patients received appropriate advice during the first contact with a cardiologist via teleconsultation. 80% of participant patients received the appropriate treatment within just two weeks. The treatment plan for these patients varied between prescribing therapeutic medicines or recommendations for diet and executing lifestyle changes. Two of the 15 patients have transient symptoms of cardiovascular disease. The remaining three patients were referred to the hospital for further investigations due to the need of equipment that only available at the hospital. As a result, only three patients out of 15 were required to travel to the regional hospital.
- The waiting list and burden on hospital outpatients: The waiting is the number patients waiting to be seen in an outpatient clinic. The pilot project shows that

80% of participant patients received their treatment in PHC through teleconsultation. Consequently, the teleconsultation removed the need for patients to travelling to hospital and languishing on waiting lists. This result indicates that adding teleconsultation to PCP of CVD patients can reduce the size of the waiting list. In addition, evidence-based referral in corporation with teleconsultation, prevent inappropriate patients from waiting unnecessarily in queues. Indeed, this management and reduction in the waiting list would also reduce the burden on a hospital outpatient clinic.

- Patient management: The implementation of teleconsultation provided immediate patient management. Twelve of the 15 patients were diagnosed and managed locally without the need for travel to a hospital. Patient, GP and cardiologist agreed to a management plan for every patient at the end of the teleconsultation procedure. The treatment advice and lifestyle recommendations of the cardiologist improved the knowledge and experience of the GP to allow them to continue follow-up treatment of the patient. The other three patients also received instant feedback and initial diagnosis through teleconsultation as well as they receiving the necessary investigations in hospital. As a consequence, the GP was aware of the case condition and the next steps for the patient and was involved in patient health management.
- Primary healthcare centre and hospital relationship: It was clear that teleconsultation has improved cooperation between primary health care centres and hospitals. It builds communication and provides an interactive tool between the two levels of a health delivery system. During the pilot project, great collaboration has been achieved between GPs and cardiologists to diagnose and treat all participant cases. Moreover, the exchange of information and medical knowledge between PHC and hospitals was enhanced during implementation of teleconsultation. Furthermore, GPs became more familiar with various CVDs based on the education and experience gained through video consultations.

7.3.2.2 Patient satisfaction questionnaire

Twelve closed-ended questions were asked to participant patients to discover their current knowledge about telemedicine and to determine their opinion and attitude about their teleconsultation experience. The questionnaire was given to each participant immediately after participating in their video consultation sessions. All patients responded to the questionnaire. The results demonstrate the following items:

- Knowledge of telemedicine and pre-teleconsultation implementation attitude: None of the patients had heard of telemedicine. None of them were aware of any details about this technology and what it was used for. Regarding pre-teleconsultation implementation attitude, the majority (80%) of the patients were not sure about their feeling towards being diagnosed by a cardiologist remotely via telecommunication technology. The remaining 20% of patients were not comfortable about replacing face-to-face consultation with video consultation.
- Patient satisfaction post-teleconsultation: Nine patients (60%) were extremely satisfied with the service received through teleconsultation. Forty percent of participant patients indicated their satisfaction with the service. Furthermore, almost all patients were comfortable during the teleconsultation session. They did not experience any difficulties in seeing or hearing the cardiologist during the video consultation. Regarding the diagnosis and treatment outcome, the majority of patients were confident with the result since it was delivered through a specialist (cardiologist).
- Patient opinion: More than two-thirds (73%) of the patients considered that diagnosing via the telemedicine service was as good as seeing the physician face-to-face. The remainder were not sure as it was their first experience with teleconsultation. All patients indicated that it was not necessary to travel in the presence of teleconsultation technology. Regarding whether teleconsultation may present issues with respect to culture, religion and privacy, the majority (90%) of patients indicated that teleconsultation would not be contrary to a country's culture and religion. However, nearly all participant patients expressed concerned about privacy as the country is sensitive about the treatment of female patients.

- Quality of service: The last three questions of the questionnaire explored the most important advantages that teleconsultation services offer to CVD patients and how they rate the overall service quality. Almost two-thirds of patients were very delighted as this technology allowed them to access the specialist in less time (almost two weeks). In addition, the remainder mentioned that the teleconsultation had allowed them to avoid travel difficulties such as expense and separation from family. In terms of overall service quality, participants' responses varied between excellent and good. None of them evaluated the service negatively. They all were very enthusiastic to use teleconsultation again in the future.

Indeed, "Satisfaction is an accepted indicator of the performance of a health-care service. It reflects patients' values and expectations regarding various aspects of a health service" (Yip, et al., 2003, p.46). It is essential that consumer demand for telemedicine services is increased and patients' acceptance and adoption promoted (Purdue University, 2006). A patient's satisfaction survey found that CVD patients readily accepted teleconsultation services. Nearly all of them were pleased with the technology since they obtained the diagnosis and treatment in very short time. They preferred teleconsultation when compared to travelling hundreds of miles to see the cardiologist face to face. This is due to avoiding travel difficulties such as expense and separation from family. The majority of them appreciated participating in this telecommunication technology and were willing to experience it again in the future. Moreover, it was observed that having the remote cardiologist-consultation increased the patient's trust and acceptance of the diagnosis results and treatment advice. This confidence and satisfaction was also observed on families accompanying the CVD patient.

7.4 Modified PCP versus traditional PCP

The viability of teleconsultation was determined by comparing the pre-implementation patient care pathway with the proposed pathway using the teleconsultation in order to identify the advantages over conventional the PCP. The evaluation was based on differences observed between the modified and traditional PCP. Analysis aims to understand the implications of change and whether the diagnosis and treatment procedures

for CVD patient are improved. Based on the study criteria the results of the comparison are the following:

- Access to specialist: In the modified PCP, all CVD patients were able to access a specialist within two weeks through teleconsultation, compared to 2 months for the traditional PCP (Figure 17). In addition, adding teleconsultation technology to the modified PCP allows the majority of patients to be diagnosed and treated locally. However, conventional PCP requires CVD patients to travel to regional hospital for diagnosis and treatment.

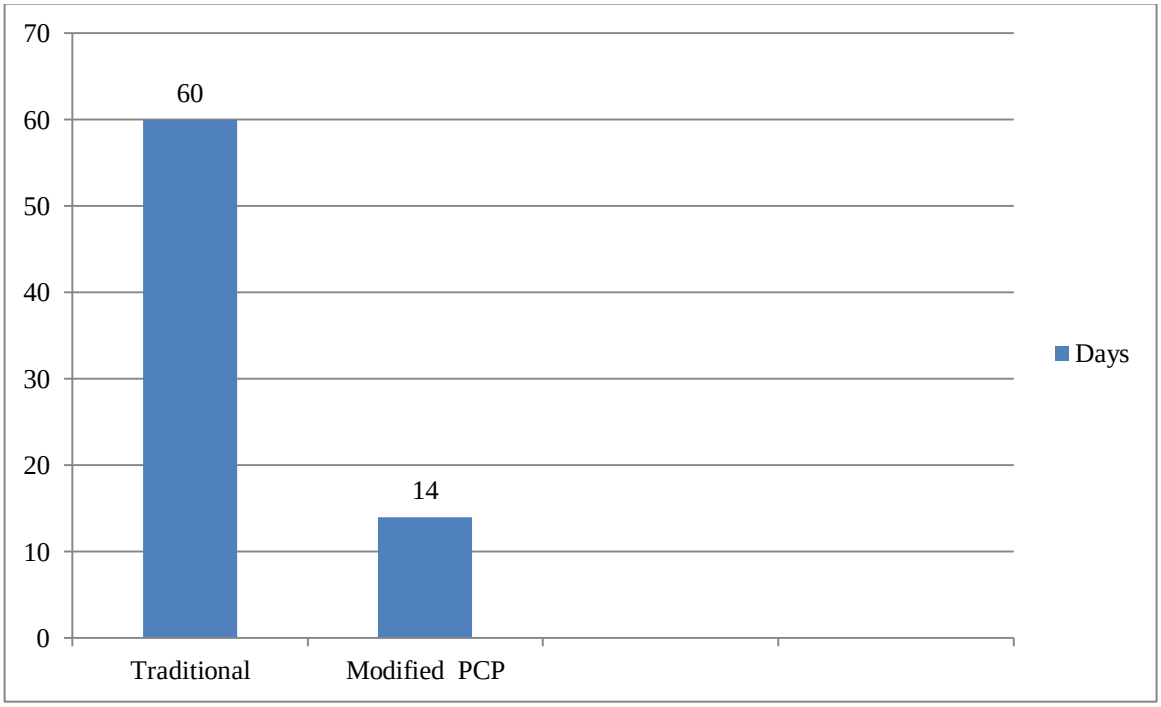

Figure 17: Access to cardiologist, traditional PCP versus modified PCP

- Diagnosis time: The teleconsultation service enabled the majority of participant CVD patients to recive diagnosis and treatment in a starter encounter period. For most patients, the average time for the teleconsultation was 10 minutes compared to 20 minutes for the traditional face-to-face encounter (Figure 18).

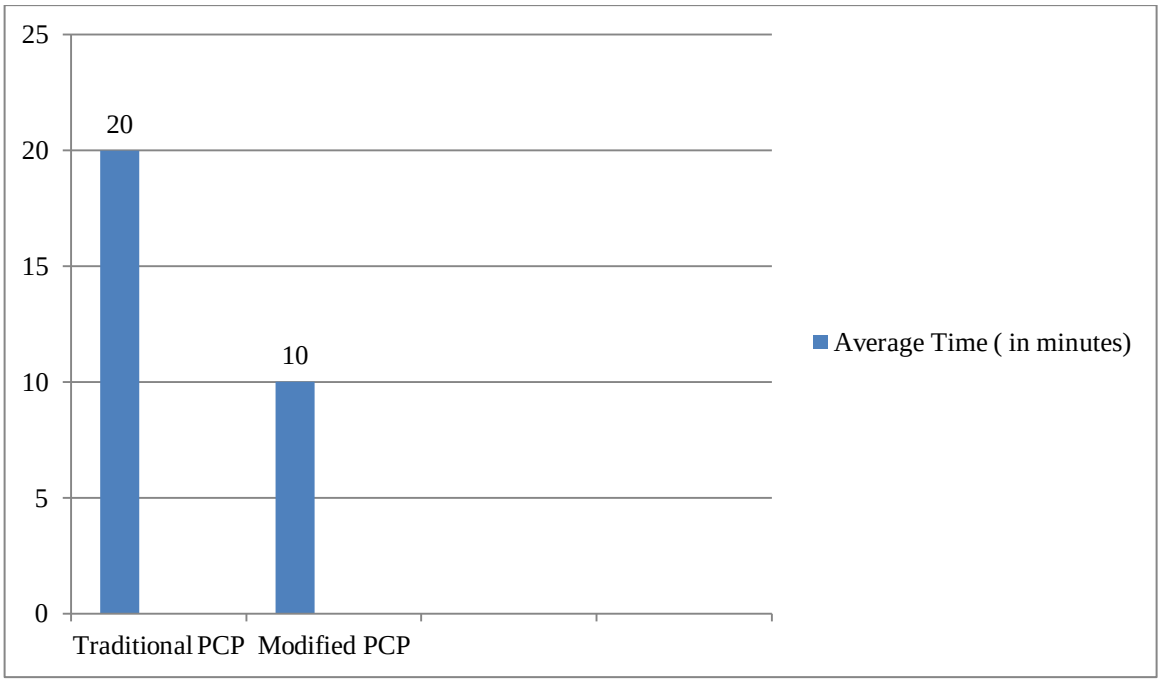

Figure 18: Diagnosis time, traditional PCP versus modified PCP

- Access to treatment: In the traditional PCP, the GP refers immediately any patient presenting cardiovascular symptoms to the regional hospital. Furthermore, CVD patients do not usually receive their treatment before five months from their first contact with the GP. This period of time can extend to one year particularly for those patients that require further investigations with advanced equipment. However, in the modified PCP, teleconsultation service allows 80% of patients to obtain treatment locally in primary healthcare centres. Also, the reminder received appropriate advice and referred to hospital during the first contact with a cardiologist via teleconsultation.
- Waiting list and burden on hospital outpatients: The pilot project shows that 80% of patients received their treatments in PHC through teleconsultation. Consequently, the teleconsultation eliminates the need for these patients to travel to hospital and languish on waiting lists. These results indicate that adding teleconsultation to PCP of CVD patients can reduce the size of waiting lists. In addition, evidence-based referral, which accompanies teleconsultation, prevents inappropriate patients from waiting in the queue. Indeed, this management and

reduction in waiting list would further reduce the burden on the hospital outpatient clinics. Currently, evidence-based referral does not exist in the traditional PCP. In the traditional PCP, all CVD patients (100%) transfer directly to the hospital, which increase the waiting list for diagnosis and treatment as well as increasing the burden on outpatient clinics in hospital. See Figure 19.

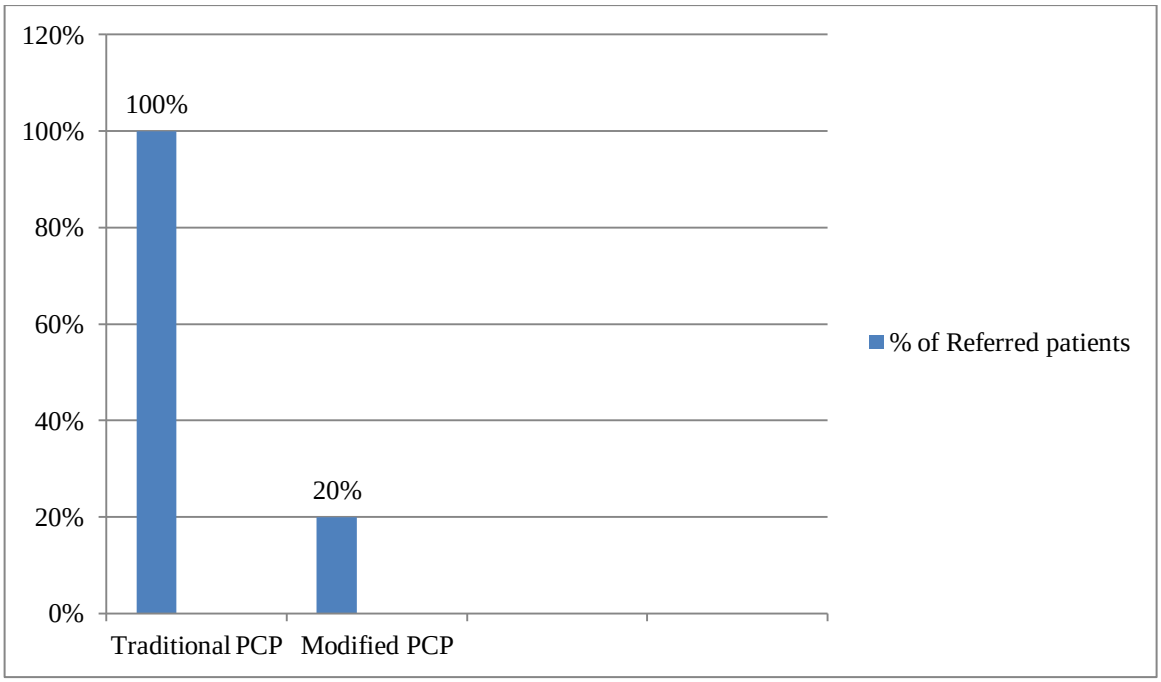

Figure 19: Referred patients, traditional PCP versus modified PCP

- Patient management: The flow of patient information between primary and the hospital is not protocol-based in the conventional PCP. More important, there were absences of hospital feedback reports to primary healthcare centres that frequently cause incomplete and inadequate follow-up treatment. This consequently can seriously affect the health management of the patient. However, teleconsultation implementation led to immediate patient management. Twelve of the 15 patients were diagnosed and managed locally without the need for travel to regional hospital. Patient, GP and cardiology agreed to a management plan for every patient by the end of teleconsultation procedure. The treatment advice and lifestyle recommendations of the cardiologist improved the GP's knowledge and ability to continue the patient follow-up treatment. The three patients referred to

hospital did also receive immediate feedback and initial diagnosis in the teleconsultation as well as follow-up necessary investigations in the hospital. As a consequence, the GP was aware of the case condition and next step for the patient plus involvement in patient health management.

- Primary healthcare centre and hospital relationship: Teleconsultation has improved the cooperative relationship between primary care and hospitals. It has built a communication and interactive tool between these two levels of health delivery system. During the pilot project, strong collaboration was achieved between the GPs and the cardiologists. Moreover, the exchange of information and medical knowledge between primary care and hospitals was enhanced during the teleconsultation. Furthermore, GPs became more familiar with aspects of CVD based on education and experience gained through video consultation. However, the healthcare levels in the traditional PCP are based on a vertical system structure and the interchange of data between these levels is in one direction. These arrangements cause the GP to be isolated and interactions between health institutions to be very poor.
- Overall quality of service: The patient satisfaction survey found that CVD patients readily accept teleconsultation services. Nearly all of them were pleased with the technology as they obtained the diagnosis and treatment very quickly. They preferred teleconsultation when compared to driving many miles to see the cardiologist face to face. Difficulties such as expense and separation from family were avoided by adding teleconsultation to the PCP. This compares to the inequity of access to highly specialised care, especially for their in rural areas, in conventional health system. The poor referral and feedback process in the traditional PCP also leads to serious complications for CVD patients as well as incomplete and inadequate follow-up treatment.

This comparison is summarised in the table below (Table 1):

	Traditional PCP	Modified PCP
Access to specialist	Not less than 60 days	Up to 14 days
Diagnosis time	20 minutes	10 minutes
Access to treatment	3 to 5 months	14 days to 1month
Waiting list and burden on hospital outpatients	Increase	Decrease
Patient management	Incomplete follow-up treatment	Complete follow-up treatment
Primary healthcare centre and hospital relationship	Nonexistent	Improved
Overall quality of service	Patients unsatisfied	Patients Satisfied

Table 1: Modified PCP versus Traditional PCP

Indeed, compared to the traditional PCP, the modified PCP utilising teleconsultation technology improved the quality of healthcare through:

- Improved access to medical care, enabling a general physician (GP) to obtain advice on the test results of a patient from a cardiologist in another location.
- Improved quality of diagnosis by obtaining the expertise of a distant specialist.
- More efficient medical evaluation and management.
- Avoiding unnecessary travel.
- Enhanced role of primary healthcare centres in the health system and participating hospitals by providing all levels of health services for patients.
- Improved relationship between primary health care centres and hospitals.
- Evidence-based referral.
- Less waiting list - less burden on outpatient.

7.5 Obstacles faced during implementation of teleconsultation

During the pilot project, the implementation of teleconsultation in the modified PCP is affected by several challenges and barriers. Most of these obstacles affect the start-up and development of the project and some affect the operational stage. Factors that can hinder the gain of teleconsultation benefits were observed during the implementation.

7.5.1 Observation

Barriers include:

- Technical barriers: Limited telecommunication technology and infrastructure in rural areas. Most remote primary healthcare centres are located in underdeveloped areas and the network connections in these areas varied from basic telephone to low bandwidth Internet. As showing medical images in a real-time teleconsultation requires moderate to high bandwidth, asynchronous modes are also utilised. This allows the patient data and images to be transferred over the Internet to a cardiologist prior to a video-conference session. Furthermore, the majority of PHC equipment is not up-to-date and is not digital, which makes the transfer of data over the Internet a long process.
- Operation barriers: Language was an issue. Clarity of communication between participants was lacking in some cases. The native language of Saudi Arabia is Arabic. However, most GPs and cardiologists even Arab would communicate in English during the teleconsultation. This may be due to their education and the familiarity with English medical vocabularies. Consequently, this act made teleconsultation sessions prone to misunderstanding, particularly for patients whose native language is Arabic. Moreover, some of the patients become restless during the teleconsultation as they cannot understand the language and thus cannot participate and interact. See Figure 20.

Figure 20: Teleconsultation between Halat Ammar primary care centre and King Khalid Hospital

There were difficulties in scheduling some of teleconsultation. Both the GPs and Cardiologists are busy and getting GP, cardiologist and patient together at the same time for a teleconsultation is a cumbersome process. This is one of the reasons why we only 15 patients were involved in the study. During the two months of the pilot project, many teleconsultations were cancelled and rescheduled. Frequently, cardiologists were using break times to participate in the consultations.

7.5.2 Stakeholders opinions

A set of 14 questions was prepared in advance to evaluate the modified care pathway for cardiovascular disease patients utilising teleconsultation technology. A total of 60 interviews were completed with stakeholders including GPs, cardiologists, nurses, technicians, IT and decision-makers. Thematic analysis techniques were used to process,

analyse and interpret the qualitative raw data. NVIVO computer software (version 9.2) is used to organise and analyse the non-numerical response of stakeholders. The following themes emerged:

- Stakeholder attitude: There was consensus among the stakeholders that information and communication technology will help improve health delivery systems and quality of care. The majority of stakeholders were positive towards teleconsultation use. The cardiologist and GPs were particularly motivated to participate in the teleconsultation trials. The benefits of teleconsultation for CVD patients were recognised after the pilot project was undertaken. Moreover, they expressed their satisfaction in how teleconsultation was integrated to PCP. Their opinion on how teleconsultation benefitted the healthcare of CVD patients included quick ways to access remote patients, more efficient medical evaluation and patient management, enhanced role of primary healthcare centres in the health delivery system and GP experiences and improved coordination between primary health care centres and hospitals. Nearly all users involved in teleconsultation stated that the technology is very user friendly, reliable, convenient and easy to learn, particularly for persons who have only basic computer skills. A few participants recommended training sessions for users who might engage in teleconsultation. Most comments were directed at the data transfer process and how to digitise hard copies such as medical records and x-rays.
- Stakeholder opinion regarding challenges facing implementation of teleconsultation. The analysis of interview data has produced the following major common themes of challenges for teleconsultation:
    1) **Inadequate finance and infrastructure.** According to most stakeholders and decision-makers, the implementation and sustainability of teleconsultation systems will depend mainly on the availability of financial resources. They assert that the financial cost of installing network infrastructure, facilities and equipment in rural areas is significant, and continued availability of national support to initiate such systems is uncertain. Moreover, the ability to provide financial support to maintain

such telemedicine systems once established is also uncertain. The telemedicine service also has other cost implications. A new telemedicine service needs to recruit more technical and medical staff as well as clerical staff and office managers to support the running and development of the service. Furthermore, there are financial requirements to train the doctors, specialists and nurses who will work in the new system. However, most stakeholders consider that teleconsultation is cost-effective technology. In terms of infrastructure, stakeholders considered that the underdeveloped infrastructure, especially in rural areas, will constrain teleconsultation implementation. Mostly, limited infrastructure and unreliable Internet connectivity hinder the utilisation of Internet technology, which is the key element in telemedicine applications. Shortage of technical expertise has also been stated by a number of stakeholders as a teleconsultation barrier. Human resources and expertise capabilities are fundamental in sustaining teleconsultation operation and systems.

2) **Legal and regularity barriers.** The majority of stakeholders expressed that the absence of regulation and legal legislation can obstruct teleconsultation utilisation. Their concern regarding the privacy and security of computer-based patient records is significant. For example, for liability issues and future retrieval, most GPs and cardiologists confirmed that the video consultation session should be recorded and stored in a patient's medical file. These confidential medical records are jeopardised if left unprotected, especially in Saudi Arabia, which is sensitive about medical data and images of female patients. See Figure 21. They stated that policies should be enacted prior to implementation to address these issues.

Figure 21: Video-consultation, female participants (GP & patient)

Malpractice liability is another important issue and was raised by many stakeholders during the interview. According to them, teleconsultation is diagnosis and treatment process over the Internet, and errors are inevitable. Less skilled or negligent physicians can harm CVD patients. Also, teleconsultation may involve more health care providers than conventional face-to-face encounters, and this could potentially lead to confusion as to who is accountable for individual decisions and for the overall care of the patient as well as where liability falls. These concerns, according to them, need policy to be created in advance to clarify responsibility and to avoid potential malpractice or negligence complaints.

3) **Perceived increase in workload.** Concern was expressed by stakeholders, particularly GPs and cardiologists. They have understandable fear that teleconsultation will add more duties and additional workload.

Cardiologists stated that seeing extra patients over the Internet will be a cumbersome task especially with patients who need more frequent follow-up appointments. GPs were also worried about increasing workloads. They will have additional work when dealing with CVD patients such as performing stress tests and recording vital signs. In addition, the CVD patient management process will be in their responsibilities.

4) **Literacy on technology.** It refers to a lack of knowledge and skills to using information and communication technologies. This aspect was raised by the majority of stakeholders. They commented that the lack of capabilities of medical staff to manipulate the teleconsultation equipment and exchange digital data electronically between three tiers of the healthcare system (primary, secondary and tertiary) can obstruct teleconsultation use. Furthermore, it may cause the teleconsultation application to be under-utilised as not used at all.

The major barriers to teleconsultation utilisation in new the PCP for CVD patients in Saudi Arabia may be summarised:

- Inadequacy of finance.
- Limited infrastructure.
- Language.
- Scheduling difficulties.
- Legal and regularity difficulties.
- Perceived increase in workload.
- Literacy on technology.

8 Discussion

8.1 Introduction

The following section will discuss the results of this research. The format of the discussion will be based on the research objectives set beginning of thesis. The impact on and benefits for cardiovascular patients as well as the healthcare system will be assessed. The discussion includes how the national health policies, strategies and readiness may support the adoption of teleconsultation and where appropriate changes should be made to tackle obstacles**.**

8.2 Teleconsultation implementation key findings

Review of the literature and projects lunched in developed countries, especially in the field of teleconsultation, revealed the factors that have been found can maximize the likelihood of successful implementation of teleconsultation. The essential features are:

- Determine the goal of using teleconsultation by addressing patient needs along with assistance and involvement of healthcare givers.
- Identify a financial strategy.
- Set reasonable expectations and establish a plan to meet them.
- Pragmatic approach while responding to objectives with step-by-step advancement.
- Deploy teleconsultation in the health care system with minimal disruption.
- Ensure consumer acceptance and satisfaction by improving the quality of the health service.
- Ensure health provider acceptance by creating a motivating work environment with easy-to-use technology tools and less need for training.
- Implementation mentoring.
- Definition of key points (milestones) for evaluation.

Successful implementation of teleconsultation necessitates that the technology be introduced to the health care system with minimal disruption. The positive reactions and

experiences of patients who receive a telemedicine service suggest that telemedicine should be incorporated into the routine pathway of care that includes all the clinical routines or processes (Devine, 2009). The successful mainstreaming of telemedicine into the standard care process requires delivering care with telemedicine in the same way as delivering care without telemedicine. 'The more different it is, even in minor issues, the more change that has to be accepted. A simple rule to keep in mind is that the more change that must be adopted the higher the likelihood of failure' (Vanderwerf, 2004).

However, overall lack of evaluation data, trials, and published results concerning telemedicine initiatives has limited the amount of evidence on the impact and effectiveness of telemedicine (WHO, 2010). In addition, there is a lack of reports on current teleconsultation projects that describes how the teleconsultation application was deployed in their healthcare system.

The methodology adopted to develop the model of this pilot project was based upon using the patient care pathways (PCP) approach. PCP is a valuable approach when we work with complex systems such as healthcare delivery systems. Patient care pathways, which are also known in the literature as clinical pathways, care pathways, critical pathways or care maps generally refer to the route that a patient will take from their first contact with their GP, through referral, to the completion of treatment. It also covers the period from hospital admission to discharge. Patient pathways of care have also been presented as a concept and proposed as a tool to identify the interface between providers, the communication paths and give insight into the optimal design for delivery of services.

Based on the project, the patient care pathways tool provides a way to increase the chance of successful introduction of telemedicine. It allows the existing traditional healthcare delivery system to be depicted and understood. It was also utilized to predict the integration of teleconsultation into the mainstream healthcare delivery system and manage change. One most important benefits of using patient care pathways is to identify the challenges to alternative design and allows the different scenarios to be trialled without actually modifying or disturbing the system itself.

8.3 Discussion of Research objectives

8.3.1 Development of teleconsultation model

By modifying the traditional patient care pathway of cardiovascular patients, the teleconsultation model was built. The patient care pathways tool allowed the new care pathway of cardiovascular patient to be designed and clearly illustrate both the patient journey through the system and the information flow. Careful thought and consideration are needed in the design of the patient pathway of care to ensure that the protocols used for pathways including teleconsultation technology follow standard protocols as much as possible. It is very difficult to cut a program that is delivering a highly regarded volume of services. 'A consistent characteristic of unsuccessful telemedicine programs is that they saw themselves as somehow separate from the overall organization and had independent objectives. These programs lost support over time or were relegated to a minor and often experimental role in care delivery' (Vanderwerf, 2004). Due to these issues, the new model for the PCP for cardiovascular patients has only minor modifications in addition to the ICT.

Teleconsultation technology is used to improve the delivery of services and to enhance the management process for treatment. The traditional routes of care were observed first in order to determine the patient journey through all the stages of treatment. In addition, the Department of Primary Healthcare in the Saudi Ministry of Health and the decision-makers were visited in order to obtain the protocols that govern the clinical pathways for these patients. Observation was a key part of the study as it is a valuable tool in describing patient movement to obtain treatment. The observational approach is usually a flexible methodology. Also, observational data gathering is considered to be valid because the researcher is able to collect a wealth of information about a particular behaviour.

In the pre-implementation stage, mapping the traditional PCP through a flow chart (linear fashion) was very beneficial especially when dealing with a complex system like healthcare delivery system. It allows the flow of patient and information between the three health-care tiers to be depicted and understood. In addition, it allows the most appropriate points to insert technology to be determined.

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A case-study approach was an important aspect of the research. It was used to present the main work of this project, in order to validate and examine the proposed framework of the new cardiovascular disease patient care pathway in Saudi Arabia. This study also employed case-study methodology to investigate factors and issues that might act as barriers to establishing a teleconsultation system, and explored its impact on stakeholders. Case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2003). This method has been considered to be the most suitable for the exploration research method as it provides deep understanding of the phenomenon in its natural setting.

The re-modelled patient care pathway has been created based on recommendations of cardiologists and general physicians in addition to available facilities. This new PCP was also designed based on following considerations:

- The role of primary health-care centres should be strengthened and participating hospitals in providing health services for patients.
- There is a need to adopt an 'evidence-based' referral system in all health-care areas in order to reduce the burden on outpatient clinics.
- The interaction between all health-care levels must be promoted with the intention of developing better management of patients.
- Feedback reports to be used at in all health sectors to ensure completion of patient's treatment.

Therefore, it is suggested that the teleconsultation service needs to be sited in primary healthcare centres and regional hospital. This means that the patient is not required to make unnecessary travel and, more importantly, to travel large distances to a secondary hospital. All referral is evidence-based. Thus, for many who have transient CVD symptoms, unnecessary travel is avoided. Moreover, geographical and managerial obstacles remain to be overcome in order to deliver fast and efficient healthcare to CVD patients. Using this approach, both the patient and GP will be aware of the next steps that are to be taken based upon the specialist's advice. The patient will travel to hospital only when emergency intervention is needed, or when further investigations with advanced

medical equipments are necessary. Priority referral and less waiting time to see a cardiologist also result.

8.3.2 Adoption of the model with existing communication infrastructure

The teleconsultation service was established to connect the rural primary healthcare centre with the regional hospital in Saudi Arabia. Most remote primary healthcare centres are located in underdeveloped areas with limited telecommunication technology and infrastructure. The network connections in these areas can vary from basic telephone to low bandwidth Internet network. The bandwidth of the telecommunication link available in most primary healthcare sites in this pilot project was limited. High-resolution images require moderate to high bandwidth network to be show during real-time consultation. A hybrid mode of teleconsultation, combining two modalities asynchronous and synchronous is therefore adopted.

1) Asynchronous approach (store and forward) – all clinical information of patients (medical records and medical images) are captured, processed, analysed and then sent to consultant(s) in other locations.
2) Synchronous approach (real-time interaction) – face-to-face contact (image and voice), via video-conferencing equipment, between patient and specialist, who are geographically distant.

A combination of synchronous and Asynchronous approaches is required when features of both types are desired. This teleconsultation system awards the need for high bandwidth connections as the still images can be forwarded over low bandwidth lines in advance. Sending the physical examination record via store and forward can avoid the limitation on diagnosis capabilities during live video-consultation and maintain the cardiologist-patient live-interaction.

8.3.3 Evaluation of the model's impact on and benefits for cardiovascular patients as well as the healthcare system.

Evaluation is a necessary and important component of any telemedicine project. Evaluation results can help streamline potential telemedicine implementation and generate reliable data to develop national telemedicine policy and strategy. Moreover, it provides evidence-based data for further telemedicine adoption.

Review of the literature and previous research allowed a framework for assessing the telemedicine program to be created. Quality, access, cost, patient perceptions, and clinician perceptions are the five main dimensions used to evaluate telemedicine. However, there is no approved methodology regards how these evaluation dimensions should be measured.

For this study, it was important to conceptualize the teleconsultation service for its evaluation; the teleconsultation application should be examined in its natural setting. Therefore, this service was examined in the context of the patient care pathway.

The evaluation process was based on the following key points which also represent the five dimensions of evaluation.

- Access to specialists.
- Diagnosis time.
- Access to treatment.
- Waiting list and burden on hospital outpatients.
- Patient management (follow-up and feedback report (discharge letter)).
- Primary healthcare centre and hospital relationship.
- Quality of service.

Comparing the pre-implementation patient care pathway with the proposed pathway that using teleconsultation application was another important requirement in the evaluation process. This comparison would identify the implications of the changes and whether the PCP with teleconsultation has advantages over the conventional PCP.

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Data collection was largely based on observation. Observations were a key part of the study as they are a valuable tool in describing and evaluating a project, or process. Observation included all aspects including sensory elements such as sounds, time, and number of participants as well as non-sensory elements, such as feelings, thinking and impressions. Furthermore, photos of important events and places were also taken. The observation process for this thesis consists of two main parts. Firstly, the workflow of patients and information through the traditional patient care pathway was observed to capture the virtual health delivery process. Then, the modified patient care pathway with telemedicine technology was observed. Compared to traditional PCP, the modified PCP with teleconsultation benefits CVD patients through:

- Improved access to medical care by reducing the time required to access the cardiologist.
- Improved quality of diagnosis by obtaining the expertise of a distant specialist.
- More efficient medical evaluation and follow up management.
- Avoiding unnecessary travel.

Furthermore, Measurable benefits have been observed from the proposed model:

- Enhanced role of primary healthcare centres in the health system and participating hospitals by providing all levels of health services for patients.
- Improved relationship between primary health care centres and hospitals for the sake of patient management.
- Evidence-based referral (less waiting list - less burden on outpatient clinics in hospitals).

Telemedicine applications are a socio-technical network. Hence, introducing teleconsultation technology into the traditional PCP was not just reorganising the movement of patients between healthcare tiers, but also included human interaction and organisational dynamics. Accordingly, both quantitative and qualitative research methodology was adopted in this project. The questionnaire reveals aspects related to satisfaction, acceptant and concerns for the patients as well as work patterns and outcomes regards clinical aspects. Further aspects of the new patient care pathways would include quality of service, time efficiency and patient satisfaction.

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In this case, the patient satisfaction survey found that CVD patients readily accepted teleconsultation services. Nearly all of them were pleased with the technology as they obtained the diagnosis and treatment from the specialist remotely in very short time. They preferred the teleconsultation when compared to driving many miles to see the cardiologist face to face, due to avoiding travel difficulties such as expense and separation from family. Furthermore, the remote cardiologist-consultation raised the patient's trust in the diagnosis results and treatment advice. This confidence and satisfaction also was observed in families accompanying the CVD patient.

A face-to-face semi-structured interview was also conducted in this case study. A total of 60 interviews were completed with key stakeholders: GPs, cardiologists, nurses, technicians, IT, and decision makers. The interviews were conducted after the completion of the teleconsultation service with the intent that participant would have of the experience teleconsultation technology. The information obtained represents stakeholder attitudes and opinions regarding teleconsultation services. In addition, the interview questions investigated factors and issues that might act as barriers to teleconsultation adoption in the country. There was a consensus among stakeholders that information and communication technology will help improve health delivery systems and quality of care. Cardiologists and GPs were particularly motivated to participate in the teleconsultation trials. The benefits of teleconsultation to CVD patients were recognised after the pilot project was undertaken. Moreover, they expressed their satisfaction in how teleconsultation was integrated to the PCP. Their comments on how teleconsultation benefitted the healthcare of CVD patients included providing quick access to remote patients, more efficient medical evaluation and patient management, enhanced role of primary healthcare centres in the health delivery system, as well as enhanced GP experiences and improved coordination between primary health care centres and hospitals. Nearly all users involved in teleconsultation practice stated that the technology is very user friendly and reliable, convenient and easy to learn, particularly for persons who have basic computer skills.

Stakeholder opinion regarding challenges facing teleconsultation implementation in Saudi Arabia can be summarized as:

- Inadequate of finance
- Limited infrastructure
- Language
- Scheduling difficulties
- Legal and regularity difficulties
- Perceived increase in workload
- Literacy on technology

8.3.4 Exploration of national health policies, strategies and readiness to adoption of teleconsultation service.

In term of strategies, The Kingdom of Saudi Arabia realized years ago the importance of information and communication technology and shares the world view towards information and communication technology. Therefore, over recent years, remarkable progress has been made in different ICT fields including connectivity and access, sector reforms, national IT initiatives and e-Services. The Kingdom has adopted a multi-phase plan to restructure the ICT sector in four phases and has strengthened national plans and initiatives through close cooperation with agencies such as the United Nations Development Programme (UNDP, 2006), the Communications and Information Technology Commission (Commission, 2005), and the Economic and Social Commission for Western Asia (ESCWA, 2005) among others (Qurban & Austria, 2008). The national ICT plan includes a long-term vision and a first five-year plan for ICT in the Kingdom. The long-term vision is to convert the country to an information society, so as to increase effectiveness and efficiency and provide services for all sectors of society. The five-year plan includes projects that cover the main aspects of ICT usage such as e-Government, e-Commerce, e-learning, telemedicine, telework, digital Arabic and Islamic/cultural content (Commission, 2005). The use of ICT in the healthcare sector, however, is still in its infancy, with limited implementation. The Saudi Arabian Ministry of Health, which serves almost 60% of the population, conducted a study to assess the benefits, especially the financial aspect, of using ICT in the health sector. They found that

the government would save around 10 to 15% of its annual health budget with the implementation of e-health. As a result, the Ministry of Health has allocated 4 billion Saudi Riyals (approximately 1.1 billion USD) to the development of e-health programs within the next four consecutive years (2008-2012) in order to elevate the quality of healthcare and service delivery (Qurban & Austria, 2008). Today, the Kingdom of Saudi Arabia is increasingly interested in hosting global ICT conferences such as the Saudi E-Health 2010 Conference to bring together both healthcare providers and information technologists from all over the world to harness their expertise as well as to empower advancements in the delivery, quality, and continuity of health care in Saudi Arabia.

Readiness is an essential and preliminary step in the successful implementation of telemedicine services in existing health systems. It can be measured prior to the implementation of telemedicine. For an innovation in healthcare, the assessment of readiness can decrease the risk of its failure after introduction (Jennett, Gagnon, & Brandstadt, 2005). Readiness for telemedicine is a versatile concept related to planning and the workplace environment (Jennett, et al., 2003). It is reflected in an organization's beliefs, attitudes, and intentions about the extent to which changes are needed, as well as its capacity to successfully make a change (Susanto, 2008). Public perception also plays a central role in readiness to shift to telematic health and in evaluating the barriers that could limit deployment of and access to telemedicine services. Previous studies on public perception related to telemedicine and other e-health initiatives in Saudi Arabia are almost non-existent. However, this study has found that most of the stakeholders involved had a positive impression toward the teleconsultation service. This indicates that technology acceptance among the public in Saudi Arabia can be achieved through maximizing the knowledge and awareness of the stakeholders regarding telemedicine technology. Also, information literacy activities such as information dissemination, awareness campaigns, and training initiatives should be undertaken to resolve the lack of knowledge of e-health issues, as well as reduce the digital divide between Saudi nationals (Qurban & Austria, 2008). Further, according to one of the participants in the study, "challenges that face telemedicine implementation in Saudi Arabia can limit the community readiness for change to ICT utilization".

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Structural readiness includes appropriate infrastructure, adequate funding, human resources and equipment are enablers for successful teleconsultation services. The challenges that have been raised through observation and interviews with stakeholders are have the following solutions suggested.

- Inadequacy of finance: By reviewing literature, the Saudi Arabian Ministry of Health, conducted a study to assess the benefits, especially the financial aspect, of using ICT in the health sector. They found that the government would save around 10 to 15% of its annual health budget with the implementation of e-health. As a result, the Ministry of Health allocated 4 billion Saudi Riyals (approximately 1.1 billion USD) to the development of e-health programs within the next four consecutive years (2008-2012) in order to elevate the quality of healthcare and service delivery (Qurban & Austria, 2008). This shows that the government are willing to support and fund potential telemedicine projects in the country but for the most series issues, they guarantee the continuity of support and funding. Inadequate fund planning for projects is a key reason for failure.

  The Ministry of Health is required to adopt long term financial police and strategies for any potential ICT implementation and commit to integrating it into the national health delivery system. A financial analysis of a telemedicine project should be conducted to define current and projected expenses (including capital and operating costs and potential network fees) (TecKnowledge, 2002). Regarding the new model, the costs of the teleconsultation service are divided into two categories: recurring (ongoing) costs and non-recurring (one-time or start-up) costs.

  Recurring Costs:

  - Personnel salaries, benefits, and training costs
  - Telecommunications costs (fixed and variable) such as hardware maintenance, upgrade and replacement also software licenses, maintenance and upgrades
  - Technical Support Supplies

Non-Recurring Costs:

- Consulting Fees for specific project/program
- Hardware, Software or Network Purchases - new equipment or infrastructure
- Training on new equipment or applications

❖ Limited infrastructure: In this pilot project, the new model was adapted to the available communication infrastructure. The challenge of low bandwidth internet was overcome by utilizing two teleconsultation approaches (asynchronous and synchronous). Telecommunication infrastructure in Saudi Arabia has been highly developed in the last few years, particularly in utilizing Internet technologies. However, access to computing and reliable internet connections with medium to high bandwidth are only available in large cities. Most primary healthcare centres are located in underdeveloped rural areas where network connections vary from basic telephone to low bandwidth Internet network. Inadequate access to computing and unavailability of Internet connectivity impose limitations on teleconsultation use. Low bandwidth Internet can limit the efficacy of remote diagnosis and delay imaging during use of videoconferencing. Bringing changes in infrastructure to allow easier access to computers, Internet, and other necessary information in all the country are necessary for a smooth transition for e-Health (Khoja, Durrani, & Fahim, 2008). All relevant government institutions should develop clear policies and guidelines for providing a suitable telecommunication infrastructure to promote ICT utilization. Proactive policies to encourage growth of the telecommunication sector in the country and increase connectivity especially in rural areas will enhance the chances of implementing successful telemedicine services and integrate it to the healthcare delivery system.

❖ Legal and regularity difficulties: The aim of legislation is to regularize all aspects of telemedicine and to clarify the legality of the doctor-patient relationship during telemedicine sessions. Moreover, it is essential to guarantee the safe and high-quality practice of telemedicine (Klapan & Poropatich, 2006). The King Abdul Aziz City for Science & Technology (KACST) was established by the

government of Saudi Arabia to assist the country into transformation of ICT. The main task of this institution is to set a comprehensive national ICT plan and related legal and regulation frameworks. Legal and regulatory frameworks are increasingly being updated and adapted, albeit insufficient for ICT industrial and consumer needs, with poor performance on enforcement (ESCWA, 2008). In the field of teleconsultation, the legal and regulatory problems that can be faced are related to privacy, security and malpractice liability. These concerns have also been raised by the stakeholders through the interviews. Their concern regarding the privacy and security of computer-based patient records is significant. For example, for liability issues and future retrieval, most GPs and cardiologists confirmed that video consultation session should be recorded and stored in the medical file of the patient. These confidential medical records are jeopardised if left unprotected, especially in our country, which is sensitive about the medical data and images of female patients. Malpractice liability is another important issue and was raised by many stakeholders during their interview. According to them, teleconsultation is diagnosis and treatment process over the Internet, and errors are inevitable. Less skilled or negligent physicians can harm CVD patients. Also, teleconsultation may involve more health care providers than conventional face-to-face encounters, and this could potentially lead to confusion as to who is accountable for individual decisions and for the overall care of the patient as well as where liability falls.

A suggested legal and regularity framework can be summarized as following:

- Registration and accreditation of practitioners providing telemedicine services with the relevant national authorities.
- Identification of appropriate legislation when dealing with liability claims.
- Enact national security laws to protect privacy and confidentiality.

- Organizational matters: Scheduling difficulties and fear of increase in workload are concerns expressed by stakeholders, particularly GPs and cardiologists. They fear that teleconsultation will add more duties and additional workload.

CHAPTER EIGHT– DISCUSSION

Cardiologists stated that seeing extra patients over the Internet will be a cumbersome task especially with patients who need more frequent follow-up appointments. GPs were also worried about increasing workloads. The CVD patient management process will become one of their responsibilities. Difficulties in teleconsultation scheduling were also observed. In Saudi Arabia, GPs are very busy people, especially in rural areas. Cardiologists are busy too due to high demand and shortages of specialists in most hospitals in the country. As a consequence, arranging GPs, cardiologists and patients to be together at the same time for the teleconsultation is a cumbersome process.

In such cases, a new management strategy is the key point. Teleconsultation activities need to be integrated into the routine duties of healthcare staff. Rearranging working schedules of doctors and assistant staff can be adequate to deal with the timetable for teleconsultation sessions. Normally, assistant health staff such as nurses and administrators is the ones who have to organize and prepare teleconsultations. Moreover, telemedicine does not increase the number of patients rather it changes the way consultation is conducted from traditional face to face to teleconsultation.

In conclusion, teleconsultation needs to be integrated into the mainstream health care delivery system with minimal disruption. By considering the conventional care pathway and redesigning it by adding the teleconsultation service is the most successful approach for implementation. Promoting community perception and readiness for ICT service transformation is also an essential and preliminary step. In addition, structural readiness including appropriate infrastructure, adequate funding, human resources and equipment are enablers for successful teleconsultation services. Finally, proactive policies to encourage growth of the telecommunication sector and to address concerns regarding to privacy and security are crucial issues.

9 Conclusion

9.1 Introduction

In this chapter, the main findings and key results of the pilot study will be highlighted. Conclusions made here are the interpretations of empirical material and issues drawn from the discussion section. This study was aimed to design and develop a new care pathway for cardiovascular disease patients by utilizing telemedicine technology, investigating factors and issues that might act as barriers to its adoption, and then evaluating the impact of this model on stakeholders. A pilot project was used in order to evaluate the validity and applicability of this service and technology in Saudi Arabia.

Research limitations will be also considered at the end of the chapter.

9.2 Main conclusions

The project was initiated with the aim of developing health services for cardiovascular disease patients within healthcare institutions of the Saudi Arabian Ministry of Health by using information and communication technology. Teleconsultation technology is used to improve the delivery of services and to enhance the management of treatment.

A pilot project has been conducted in medical institutions belonging to the Saudi Ministry of Health to investigate the introduction of teleconsulation services. In addition, evaluate its impact on stakeholders and the healthcare delivery system. This activity has been carried out in four rural primary healthcare centres and two district hospitals. The teleconsultation service was established to connect rural primary healthcare centres with their regional hospital with the intent to bring together CVD patient and cardiologist in the shortest time and without the need to travel.

The methodology adopted to develop the model for this pilot project was based upon using the patient care pathways (PCP) approach. From the project, it was seen that the patient care pathway tool provides an opportunity to increase the chance of successful introduction of telemedicine and successful implementation. It allows conceptualization and understanding of the existing traditional healthcare delivery system. Also, it was utilized to plan the integration of teleconsultation into the mainstream healthcare delivery

system and manage change. One of the most important benefits of using patient care pathway is to identify challenges to alternative designs and allows consideration of different scenarios without actually modifying or disturbing the system itself.

A total of 15 patients and 60 stakeholders including GPs, cardiologists, nurses, technicians, IT, and decision makers participated in this study. Observation, questionnaires and interviews were used as the data collection tools. Empirical data was collected with aim to determine and appraise the following criteria:

- Access to specialists.
- Diagnosis time.
- Access to treatment.
- Waiting list and burden on hospital outpatients.
- Patient management (follow-up and feedback report).
- Primary healthcare centre and hospital relationship.
- Quality of service.

The main key findings confirmed that the teleconsultation service can benefit both cardiovascular patients and the healthcare delivery system in Saudi Arabia through:

- Improved accesses to medical care and enable CVD patients to have live interaction with the cardiologist in another location.
- Improved quality of diagnosis by obtaining the expertise of a distant specialist.
- More efficient medical evaluation and management.
- Evidence-based referral (less waiting list - less burden in outpatient clinics in hospitals)
- Avoiding unnecessary travel.
- Enhanced role of primary healthcare centres in the health system and participating hospitals, by providing all levels of health services for patients.
- Improved relationship between primary health care centres and hospitals for the sake of patient management.

This study concludes that community perception and readiness promotion for ICT services transformation is also an essential and preliminary step. In addition, structural

readiness including appropriate infrastructure, adequate funding, human resources and equipment are enablers for successful teleconsultation services. Proactive policies to encourage growth of the telecommunication sector and to address concerns regarding to privacy and security are also a crucial issue.

Finally, this study can provide significant data for future application of telemedicine in Saudi Arabia, since it identifies potential obstacles to its implementation.

9.3 Research limitations

There are a number of limitations in this study that need to be addressed.

1. This pilot project has been conducted in only 2 of the 19 health regions that represent the country. The sample of participant patients was also small, so the results may not be generalizable to the whole population. Reasons such as time and the long process to obtain permissions to access health institutions and involve patients in the study did not allow more hospitals and primary centres as well as additional patients to be included.
2. Cost is an important factor in telemedicine adoption. A full cost evaluation to identify cost-benefit of teleconsultation service can provide full evidence for decision-making. Further research on estimating the cost and cost-effectiveness of teleconsultation service compared with usual routine care are required in the future.

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11 APPENDICIES

11.1 Appendix 1 Ethical Approval

School of Information Systems, Computing and Mathematics
David Gilbert, Head of School, Professor of Computing
Jasna Kuljis, Head of Information Systems and Computing, Professor of Computing
Tony Rawlins, Head of Mathematical Science, Professor of Mathematics

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Date: 16 December 2011

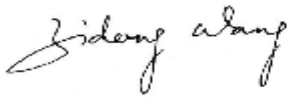
STATEMENT OF ETHICS APPROVAL

Proposer: Naif Almotiri

Title: Teleconsultation perspective for cardiovascular disease in Saudi Arabia

The school's research ethics committee has considered the proposal recently submitted by you. Acting under delegated authority, the committee is satisfied that there is no objection on ethical grounds to the proposed study. Approval is given on the understanding that you will adhere to the terms agreed with participants and to inform the committee of any change of plans in relations to the information provided in the application form.

Yours sincerely,



Professor Zidong Wang
Chair of the Research Ethics Committee
SISCM

APPENDICIES

11.2 Appendix 2 Information Sheet

(English copy)

Telemedicine Information Sheet

Title of Project: Teleconsultation perspective for cardiovascular diseases in Saudi Arabia

You are invited to take part in a research study. Before deciding whether you wish to participate, it is important that you understand the purpose of this research and what it involves. Please take time to read the following information carefully and to discuss it with relatives or your general practitioner (GP) if you wish. Ask if there is anything that is not clear or if you require more information.

1. **What is the purpose of the study?**

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in Saudi Arabia. There is an urgent need to adopt new health strategies and management programmes that can assist in handling the CVD risk. One such strategy is the use of information and communication technology. Many benefits can be obtained by utilising telemedicine to tackle CVD. The overall aim of this pilot study is to design and develop a new approach for managing cardiovascular disease patients by using telemedicine technology. It will investigate the factors that might act as barriers to its adoption and evaluating the impact of this model on stakeholders.

2. **Do I have to take part?**

It is totally your choice whether to take part. First, however, take your time to read this information sheet. If you decide to participate, you will be asked to sign a consent form. You are free to withdraw at any time during the study, without giving a reason. Withdrawal will not affect the standard of care you receive or affect your medical or legal rights and we will respect your decision.

3. **What will happen to me if I take part?**

You will receive treatment in accordance with the approach, which includes use of information and communication technology. In the first stage, you will be seen by a primary healthcare physician for evaluation and, if necessary, medical tests. After that, if you are thought to have cardiovascular disease, all the information, including your medical history, tests, images, and reported symptoms will be sent directly to a

cardiologist in a remote hospital via the internet as an e-mail. In the second stage, the cardiologists will assess your condition and provide his opinion. One of the following will be the outcome:

- The symptoms are not associated with a cardiovascular problem.
- A problem is indicated and you will be invited to a (live two-way audio and video interaction with the cardiologist to discuss the next stages of for treatment and to receive advice.
- You will be referred to hospital for further medical tests and to see a doctor afterwards in an outpatient clinic.
- You need to be referred to hospital immediately.

4. What are the possible benefits of taking part?

- Improved medical care by enabling your general physician (GP) to give advice on your treatment in more timely fashion.
- Reduced need to travel.

5. What are the possible risks of taking part?

There are no risks in taking part in the research

6. What will happen to the results of the research study?

The results of the study will form part of my thesis and will be published in scientific journals and presented at conferences. The raw data will be anonymised and stored securely until destroyed.

If you have any concerns or complaints regarding this project please contact siscm-srec@brunel.ac.uk **or Dr Annette Payne Tel. No. 0044 (0)1895266295**

Please initial here after reading this page: _____ Date_____

APPENDICIES

Information Sheet (Arabic)

التطبيب عن بعد (معلومات للمشارك بالبحث)

أسم البحث: منظور تكنولوجيا التطبيب عن بعد لمرضى القلب والجهاز الدوري في المملكه العربيه السعوديه

انت مدعو إلى المشاركة في دراسة بحثية لأحدى تطبيقات التطبيب عن بعد. قبل أن تقرر ما إذا كنت تريد أن تشارك، من المهم أن تفهم لماذا سيجري البحث وماذا سوف يشمل . يرجى أخذ الوقت الكافي لقراءة المعلومات التالية بعناية ومناقشتها مع أقاربك أو طبيب مركز الرعايه الصحيه إذا كنت ترغب في ذلك. كما ارجوا منك ان لا تردد في سؤالي إذا كان هناك أي شيء غير واضح أو إذا كنت ترغب في مزيد من المعلومات.

١. **ما هي الغايه من البحث؟**

ان أمراض القلب والأوعية الدموية هي احدى الاسباب الرئيسيه لزيادة معدلات الاعتلال والوفيات في المملكة العربية السعودية. وهناك حاجة ماسة إلى اعتماد أستراتيجيات صحية جديدة وبرامج إدارة للمرضى تمكن أن تساعد في التعامل مع خطر الأمراض القلبية الوعائية. واحد هذه ألاستراتيجيات هو استخدام تكنولوجيا المعلومات والاتصالات. حيث يمكن الحصول على فوائد كبيرة من خلال الاستفادة من تكنولوجيا التطبيب عن بعد لمعالجة معضلة الأمراض القلبية الوعائية. الهدف العام لهذه الدراسة الرائدة هو تصميم وتطوير طرق رعايه جديده للمرضى الذين يعانون أمراض القلب والشرايين، ومن ثم الأستقصاء عن العوامل والمسائل التي قد تكون بمثابة الحواجز التي تحول دون اعتماده ، كذلك تقييم تأثير هذا النموذج على أصحاب المصلحة.

٢. **هل يجب علي المشاركه في البحث؟**

الأمر متروك تماما لك أن تقرر ما إذا كانت تريد المشاركة أم لا، وإذا قررت المشاركة سوف يطلب منك التوقيع على استمارة الموافقة. يجب أن تعلم ان لك كامل الحريه في الانسحاب في أي وقت خلال الدراسة ، من دون اعطاء سبب. لن يؤث الانسحاب على مستوى الرعاية المقدم لك او على حقوقكم الطبية أو القانونية وسنحترم قرارك.

٣. **ماذا سيحدث لي اذا شاركت؟**

سيتم تقديم الرعاية لكم من خلال مسار جديد إلى جانب استخدام تكنولوجيا المعلومات والاتصالات. في المرحلة الأولى ، وكالعادة، سوف تقيم من قبل طبيب الرعاية الصحية الأولية وسوف يجرى لك بعض الفحوصات والتحاليل الطبيه إذا لزم الأمر. بعد ذلك، إذا كانت حالتك تستدعي ان تقيم من قبل طبيب أخصائي فأن كل المعلومات التي قد تشمل التاريخ الطبي الخاص بك والصور والعلامات الجسدية، وكذلك تقرير الاعراض المصاحبه سيتم إرسالها مباشرة إلى أخصائي القلب والأوعية الدموية في المستشفى عبر الإنترنت عن طريق البريد الإلكتروني. و لتعزيز سرعة ألاستجابة سوف نرسل إشعارا عن طريق خدمات

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الرسائل القصيرة (SMS) عبر الشبكة الخلوية. في المرحلة الثانية سوف يقوم الأستشاري بتقيم حالتك وارساله الينا في نفس اليوم او اليوم التالي على الأكثر. ان نتيجة تقييم الأستشاري، سوف تحدد المرحله التاليه والتي ستكون احد الأمور التاليه

- حالتك لا ترتبط مع أعراض المشكلة القلب والأوعية الدموية.
- الأعراض قد تنبأ عن بداية أحدى المشاكل في جهزك الدوري وعليه سيجرى اتصال صوتي ومرئي بينك وبين الأستشاري وذلك في حضور طبيب مركز الرعايه الصحيه الأوليه. ذلك لتقديم المشوره والعلاج أذا لزم الأمر.
- تحتاج إلى أن تحال إلى المستشفى لمزيد من الفحص الطبي ورؤية الطبيب في العيادات الخارجية.
- يجب أن تحال الى الطوارئ في المستشفى.

٤. ما هي الفوائد التي يمكن أن تتاح للمشارك؟

- تحسين فرص الحصول على الرعاية الطبية من خلال تمكين المريض من البقاء في موقعه، في حين أن طبيب مركز الصحه الأوليه سيعمل على اخذ راي المختص من بعد.
- تقييم طبي أكثر كفاءة وأداره مستقبليه لحالة المريض.
- الحصول على خبرة متخصصة أياً كان موقها.

٥. ما هي المخاطر المحتملة من المشاركة؟

ان استخدام هذه التقنيه أمن ولن يصاحبها اي مخاطر على الأطلاق.

٦. ماذا سيحدث لنتائج الدراسة البحثية؟

ستكون نتائج هذه الدراسة جزءا من أطروحتي لرسالة الدكتوراه، وقد يتم نشر بعض من اوراق هذه الرساله في المجلات العلمية وعرضها في المؤتمرات. أما البيانات الشخصيه لهذه البيانات سيكون مجهولاً وسيتم اتلاف جميع البيانات عند أنتهاء الغرض منها.

اذا كان لديك اية شكوى بخصوص هذا المشروع يرجى الاتصال بالدكتور انيت باين على الهاتف رقم ٠٠٤٤١٨٩٥٢٦٦٢٩٥ او المراسله على البريد الالكتروني siscm-srec@brunel.ac.uk

ألرجاء التوقيع هنا _____ التاريخ _____

APPENDICIES

11.3 Appendix 3 *Teleconsultation Consent Form*

(English Copy)

Informed Consent for Teleconsultation service

Title of Project: Teleconsultation perspective for cardiovascular diseases in Saudi Arabia

Name of Researcher: Naif Almotiri

I accept to use teleconsultation service in the course of my diagnosis and treatment. I understand that teleconsultation involves two-way interactive video communications and/or electronic transmission of information. This means that I may be evaluated and treated by other health care practitioners located in other parts of the country. Since this is different than the type of consultation with which I am familiar, **I understand and agree to the following**:

1. My participation is voluntary and that I am free to withdraw at any time, without giving any reason.
2. The consulting health care provider or specialist will be at a different location from me. A physician or other health care provider (GP) will be at my location with me to assist in the consultation.
3. My physician will communicate medical information that concerns me to physicians and other health care practitioners located in other parts of the country.
4. I will be informed if any additional personnel are to be present other than myself, individuals accompanying me, the consultant, presenting practitioner and Mr Naif Almotiri. I will give my verbal permission prior to additional personnel being present.
5. The laws that protect the confidentiality of medical information apply to telemedicine, and that no information or images from the telemedicine interaction which identify me will be disclosed to other entities without my consent.
6. Video recordings may be taken of the teleconsultation, after I have given my written permission prior to recording. Video recordings and other data, including x-rays, images and photos may be kept, viewed and used for research purposes, but my identity will in no way be linked to this data.
7. I have the right to inspect all information obtained and recorded in the course of a telemedicine interaction.
8. I may expect the anticipated benefits from the use of telemedicine in my care, but that no results can be guaranteed or assured.

Name of Patient	Signature	Date

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General Physician (GP) Section

I am willing to work with Dr_____at _____ in cooperation with patient (signature above) regarding his/her medical care.

_____	_____	_____
GP Name	Signature	Date

Consultant Section

I am willing to work with Dr_____at _____ in cooperation with patient (signature above) regarding his/her medical care.

_____	_____	_____
Consultant Name	Signature	Date

APPENDICIES

Interview /Questionnaire Consent Form (English)

Consent Form

Title of Project: Teleconsultation perspective for cardiovascular diseases in Saudi Arabia

Name of Researcher: Naif Almotiri

Please tick box

1.	I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information and ask questions, and have had these answered satisfactorily.	☐
2.	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.	☐
3.	I agree to the interview being audio taped.	☐
4.	I agree to take part in the above study.	☐

Name of participant Date

Signature

--- --- ---

APPENDICIES

Teleconsultation Consent Form (Arabic)

تبليغ موافقه على المشاركه في خدمة التطبيب عن بعد

أسم البحث: منظور تكنولوجيا التطبيب عن بعد لمرضى القلب والجهاز الدوري في المملكه العربيه السعوديه

اسم الباحث: نايف المطيري

أنا الموقع أدناه اوافق على المشاركه بخدمة الاستشاره عن بعد (teleconsultation) في سياق التشخيص والعلاج لحالتي. أنا أفهم هذا التطبيق ينطوي عليه اجراء اتصال مرئي تفاعلي و / أو نقل المعلومات الكترونيا. وان هذا يعني أنه من الممكن تسخيص وتقيم حالتي المرضيه من خلال طبيب مختص سيكون في منشاه صحيه في موقع اخر. كما افهم ان هذا اتشخيص هو نوع مختلف التشخيص الاعتيادي الذي يتم وجها لوجه مع الطبيب المختص. **كما انني أفهم وأوافق على ما يلي:**

١. مشاركتي أمر طوعي وأنني حر في الانسحاب في أي وقت ، دون إبداء أي سبب.
٢. سيكون الطبيب الأخصائي في موقع مختلف. بينما سيتواجد معي طبيب مركز الرعاية الصحية الأوليه في نفس الموقع للمساعدة في عملية التطبيب عن بعد.
٣. سوف يقوم طبيبي في مركز الرعايه الصحيه الأوليه بتوصيل المعلومات الطبية المتعلقة لي الى الطبيب الأخصائي في موقع أخر في المملكه.
٤. ان هذا التطبيق سيتطلب فقط وجودي اضافة الى المرفقين معي . كما سيتطلب وجود طبيب مركز الرعايه الصحيه الأوليه والطبيب الأخصائي بالأضافه الى السيد نايف المطيري ، وأي مشركه لأ ي فرد أخر سيتم إبلاغي بها مسبقا لأعطاء الأذن.
٥. ان القوانين التي تحمي سرية المعلومات الطبية سوف تطبق على هذا الأجراء. كما ان اي معلومات أو صور تخصني خلال عملية التطبيب عن بعد لن تكشف الا بأذن مني.
٦. من الممكن ان يتم تسجيل عملية الأتصال المرئي وعليه فان اي استخدام لهذه التسجيلات او البيانات المصاحبه من صور او أشعه او معلومات طبيه سيكون لغرض البحث فقط وسوف يتم مسح هوية صاحب البيانات.
٧. سيكون لدي الحق في تفتيش جميع المعلومات التي تم تسجيلها و الحصول عليها خلال عملية التطبيب عن بعد.
٨. قد يكون هناك فوائد متوقعة من استخدام التطبيب عن بعد، ولكنها ليست مضمونه.

أسم المريض	التوقيع	التاريخ

طبيب مركز الرعايه الصحيه

أنا على استعداد للعمل مع الدكتور _____ والذي يعمل في _____

APPENDICIES

في تشخيص وعلاج المريض (الموقع أعلاه) وذلك من خلال استخدام تطبيق التطبيب عن بعد.

أسم الطبيب	التوقيع	التاريخ

الطبيب الأخصائي

أنا على استعداد للعمل مع الدكتور _____ والذي يعمل في _____

في تشخيص وعلاج المريض (الموقع أعلاه) وذلك من خلال استخدام تطبيق التطبيب عن بعد.

أسم الطبيب	التوقيع	التاريخ

APPENDICIES

Interview / Questionnaire Consent Form (Arabic)

نموذج موافقه

أسم البحث: منظور تكنولوجيا التطبيب عن بعد لمرضى القلب والجهاز الدوري في المملكه العربيه السعوديه

اسم الباحث: نايف المطيري

يرجى وضع علامه في

الخانات التاليه

١. أؤكد أنني قد قرأت وفهمت كل ما جاء في ورقة المعلومات الخاصه بالدراسة المشار إليها أعلاه. كما قد أتيحت لي الفرصة للنظر في المعلومات وطرح الأسئلة ، وكانت جميع الأجابات مرضية لي.	☐
٢. أنا أفهم أن مشاركتي طوعية وأنني حر في الانسحاب في أي وقت ، دون إبداء أي سبب.	☐
٣. أوافق على ان يتم تسجيل المقابله صوتيا.	☐
٤. أوافق على المشاركه في الدراسه المشار اليها أعلاه.	☐

_____	_____	_____
أسم المشارك	التوقيع	التاريخ

APPENDICIES

11.4 Appendix 4 Questionnaire

(English copy)

Patient Satisfaction Questionnaire

Name: _____ Age: _____Gender: _____

Before beginning video-consultation

1. Have you ever heard about telemedicine?

   ( ) Yes **( ) No**

2. How do you feel about being diagnosed remotely by a consultant?

   ( ) Comfortable **( ) Not sure** **( ) Uncomfortable**

After Taking part in teleconsultation

3. How satisfied are you with the type of consultation you received?

   ( ) Extremely satisfied **( ) Satisfied** **( ) Unsatisfied**

4. Were you comfortable during the telemedicine consultation?

   ( ) Very comfortable **( ) comfortable** **( ) Uncomfortable**

5. Did you experience any trouble seeing or hearing the specialist during the Teleconsultation?

   ( ) Yes **( ) No**

6. Are you satisfied with the information given to you regarding your diagnosis results and treatment?

   ( ) Extremely satisfied **( ) Satisfied** **( ) Unsatisfied**

7. Do you think that diagnosing via telemedicine service is as good as seeing the physician face-to-face?

   ( ) Yes **( ) Not sure** **( ) No**

8. Would prefer travelling to hospital to discuss your health with the consultant in person?

   ( ) Yes **( ) No**

9. Do you think applying telemedicine in the country might be contrary to the following:

   - **Culture** **( ) Yes** **( ) No**
   - **Religion** **( ) Yes** **( ) No**
   - **Privacy** **( ) Yes** **( ) No**

10. Would you please rank the following items in order of importance regarding advantages of Telemedicine service being provided to you (most important = 1, least important=3):

    ( ) Save time

    ( ) Avoid travel difficulties such as expense and separation from family

    ( ) Access to specialist physician

11. How would you rate the quality of the service you have received whilst using the telemedicine consultation?

    ( ) Excellent **( ) Good** **( ) Fair** **( ) Poor**

12. In the future, would you be happy to use the telemedicine service again?

    ( ) Yes **( ) Not sure** **( ) No**

*General Physician (GP):*_____

*Specialist physician:*_____

*Location:*_____

*Date of Completion:*_____

Thank you very much for your time

APPENDICIES

Tele-consultation Questionnaire (Arabic Form)

استبيان مدى رضا المرضى حول تطبيق التطبيب عن بعد

الاسم: _____ العمر: _____ الجنس: _____

قبل البدء في الاتصال المرئي مع الاستشاري

١) هل سبق لك ان سمعت عن تقنية التطبيب عن بعد؟

( ) نعم **( ) لا**

٢) كيف تشعر حيال عملية تشخيصك من قبل الطبيب المختص عن بعد؟

( ) مرتاح **( ) غير متأكد** **( )غير مرتاح**

بعد تطبيق الاتصال المرئي مع الاستشاري

٣) الى اي مدى انت راضي عن طريقة التشخيص التي اجريت لك؟

( ) راضي جدا **( ) راضي** **( )غير راضي**

٤) هل كنت مرتاح خلال عملية الأستشاره عن بعد؟

( ) مرتاح جدا **( ) مرتاح** **( )غير مرتاح**

٥) هل واجهتك اي صعوبات في رؤية او سماع الطبيب خلال عملية الاتصال المرئي؟

( ) نعم **( ) لا**

٦) هل انت راضي عن المعلومات التي تلقيتها بشأن نتيجة التشخيص والعلاج المقترح؟

( ) راضي جدا **( ) راضي** **( )غير راضي**

٧) هل تعتقد ان تشخيص المريض عن بعد من قبل الطبيب المختص خدمه جيده كما هي مقابلته وجها لوجه؟

( ) نعم **( )لست متأكد** **( ) لا**

٨) هل انت تفضل السفر لرؤية الطبيب المختص وجها لوجه عن استخدام التقنيه؟

( ) نعم **( ) لا**

٩) هل تعتقد ان تطبيق التطبيب عن بعد في المملكه قد يتناقض مع ما يلي:

- **الثقافه :** **( ) نعم** **( ) لا**
- **الدين :** **( ) نعم** **( ) لا**
- **الخصوصيه :** **( ) نعم** **( ) لا**

١٠) يرجى منك ترتيب العناصر التاليه من حيث الأهميه فيما يتعلق بمزايا التطبيب عن بعد المقدمه (الاهم =١، الأقل اهميه =٣):

( ) توفير الوقت

( ) تجنب صعوبات السفر كالنفقات المترتبه والبعد عن العائله

( ) امكانية الوصول الى الطيب الأختصاصي

١١) كيف يمكن ان تصنف جودة الخدمه التي قدمت لك من خلال التطبيب عن بعد؟

( ) ممتازه **( ) جيده** **( ) مقبوله** **( ) ضعيفه**

١٢) هل ستفضل استخدام هذه التقنية في المستقبل ان اتيحت لك الفرصه مرة أخرى؟

( ) نعم **( )لست متأكد** **( ) لا**

طبيب الرعايه الصحيه:_____

الطبيب الأخصائي:_____

الموقع:_____

التاريخ:_____

شكرا جزيلا على وقتك

APPENDICIES

11.5 Appendix 5 Interviews Questions

Interviews Questions Form

Participant Name:

Interview Date:

1) Could you please tell me what is your job and responsibilities?
2) To what extent do you think information and communication technology has a role to play in the future provision of healthcare services?
3) Have you ever heard of telemedicine?
4) If yes, what can you tell us about telemedicine and teleconsultation?
5) Thank you for taking part in the video-consultation. Could you tell me what was your role in the teleconsultation implementation?
6) What was your first impression of the teleconsultation service?
7) Would you recommend this type of service? If no, why?
8) In your opinion, to what extent do cardiovascular patients benefit from this service and who else can benefit from telemedicine?
9) What disadvantages do you think are present within this service?
10) Can telemedicine improve the quality of healthcare services in the country? If yes, how?
11) Do you think you have the basic skills to use a computer, internet and email?
12) In the future, what motivations and skills are required to involve staff in this type of health service?
13) Based on your short experience of video-consultation, can you list the most common challenges that could obstruct the application of telemedicine in this country?
14) Would you describe briefly how we could overcome such obstacles?