Telemedicine Practices in Nepal

(A case study of Dhulikhel Hospital and OM Hospital & Research Centre)

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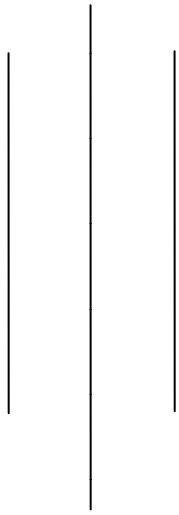

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RECOMMENDATION

This is to certify that the thesis

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I hereby declare that this thesis entitled **"Telemedicine Practices in Nepal"** submitted to the Dean, Faculty of Management, Tribhuvan University is my own original work in partial fulfillment of the requirements for the degree of Master of Business Studies. This report is conducted by Shankar Dev Campus under strict supervision and guidance of Associate Prof. Prakash Singh Pradhan and Er. Shanker Adhikari (Subject Teacher).

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ABBREVIATIONS

CBIS	Computer Based Information System
CCU	Coronary Care Unit
CDMA	Code Division Multiple Access
CME	Continued Medical Education
DFD	Data Flow Diagram
EPRS	Electronic Patient Records
ERD	Entity Relationship Diagram
GP	General Practitioner
HIS	Hospital Information System
HMIS	Hospital Management Information System
ICT	Information and Communication Technology
ICU	Intensive Care Unit
IT	Information Technology
MIS	Management Information System
OMHRC	OM Hospital and Research Centre
PICU	Pediatric Intensive Care Unit
TSC	Telemedicine Specialty Centre

CHAPTER I

INTRODUCTION

1.1Background Information

Information today is very important in making every informed decision that we are faced. A hundred to ten years ago we could not be able to make such informed and wise decisions with the limit information technologies that were limited back then. Today we have telephones, computers, internet wireless technology and more that gives the consumers and producers unlimited information at their figure tips in making an informed and wise decision. Many if not all consumers and producers rely on information in order to make a decision. With all the information technology that is available today we are able to make informed and wise decisions that changes or lives for the best. Information is key component in making a decision with the right and accurate information technology.

It has been said before and we hear it everywhere: Information is power. The importance of information to individuals and organizations, and therefore the need to manage it well, is growing rapidly. Now more than ever, we need to understand the critical role information plays in so many aspects of business and life. It drives our communication, our decision making, and our reactions to the entire environment.

Health care systems globally, have been evolving and adapting the last couple of years to the impact of an ageing population and to epidemiological changes in the context of fiscal restraints. There is an increasing trend towards integrated care with the linking up of the range of healthcare facilities including primary care and diagnostic centres, acute care hospitals and clinics. In this light, healthcare organizations are constantly trying to ensure high degrees of efficiency and effectiveness in the provision of their services. An overriding priority in many

countries remains the full implementation of Healthcare Information Systems, especially for e-Health on this matter. This has created a clear interest to accelerate the transformation of clinical care so that clinicians will routinely use appropriate information systems technologies when diagnosing problems and subsequently planning and administering care to a patient.

Today, healthcare executives are under tremendous pressure to address a host of different challenges: medical errors, rising costs, inconsistent quality, inefficiency, declining doctor satisfaction, and mounting staff shortages. Dealing with these issues will ultimately lead to better healthcare, but the process appears as complex and overwhelming as the challenges themselves. Information or lack of it is a big part of today's healthcare problems. Accordingly, Information Technology should be a big part of the solution.

In theory, the whole concept seems quite simple: we should be able to accurately record detailed and legible clinical notes; populate a comprehensive, lifetime digital record for every patient (including medication history, lab tests, and radiology images); provide access to disease management and outcomes information to help doctors make clinical decisions; prevent medical errors by having complete patient histories on hand, and so on.

Yet in practice, only a small percentage of doctors are actually using such technologies daily and it's not hard to understand why. Historically, healthcare IT systems have been too expensive and hard to implement for the average provider organization to adopt. They didn't fit in with typical workflows and, there was very little evidence demonstrating the value of specific Healthcare IT investments. Fortunately, as the healthcare IT industry matures, this is all changing.

1.1.1 Management Information System (MIS)

Management Information System is a system or process that provides information necessary to manage the organisation effectively. MIS and the information it

generates are generally considered essential components of prudent and reasonable business decisions. MIS should have a clearly defined framework of guidelines, policies or practices, standards, and procedures for the organization. These should be followed throughout the institution in the development, maintenance, and use of all MIS. MIS is viewed and used at many levels by management. It should be supportive of the institution's longer term strategic goals and objectives.

Management Information Systems (MIS) is the term given to the discipline focused on the integration of computer systems with the aims and objectives on an organisation. The development and management of information technology tools assists executives and the general workforce in performing any tasks related to the processing of information. MIS and business systems are especially useful in the collation of business data and the production of reports to be used as tools for decision making. An institution's MIS should be designed to achieve the following goals:

- Enhance communication among employees.
- Deliver complex material throughout the institution.
- Provide an objective system for recording and aggregating information.
- Reduce expenses related to labour-intensive manual activities.
- Support the organization's strategic goals and direction.

Because MIS supplies decision makers with facts, it supports and enhances the overall decision making process. MIS also enhances job performance throughout an institution. At the most senior levels, it provides the data and information to help the board and management make strategic decisions. At other levels, MIS provides the means through which the institution's activities are monitored and information is distributed to management, employees, and customers.

In one sentence we can define MIS as an organized approach to the study of the information needs of an organization's management at every level in making operational, tactical, and strategic decisions. Its objective is to design and implement procedures, processes, and routines that provide suitably detailed reports in an

accurate, consistent, and timely manner. In a management information system, modern, computerized systems continuously gather relevant data, both from inside and outside an organization. This data is then processed, integrated, and stored in a centralized database (or data warehouse) where it is constantly updated and made available to all who have the authority to access it, in a form that suits their purpose.

1.1.2 General background of MIS

Before the concept of management information systems was created, computer scientists were just programmers creating applications for science and math calculations. As computer usage evolved in fields of business and data management, software applications were needed to process non-scientific data. A field of study would be needed to bridge the gap between computer programmers and the business world to create information-based applications for business and networks. The solution was to design a course of study which merged information technology, business and computer programming. This field was called, Management Information Systems (MIS). The idea was to create a workforce who could bridge the communication and technical gaps between management and computer programmers.

From 1980 to the present, there has been an explosion of technology in the field of information systems. The integration of the personal computer (PC) into the workplace and homes has made information readily available to all people. The concept of Management Information Systems has expanded to include data mining (databases of archived information), data retrieval sciences (critical business data stored on microchips) and technology used in everyday devices such as cell phones, wireless devices that require the passage of important data as well as integrated software for common functions.

The use of computer technology in today's world has changed the concept of management and; makes the managerial activities easier. Thus, the use of computer provides up-to-date information to managers to run their organizations efficiently. (Adhikari, 2005:21) Almost all of the organizational activities are based on

availability of proper managerial information such as planning, organizing, staffing, directing, controlling etc. All these activities can be conducted effectively only if information provided are relevant and accurate and made available in time.

At present world, Information is materialized as one of the most important resources of the organization among Men, Machine, Materials, Land, and Capital. Information system plays a vital role in obtaining organizational goal. Success of any organization largely depends upon the Information System that they are using and how effectively it has been used. In the last two decades, Information Technology has emerged in the world affecting our personal, social, and public life and has made a significant impact on the quality of life. It handles data and information represented in digital, text, image, graphics or voices media and deals with communication, storage, processing and printing or exhibition in the manner and kind as desired by the users. It is an outcome of the advances in telecommunication and computer technology.

Information Technology (IT) helps to optimize the use of scarce resources through intelligent information support for decision-making, and helps further in its implementation by supporting coordination effort without wasteful delays. Decision-making has become a very complex process due to competitive environment, scarce resources, time pressures, and unavoidable compulsions to achieve goals. Information technology has made decisive inroad in all occupations in offices, factories, airports, communications, entertainment, banking, education, hotels, hospitals, transportations, and shopping. It is used extensively for decision-making; ease of operations, communication, and record keeping and for obtaining higher productivity from the system in which it is put to use.

It replaces old out-dated slow methods by fast ones. It allows you to handle big and complex data and its structure with ease, which was never possible earlier. It helps you to test the solution without implementing them. The distance and access are no longer technical or operational problems, as information stores anywhere can be

used without its personal possession. It has affected the work culture in organization and lifestyle of each individual.

In today's world, the concept of MIS is a system, which handles the databases, provides computing facilities to the end user, and gives a variety of decision-making tools and technique to the user of the system. MIS is also popularly known as the Information System, the Information and Decision System, the Computer Based Information System (CBIS). In this regard, MIS can be defined as the systematic or organized way of providing informational support to the managerial functions of an organization. The system utilizes computer hardware, software, manual procedures, and models for analysis, planning control and decision-making and a database. In other words, MIS is an automated system, which presents information both internal and external to the organization that aids in making a specific set of routine decisions.

1.1.3 Telemedicine – Concepts and definition

The term **telemedicine** is very simply a description of supporting medical services through the use of telecommunications. 'Tele' is a prefix for distant, originated from ancient Greek. So, telemedicine literally translates to providing medical services over distance. Telecommunications used in medical applications can be categorized as sending medical information between a pair of transmitters and receivers. The so-called 'medical information' can be as simple as a doctor providing consultation to sophisticated data captured from a human body.

The word **"Telemedicine"** has often been used interchangeably with other terms such as "telehealth", "telecare" and sometimes "e-health" (Norris, 2002). It has also been synonymously used with the terms like "Health Telematics", "Medical Informatics", or simply "ICT in Health" (NST, 2009b). Telemedicine, in fact, differ from the above terms in terms of specificity and range it covers and the use of information and functioning. For instance, telehealth includes telemedicine and

refers to administrative work as well. On the other hand, telecare refers to the use of telemedicine to take care of patients at their homes. The most influencing term today is e-health; it's an emerging concept that is evolving rapidly with the increasing use of internet and encompasses all the above terms (Yellowlees, 2003).

Telemedicine did not arise as a separate and well-defined discipline with specialized instrumentation, standards and protocols (Norris, 2002), rather it developed as continuous efforts of people (clinicians) trying to use technologies into medical practice, and as information and communication technologies advanced to new heights. Telemedicine has pioneered the use of communication technologies within healthcare, and has been principally available for decades (EHTEL, 2008). Often termed as "distant medicine", telemedicine initially developed to provide health service to remote and rural or underserved communities in primary and secondary care, and in emergency conditions and locations such as in military services and natural disasters (Norris, 2002). It has come a long way from telegraphy and telephony to radio and television to digital technologies, and is still in continuous process of development. It involves use of telecommunications such as a simple telephone line or a mobile phones and PDAs (personal digital assistants), fax, internet, email, web or a combination of these and dedicated computerized devices, hardware and software applications, for instances, videoconferencing, electronic patient records (EPRS), robotics, etc.

According to Norris (2002), telemedicine is the use of information and communication technology (ICT) to transfer medical information for the delivery of clinical and educational services, whereas telehealth also includes administrative work along with the services provided by telemedicine. Similarly, he has defined telecare as the use of ICT to deliver clinical services to patients' homes.

Different organizations or authors have defined telemedicine in several ways and there is no universally accepted definition. The Norwegian Centre for Integrated Care and Telemedicine (NST) uses following definition of telemedicine:

"Telemedicine is the investigation, monitoring and management of patients and the education of patients and staff using systems which allow ready access to expert advice and patient information no matter where the patient or relevant information is located." (NST, 2011)

American Telemedicine Association (ATA) has defined telemedicine as *"The use of medical information exchanged from one site to another via electronic communications to improve patients' health status"* (ATA, 2011).

Telemedicine has also been defined as the *"Use of advanced telecommunications technologies to exchange health information and provide healthcare services across geographic, time, social and cultural barriers"* (Reid, 1996).

Nevertheless, whatever may be the definition the core principle of telemedicine is common in all, i.e. the use of ICT tools to deliver healthcare services to the patients or health professionals separated by geographical barriers either in the form of medical treatment, diagnosis, administrative purpose or education.

1.1.4 Classification of Telemedicine

Telemedicine can be classified either on the basis of interaction between the users or on the type of information being transmitted (Craig & Patterson, 2006). The interaction between the users can be in the form of real-time communication as in videoconferencing, so called synchronous interaction or in the form of pre-recorded interaction such as store-and-forward emailing services in which the patient's information and health condition are sent through email along with relevant pictures and the consultation is done through email. The store-and-forward method is very useful for dermatological and radiological consultation as well as other non-emergency cases, whereas synchronous interaction is more applicable in cases where face-to-face communication facilitates the consultation process. The information transmitted via telemedicine services can be in various forms such as data and text, audio, still images and video pictures.

Depending on the type of application and services, Norris (2002) has classified telemedicine into four main categories namely, teleconsultation, tele-education, telemonitoring and telesurgery.

Teleconsultation

Teleconsultaion takes place between two or more health professional with or without involvement of patient. The simplest example is a telephone conversation between two physicians to obtain a second opinion. The physicians may be in different rooms in the same building or in different countries over a satellite link. Teleconsultation can be done by the use of telephone, videoconferencing or sharing of medical information like X-rays or other radiological images, pathological images, patient's medical problems etc.

Tele- Education

Tele- education is means of gaining knowledge on medical practice via different sources like internet, video conferencing etc. by health professionals, patients and general public as well. These sources can offer excellent educational materials with benefit of low cost and easy access at desktop.

Telemonitoring

Telemonitoring deals with the gathering of information related to patients condition for the management and follow up process via use of telecommunication link like home telecare devices, videoconferencing, mobile phone alerts etc. The acquisition may be entirely automated so that continuous data can be submitted either in real time or in store-and-forward mode.

Telesurgery

Telesurgery describes the assistance given by the specialist to surgeons carrying out a surgical procedure at a remote location. The assistance is offered via a video and

audio connection that can extend elsewhere in the building or over a satellite link to another country. Telesurgery utilizes surgical robots, image guided surgery, tracking systems etc.

1.1.5 Brief History of Telemedicine

Telemedicine has been seen as a revolution in the healthcare delivery and in the medical field (Darkins & Cary, 2000). Telemedicine has proven to be beneficial in delivering healthcare facilities during emergencies in situation where immediate support is almost difficult such as in space, airplanes or in rural areas with undeveloped basic infrastructures. In addition, telemedicine has also reduced the cost of care since medical treatment can be made available at the site rather than requiring patients to travel to the hospital. Thus, it has helped in improving the consistency and quality of healthcare (Darkins et al., 1996).

The modern definitions of telemedicine entail the use of television, computers, radio, internet, videotapes and fax machines for the delivery of healthcare services (Darkins & Cary, 2000), but if telemedicine is simply considered as the medical activity at a distance irrespective of the communication media then the history dates behind in the Middle Ages when information about the spread of communicable diseases were communicated by the means of bells, flags or bonfires (Craig & Patterson, 2006; Darkins & Cary, 2000).

Darkins and Cary (2000) mentioned that the major milestone for the arrival of telemedicine was the invention of telephone. The main role of telephone in medical field was observed during 1910 through the transmission of amplified sounds from stethoscope (Craig & Patterson, 2006). Moreover, telephone consultation has proved to be very useful in general practice (Brown & Armstrong, 1995; Nagle, McMahon, Barbour, & Allen, 1992). A systematic review (Bunn, Byrne, & Kendall, 2004) reported that at least 50% of calls can be managed by advice through telephone and thus telephone consultation has been able to reduce General Practitioner (GP) or home visits.

Though the telemedicine projects had a good start, they failed to create significant role in the routine health practice at that time and slowly collapsed. The crucial reason for this was lack of funding (Myers, 2003). According to Darkins and Cary (2000), the high cost of technology, poor quality of images, lack of uptake of services and inability to interface telemedicine with mainstream healthcare provision were also the cause of failure. However, the telemedicine projects between 1974 and 1989 can be said to be remarkable landmarks in the history of telemedicine giving an opportunity to determine possible areas where telemedicine can be successful.

Later in the late 1980s and the early 1990s, there was significant rise in telemedicine usage. The main credit for this goes to the Norwegian government decision to fund 90% of the costs of care in Norway's national healthcare system and commitment to provide universal healthcare to all the citizens (Darkins & Cary, 2000). The Norwegian experience and success in telemedicine generated new projects in the United Kingdom (UK), the United States of America (USA), France, Canada, Australia, New Zealand, Hong Kong, Germany, Africa, Middle East and other parts of the world. (Craig & Patterson, 2006; Darkins & Cary, 2000). From then till now, telemedicine has been supporting both diagnostic and evaluative care for patients and the clinicians (Myers, 2003). The new applications are constantly being introduced and have remarkable advantages in home care and remote monitoring.

1.1.6 Introduction to Organisation under Study

Dhulikhhel Hospital, located in Dhulikhel Municipality; headquarter of Kavre district at about 30km Northeast of Kathmandu, capital of Nepal, was established in 1996 as a collaborative project of the Municipality of Dhulikhel, NepaliMed International and Dhulikhel Health Service Association. Dhulikhel Hospital is an independent, non-profit, non-government institution which was conceived and supported by the Dhulikhel community, as a quality health services provider. Dhulikhel hospital is also the university hospital for all the medical programs run under the collaboration with Kathmandu University (constituent medical programs

of Kathmandu University). The hospital is involved in a range of activities from basic community health at the grass roots level to the services of a modern teaching hospital and including basic research facilities.

Dhulikhel Hospital provides healthcare services at minimal cost through well trained staff in both inpatient and outpatient departments. The hospital has well equipped general ward, Intensive Care Unit (ICU), Coronary Care Unit (CCU), Neonatal Intensive Care Unit (NICU), Paediatric Intensive Care Unit (PICU) including investigative and therapeutic services.

The hospital covers the population of approximately 1.9 million people from Kavrepalanchowk, Sindhu-palchowk, Dolakha, Sindhuli, Ramechhap, Bhaktapur and other surrounding districts. Nevertheless, Dhulikhel Hospital has already provided services to people from more than 50 out of 75 districts of the country. Apart from the therapeutic and diagnostic services within the hospital, different community based activities are also run in order to address the health issues in rural areas through Department for Community Programmes. The hospital is running 12 outreach centres at rural areas of different parts of Nepal. These centres not only function as the provider for basic healthcare services in those areas but also function as a platform to provide various preventive, curative and rehabilitative services to the community. The residential paramedic staffs provide 24 hours services in these centres. Frequent visits at regular intervals are made to these centres by a team of doctors (including various specialists) and other staffs from community department. Public health and micro-finance programs are also run from these outreach centres.

OM Hospital and Research Centre (OMHRC) is located at Chabahil, Kathmandu the capital city of Nepal. OMHRC was established in 1990 as “OM Nursing Home” in 1990. OMHRC was started with 8 beds and 3 doctors providing world class health care service at affordable cost. It was pioneering attempt by a group of dedicated professionals to make impact on health sector of Nepal.

Later on 2052 B.S. it was registered as OM Hospital and Research Centre Pvt. Ltd (OMHRC) at KamalPokhari, Kathmandu. It has building construction covering around 85000 sq. ft with total land area of around 12 ropanies. Now, it is 150 bedded general hospitals with 62 consultants of different specialization. There are about 400 employers in the hospital, including over more than 50 health personnel.

The main objective of the hospital is to provide diagnostic, preventive and curative services through a group of dedicated professionals and services. The hospital provides modern clinical services at competitive rates, provides training to health professionals and research information to the medical world. The concept of the hospital has been to provide reliable diagnosis and health care of the highest quality under one roof so that it would save patient's time while providing confidence to the patients for the services they acquire.

1.2 Statement of the Problem

Telemedicine technology has a huge potential to help solve distance related problems faced by health care systems around the world: Not all health care services can be provided everywhere. Patients in need of care or advice need to travel. It could be much more convenient, less expensive, less time consuming and, in emergency situations, far less risky if health care services could be provided at the point of need, including the home of the patient.

Many of the healthcare facilities in rural and remote areas do not have qualified staff, a physician, and they are mainly depending on a nurse practitioner or paramedical staff who cannot take a life changing decision when it comes to critical findings. Telemedicine provides alternative solution to the shortage of General Practitioners in rural and remote areas.

Sometimes we need to refer to a specialty or a subspecialty to get an expert opinion. Even in the metropolitan areas, we may not have enough available specialists who could cater the needs of all patients in their area. The case is more severe when you

go away from urban areas, where you don't have access to specialists at all. All such conditions warrant implementation of telemedicine strategies and network to support such patients who need expert opinion.

Sometimes a doctor / specialist himself needs to discuss his findings with someone who has more fresh and recent knowledge or in case of rare conditions. In most of the countries, physicians still do not have access to fresh knowledge due to lack of up-to-date medical libraries, or **Continued Medical Education** (CME) system. This makes easier for a doctor to get an expert opinion from his peers and share the case of his patient without having the need to travel.

Infrastructure in developing countries is still not serving the whole community. It could cost lot of hassle, travelling, accommodation and other expenses for a patient to come to metropolitan city to get them checked up or get a consultation. Sometimes the infrastructure and transportation is so bad that many patients in serious cases cannot make it to a nearby city even. Such situation can be solved easily utilizing technology advances in medicine and information communication and by implementing telemedicine services which Telemed Providers offers currently.

1.3 Research Questions

The main objectives of this study are to explore the infrastructural development of telemedicine, its usage, benefits and users perspectives on the stability and sustainability of the services in future with context to hospitals in Nepal. Therefore, this thesis will respond to the following research questions:

i) Why is it necessary for Nepal to adopt telemedicine technology?

ii) What are the challenges to its implementation and how are they being addressed?

iii) What are the influencing factors for the sustainability of telemedicine program?

iv) Why telemedicine services have become a need in rural health centres?

v) How can a telemedicine program be made sustainable in the context of Nepal?

1.4 Objective of the Study

The main objective of this study is to analyse the current condition of telemedicine in Nepal and the benefit of telemedicine to the medical professionals, patients and general public. The objective of this study is addressed by the following points:

i) To analyse the current Information System used for telemedicine in health sector.
ii) To study the different factors that influences the sustainability of the telemedicine.
iii) To observe the use of MIS in health sector especially in telemedicine.

1.5 Significance of the Study

The study is about the Telemedicine in health sector, which focuses on the research questions that have been addressed. The significance of the study is aware the benefits and application of telemedicine and use of the system to provide the health service to the patients in remote and rural areas where the experts are not available anytime. The study indicates that with the use of the telemedicine the patients are able to get prompt medical treatment avoiding the hassle of travelling and accommodation costs, since the transportation in rural areas are very poor.

1.6 Limitation of the study

Every studies and analysis often have some limitations, as it is to be done under certain constraints, circumstances and certain time limits. There will of course be some limitations in my study beyond its descriptive nature. The lack of time, lack of statistical techniques, and lack of experiences of field study are the major limitations Most of the data used in my study are of secondary nature, thus, the completeness and accuracy about facts about concerned organisation and its transaction completely rely on that information, which are provided to me. Since this is a case study conducted only in two organizations, it may not resemble as a whole to describe the situation in the country or similar institutions. Also, I found it very difficult to find literatures and other related documents concerning telemedicine in Nepal. Therefore it calls for further research, multiple case studies (or other methods), to explain the current situation and to predict the overall picture of how telemedicine is functioning or being implemented in Nepal.

1.7 Organisation of the Study

The whole study is organised into five chapters in following order:

Chapter One: Introduction:

This chapter simply includes the introduction of our thesis work, such as the overview of the main area under study i.e. it describes the general background of Telemedicine, history and introduction of the organization under study. Beside these things it includes the purpose, objectives, limitation and significance of the study.

Chapter Two: Review of literature:

It includes the main introductory contents of the topic on which we have focused our work so that it can explain what the theoretical concepts are on the thesis will be carried out. This chapter presents the overview of literature relating to each of three mentioned research questions.

Chapter Three: Research Methodology:

It includes all the topics describing how the entire data have been collected and designed to carry out the entire tasks of our thesis report work. This chapter is followed by research approach, research strategies, data collection method, sample collection, data analysis and research quality criteria.

Chapter Four: System analysis, design and data presentation:

It contains the entire contents related to data presentation and analysis. In fact, this is an important chapter that shows the presentation of data collected from the bank. The data presented will be analyzed. It is done through with in case-analysis and, where the data collected from different organization are compared and as well a cross case analysis is done.

Chapter Five: Summary, Conclusions and Recommendations

It includes the last contents of the entire report. It includes summary, conclusion based on the three research question and the chapter is ended with the recommendations for manager and implication for the further research will be provided.

CHAPTER II
REVIEW OF LITERATURE

The review of literature is a crucial aspect of planning of the study. Basically, it is "stock taking" of available literature in one's field of research. "The main purpose of literature review is to find out what research studies have been conducted in one chosen field of study and what remain to be done. It provides the student with the knowledge of the status of their field of research and foundation for developing a comprehensive Theoretical framework from which hypothesis can be developed for testing the validity of the study". (Wolf & Pant, 2002:35)

A literature review is a critical and in depth evaluation of previous research. It is a summary and synopsis of a particular area of research, allowing anybody reading the paper to establish why you are pursuing this particular research program. A good literature review expands upon the reasons behind selecting a particular research question.

This chapter concentrates mainly on the extensive review of the available books reports and various papers relating to the information system. The objectives of the reviewing literature is to get in-depth knowledge about the information system, to be familiar with the characteristics of MIS, to find the appropriateness of MIS and to find the easy and appropriate ways to be used data in the managerial process. Review of literature helps the researcher to build a strong foundation and create guidelines through which researcher's future research work is moulded and prepared. The existing data and theories needn't be again studied and the same could be used in the research, which reduces the duplication of the work and reduces the overhead of the researcher allowing him to be focused and concentrated on other critical research work.

2.1 Conceptual Review

Telemedicine is the use of telecommunication and information technologies in order to provide clinical health care at a distance. It helps eliminate distance barriers and can improve access to medical services that would often not be consistently available in distant rural communities. It is also used to save lives in critical care and emergency situations. Although there were distant precursors to telemedicine, it is essentially a product of 20th century telecommunication and information technologies. These technologies permit communications between patient and medical staff with both convenience and fidelity, as well as the transmission of medical, imaging and heath informatics data from one site to another. Early forms of telemedicine achieved with telephone and radio have been supplemented with videotelephony, advanced diagnostic methods supported by distributed client/server applications, and additionally with telemedical devices to support in-home care. (www.wikipedia.com)

Basically, Telemedicine allows patients to visit with physicians live over video for immediate care or capture video/still images and patient data are stored and sent to physicians for diagnosis and follow-up treatment at a later time. Telemedicine is an invaluable tool in Healthcare (www.telemedicine.com). Telemedicine seeks to improve a patient's health by permitting two-way, real time interactive communication between the patient, and the physician or practitioner at the distant site. This electronic communication means the use of interactive telecommunications equipment that includes, at a minimum, audio and video equipment.

The terms e-health and telehealth are at times wrongly interchanged with telemedicine. Like the terms "medicine" and "health care", telemedicine often refers only to the provision of clinical services while the term telehealth can refer to clinical and non-clinical services such as medical education, administration, and research. The term e-health is often, particularly in the UK and Europe, used as an umbrella term that includes telehealth, electronic medical records, and other components of health IT.

2.2 Telemedicine usage models

Telemedicine can be broken into three main categories: store-and-forward, remote monitoring and (real-time) interactive services.

2.2.1 Store-and-forward telemedicine

Store and forward telemedicine involves acquiring medical data (like medical images, biosignals etc.) and then transmitting this data to a doctor or medical specialist at a convenient time for assessment offline. It does not require the presence of both parties at the same time. Dermatology (cf: teledermatology), radiology, and pathology are common specialties that are conducive to asynchronous telemedicine. A properly structured medical record preferably in electronic form should be a component of this transfer. A key difference between traditional in-person patient meetings and telemedicine encounters is the omission of an actual physical examination and history. The 'store-and-forward' process requires the clinician to rely on history report and audio/video information in lieu of a physical examination.

2.2.2 Remote monitoring

Remote monitoring, also known as self-monitoring or testing, enables medical professionals to monitor a patient remotely using various technological devices. This method is primarily used for managing chronic diseases or specific conditions, such as heart disease, diabetes mellitus, or asthma. These services can provide comparable health outcomes to traditional in-person patient encounters, supply greater satisfaction to patients, and may be cost-effective.

2.2.3 Interactive telemedicine

Interactive telemedicine services provide real-time interactions between patient and provider, to include phone conversations, online communication and home visits. Many activities such as history review, physical examination, psychiatric evaluations and ophthalmology assessments can be conducted comparably to those done in traditional

face-to-face visits. In addition, “clinician-interactive” telemedicine services may be less costly than in-person clinical visit

2.3 Telemedicine in Developing Countries

Telemedicine has proven to be an excellent tool for providing good quality healthcare to isolated communities as well as the source of knowledge and information exchange related to health in the industrialized countries. These advantages of telemedicine will be a virtue in the developing countries where getting access to the healthcare centre is troublesome (Wootton & Bonnardot, 2010) and thus more meaningful outcome of telemedicine can be seen on developing countries than on the developed countries (Edworthy, 2001).

Several developing or low income countries such as Kosova, Ecuador, Tunisia, Nepal, Bangladesh, Malaysia, South Africa, Pakistan, Uzbekistan, etc. have piloted different telemedicine services and have gained success to provide better healthcare in the rural areas. The study showed the primary use of telemedicine for clinical purposes and education as a distant learning tool either in the form of asynchronous (such as self-study via websites) or interactive medium through videoconferencing.

Craig and Patterson (2006) have mentioned that telemedicine is being adopted globally including the developing nations and the evidence for this being the increasing number of presentations and demonstrations in conferences and meetings throughout the world. The developing nations are providing telemedicine services either through their own telemedicine network as in South Africa (Gulube & Wynchank, 2001) and Mali (Geissbuhler, et al., 2003) or via other telemedicine networks that are linked to the institutions in developed countries such as Swinfen Charitable Trust (Graham, et al., 2003; Vassallo, Hoque, et al., 2001; Vassallo, Swinfen, et al., 2001) or Medical Missions for Children (Reznik, et al., 2004).

Some of the developing nations have already developed their own telemedicine networks to improve primary health services and health education in the rural areas. The National Telemedicine System of South Africa has been reported to be the first of its kind in developing countries (Gulube & Wynchank, 2001). The project flourished through development of a national telemedicine strategy and guidelines for the implementation of telemedicine.

Telemedicine offers the hope of remote clinics identifying disease at the earliest possible stage, leading to the necessary treatment locally or at some specialised location when needed. While underdeveloped countries are unable to finance these programmes themselves, a surprising amount of progress can be made with small clinics, voluntary organisations and satellite links to specialists in industrialised countries. Examples include Russia, and countries in South and Central America, Asia and Africa with links to the **USA,** Norway and other European nations.

2.4 Benefits of Telemedicine

Telemedicine can be extremely beneficial for people living in isolated communities and remote regions and is currently being applied in virtually all medical domains. Patients who live in such areas can be seen by a doctor or specialist, who can provide an accurate and complete examination, while the patient may not have to travel or wait the normal distances or times like those from conventional hospital or GP visits.

Telemedicine can be used as a teaching tool, by which experienced medical staff can observe, show and instruct medical staff in another location, more effective or faster examination techniques. It improves access to healthcare for patients in remote locations. "Telemedicine has been shown to reduce the cost of healthcare and increase efficiency through better management of chronic diseases, shared health professional staffing, reduced travel times, and fewer or shorter hospital stays." Several studies have documented increased patient satisfaction of telemedicine over the past fifteen years.

The benefits of telemedicine can be summarized as below:

i) Better Access to Healthcare

Extending healthcare access to rural communities and disadvantaged populations poorly served or without these facilities, is still one of the major drivers of telemedicine. This socio-economic impetus has provided a strategic aspect to telemedicine programmes in several countries. Greater convenience to patients by reducing travel and disruption is also a benefit sought for and claimed by the majority of projects. Time savings for both patient and carer and faster access to care are similarly easy to demonstrate where they occur. Telecare offers many examples of these benefits.

ii) Access to Better Healthcare

Any healthcare is obviously better where none existed before but under this heading we are looking for improvements in the quality of care. A clear benefit of telemedicine is the remote access that a patient and his or her physician have to specialist advice when it is not available locally. Early intervention, more seamless care (including care protocols) and better monitoring of progress are additional advantages of telemedicine links involving a primary care doctor, a hospital specialist and a community care nurse. As we have seen, the monitoring process may also entail telemonitoring.

iii) Improved Communication between Carers

The shift to digital information offers numerous benefits for carers and their patients. Digitised data such as a patient's previous history, X-rays, test results and notes for the current episode are readily transmitted electronically using standard protocols and technologies such as email. Discharge letters are similarly available without delay. Digital communication provides healthcare information that is more accurate, more complete and more timely-attributes of quality that lead to better access and better healthcare.

iv) Easier and Better Continuing Education

One scenario not mentioned in the literature is worth a passing thought, namely the provision of healthcare courses, perhaps with awards, for the general public. Several countries are promoting a subsidised scheme for low-income families to help them gain home access to the Internet. Low-income groups are often those identified as being at greatest risk from disease due to socioeconomic conditions and lifestyle. The Internet could be used for health promotion with web sites targeting both children and parents. It could also be used to advertise health programmes such as cervical smear campaigns and facilities such as local fitness centres. Incentives could be provided to encourage take-up. The opportunities are endless.

v) Better Access to Information

Better access to information is concerned more with the individual endeavouring to 'pull' information from the Internet and other sources to answer specific questions. The individual mentioned here may be doctor accessing 'case-oriented' information in an electronic library, accessing the literature with an electronic search engine, or visiting a web site to find out about events of interest or the latest medical equipment. Alternatively, he or she may be a patient wanting information on a medical condition, times of surgery hours, or advice on how to stop smoking. It's all out there somewhere!

vi) Better Resource Utilisation

Better access to healthcare and access to better healthcare are one side of the access coin. Better resource utilisation is the other side. It is uneconomic to replicate resources in several centres when these resources have infrequent use. A preferred approach is therefore to set up a smaller number of resource sites and make these available to potential users via telemedical links. The arrangement can apply to the disposition of both specialist and expensive equipment such as MRI machines as well

as to ‘walk-in’ centres for patients with minor complaints. Any spare capacity in the telemedicine network can be used for a range of tele-education purposes.

vii) Reduced Costs

This is the most contentious benefit since few protagonists of telemedicine have been able to show cost savings in an unequivocal way. One of the reasons is that telemedicine trials often involve few presenting patients and it is not clear how costs and benefits scale. Clear cost savings have been demonstrated in teleradiology, which has been around long enough for practitioners to create a marketable service and optimise its operation. There is also evidence for economic benefits from telemedicine in home healthcare and the care of prison inmates.

2.5 Challenges to Telemedicine

We know that advancement in ICT and its use in the healthcare services have facilitated in the medical field for providing quality healthcare services in remote areas or the areas where access to basic healthcare is a problem, mostly in the developing nations. Despite of some successful pilot telemedicine projects, the adoption of full phase telemedicine in routine healthcare delivery has been a challenging task (Harnett, 2004; Wootton & Bonnardot, 2010).

In a paper, Myers (2003) mentioned that the “*2001 Telemedicine Report to Congress*” had identified four major issues which might affect the use of telemedicine in the 21st century. This includes the issue of cross-state licensure; safety standards issue; issue of confidentiality and security of electronic transmission; and the infrastructural issue. The infrastructural issue mentioned as the fourth issue has been the major problem in the developing nations regarding the challenges to telemedicine.

For the telemedicine services to run successfully and sustain, the ICT tools should be well developed within the country and accessible easily. But in contrast, rural areas of many developing countries are deprived of the basic telephone networks (Martinez, et al., 2004). This "*digital divide*" within the country has been considered to be a potential problem to telemedicine development (Geissbuhler, et al., 2003) since the rural areas are the primary region where telemedicine seems to be more advantageous and productive. In addition to this, the rural areas of such countries also have limited access to electricity and transportation facilities that results in lack of appropriate maintenance, limited ability to afford expensive telecommunication infrastructure as well as poorly trained health personnel (Martinez, et al., 2004).

Above all, the cost of the technology and lack of funding has been the main hindrance to the implementation and decision making relative to telemedicine (Puskin, 2001). The lack of funding was one of the primary reasons for slower development of telemedicine at the early stages during 1970s (Bashshur, 1995b; Myers, 2003) along with the limited development, experience and familiarity with technology; poor planning and design of the system. At that time, most of the projects were forced to cease due to scarcity of grants. Even today most of the telemedicine projects in the developing countries fail to scale up, because of this. During the pilot studies the outcomes are positive but once the funding stops, they fail to sustain which is impractical for developing countries (Wright, 1999). Thus to run a service successfully in such countries with limited resources, system design should be done with a vision of sustainability and scalability in future (Wright, 1998).

In addition, proper assessment on the effects of telemedicine on cost, quality and accessibility of healthcare should be carried out since all these three aspects are interrelated to each other (Bashshur, 1995b). This assessment is quite essential in order to trace out the potential benefits of telemedicine that overcomes the negative effects of high cost of care. The cost for ICT influences the uptake in all sectors from infrastructural development to the service level (Dzenowagis, 2009). The affordability of the technology is thus affected by the basic cost of technology and the cost relative

to per capita income. For example, the cost of telephone call and high internet service can be almost two to four times expensive in developing countries than the developed countries. Due to this high cost and low income condition, the usage of such facilities will be comparatively low which is similar to the case of low usage of telemedicine system (Gulube & Wynchank, 2001). The cost-benefit analysis will therefore serve as a valid basis for policy determination so that low cost technology could be more fully and effectively utilized.

It is thus clear that following the ICT model from other countries may not work properly with respect to the developing countries (Pradhan, 2002). The author further points up that successful information system in a country can be achieved not through the technology but through the appropriate strategies for the adoption and implementation of available resources and technologies. This viewpoint highlights the need for appropriate strategies for implementation of telemedicine within a country especially in the low-resource settings where failure to sustain can result in huge loss of the national economy and therefore it can be unethical to waste huge resources in healthcare (Wootton & Bonnardot, 2010). Thus, to overcome the financial challenge and maximize the potential during and after the implementation of telemedicine projects it will be significant to rely upon the existing infrastructures and hence progress accordingly (Harnett, 2004).

The challenges for telemedicine rise when the service provider fails to provide appropriate training about the systems and technology to the users. Training is a critical part of successful telemedicine which should be planned and delivered at regular intervals (Vander Werf, 2004). At the initial phase, the meeting and education session for using telemedicine will help the users to get familiar with the systems in a normal healthcare environment (Yellowlees, 2006). At this stage, the users can get knowledge about equipment, operation process and check whether it is non-threatening to aid patient-related consultation that develops the confidence within them to integrate the new system in their regular work practice.

2.6 Review of Related Research Studies

In review of related studies, some of the basic literatures on the management information system are reviewed. It includes theories on the topic and review of the thesis, research articles and project reports done within and outside the country. The review includes the name of the researcher, year of research, research objectives, brief description of the methodology followed, and major finding of the research.

i) The research entitled **"Telemedicine – the way ahead for medicine in the developing world" (2003) was conducted by L E Graham and M Zimmerman on Department of Medicine, Patan Hospital, Kathmandu, Nepal**. According to the research, this pilot study has shown that a low-cost telemedicine link is technically feasible and can be of significant benefit for diagnosis, management and education in a developing world setting. Nepal is one of the world's poorest countries and most people live in the mountains without access to basic medical treatment. Patients have to travel long distances to hospitals in the capital, Kathmandu, for treatment. Specialists in other fields are not available, so patients requiring specialist advice on diagnosis and management have to be referred to other hospitals in Kathmandu, with attendant costs and delays.

   Store and forward telemedicine using e-mail and a digital camera is much less expensive than real-time telemedicine using video-conferencing equipment and ISDN lines. A simple store and forward telemedicine link was therefore established in Patan Hospital in March 2000. This pilot project aimed to explore the technical feasibility and benefit of low cost telemedicine in terms of making a diagnosis and management plan for patients in this developing country.

   According to the result forty-two telemedicine referrals were sent during the 12 month period. Eight requested advice on general management of certain conditions and 34 were patient specific asking for diagnostic or management advice. On two occasions

there was a 10 hour delay in sending referrals due to difficulty connecting to the Internet.

They have concluded that this pilot study has shown that a low-cost telemedicine link is technically feasible, it is of great educational value, and it can be of significant benefit for diagnosis and management of medical conditions in Nepal. It can readily be emulated elsewhere in the developing world.

ii) **According to the article entitled " Hospitals in Rural Nepal to Get Access to Specialists via telemedicine" published on March 31, 2010 at TMCnet by Patrick Barnard** hospitals in rural Nepal is able to connect patients with outside specialists via satellite technology, with the power of telemedicine to improve health care in the region. The Nepal government plans to connect 25 district hospitals, most of them located in the remote and inaccessible Himalayas, to specialists in the capital Kathmandu via satellite uplink. Those specialists, in turn, will be linked up with 'super-specialists' working in 12 hospitals across India, to give them access to further medical expertise when needed.

According to the reports, the satellite technology being used provides enough bandwidth to support videoconferencing. Perhaps more important, the health ministry recently completed a project to network the 25 hospitals via high speed Internet connections. Local doctors will be able to send patient records, along with x-rays, ultrasound images and lab tests, to specialists in Kathmandu via a system known as 'store and forward.'

iii) **Priya Dashan Dhungana (2057)** ***"Management information System: an overview"*** defines MIS as the group of technique of systematic and regular collection and presentation of information for best business decision. MIS can be taken as the guidelines of an organization because managerial decisions are made on the basis of

timely reported information on this system. He emphasized on the establishment of advanced information system to collect, analyses and presents data in time.

As the information identifies and defines the problem and shows the ways of long-term solution, each organization needs a reliable information system in each level of analysis, plan formulation, control management and decision-making level so, it seeks various information about customers, competitors, financial environment and other factors before they make decision.

2.7 Review of Master's Degree Thesis

Review of Master's Degree Thesis plays vital role for thesis writing. In order to make this study more comprehensive, some of the most nearest thesis related to Telemedicine and e-health in Nepal from different points of view are conducted and reviewed as per below.

i) The thesis entitled ***"A study on health management information system in Nepal"*** conducted by **Karki, Prem Bahadur (1998)** defines MIS as a tools that collects, processes and analyzes of internal data that needs to be used in the managerial process of planning, direction, decision making, supervision, and performance review of an organization. He used primary and secondary source of data to achieve the objective of this study. His research study is exploratory and descriptive in nature. The general objectives of his study is to explore the existing structure of the HMIS and to expose it all the health policy makers and different levels health managers for improving the quality and efficiency of health care management. He found the following in his studies:

- The HMIS has still not systematically incorporated the service statistics from the country's hospitals, nursing homes, private clinics, and NGOs. In such an instance HMIS has shown considerably low incidence of diseases and/ or low coverage of service performance as against actual.

- The HMIS is a place in the Department of Health Service to strength quality and efficient health management. There is a process for collecting, processing, storing and disseminating data and information.
- The integrated HMIS was developed by eliminating vertical reporting system of the individual program divisions within Department of Health service. The conceptual framework of the HMIS is to collect process and disseminate data upon the requirements of the different divisions through on place.

ii) **Joshi, Manindra Raj (2005)** carried out a study **"*Management Information System in Nepalese Hospital*".** He analyzed whether the current flow of information that normal hospital flows is good enough to get the required information at the right time, in the right quantity and in the right format. To support his research study, he further analyzed the system of Bir Hospital with compare to Tilganga and Siddhartha Apollo Hospital. The study is based on the information provided by the staff members and doctors. He used different tools and techniques such as Database and Tables, Data Flow Diagrams and Flowcharts to analyze the data.

On his research he found that current scenario of most of the private and public hospital are totally manual where the same data are entered many times which makes the retrieval of information very complicate and data analysis techniques are not feasible and effective. He recommended that the implementation of MIS in Hospital would improve the transaction of hospital drastically. From the new system the concerned personnel can generate required information at the right time and in the right format.

He considered only the Impatient and Outpatient transaction in his study. The transaction such as posting of cash related transaction to the accounting, housekeeping and nutrition etc. were not interlinked on study. The study based on research conducted on only three hospitals: Siddhartha Apollo Hospital, Tilganga Eye Hospital, and Bir Hospital. It was not good enough to project the hospital related transaction and

develop the Hospital Management Information System based on only these three hospitals.

iii) **Adhikari, Bimal Prasad (2005)** conducted a research on **"*Information Technology in Security Management*".** Adhikari has analyzed the present situation of the country and provides e-solution to management security problems with the following objectives.

- Identify various reasons behind the conflicts and terrorism
- Study the existing status of IT application in security management in Nepal
- Identify basic information required for security management purpose
- Develop MIS and DSS information system models and architectures for the security management information system
- Develop conceptual DFD and ER models for the proposed SMIS

He has emphasized to implement information technology integrated with GIS (Geographical Information System) in the system. GIS can give detail information showing map of the location where corresponding searches are done. The security management information system is widely useful and highly appreciable however opinion survey has been made. The finding are based on the review of the literatures, decision making principles, interaction with security personnel in security management like senior officer of police department. Further researcher has made a survey with some security personnel as well as general publics. The response from the survey repeals that the concept is widely acceptable.

Findings are summarized as follows:

The root causes of terrorism are economic reasons, socio-cultural reasons, the system of education, psychological reasons. Sustainable security management has to tackle in these issues. The security management information system should also be capable to analyze the root causes why the conflicts are taking place. Such information is invaluable in strategic security management planning.

According to researcher, information system development and implementation is in very primitive stage in Nepal. Applying information in security management is a new and challenging field. There is very little application of information technology in the security management issues. Police Department and Royal Nepalese Army has very little used the information technology in their security management process.

The research study shows that there is an immense need of information in support of security management. A personal information system integrated with the geographic address will not only serve as a good security management information base data but also serve in several other conflict management issues. This will not only help the security management department through the management information system and decision support system in the security management, but also help to manage overall security management issues from the root causes of origins terrorism or conflicts. Adhikari presented his observation on the nature and function of the security management department reveals that the personal information and the location information are the two most, vital information essential for the security management purpose. The personal Identification number system associated with GIS and applied in the overall management of the national issues will help to make system transparent and efficient which helps to reduce the conflict find the root cause of the conflict and problems in the society. Further the researcher expressed his views as; Major problems are in taking the initiatives and the management of information technology in overall management of IT projects. The approach of applying information technology in the security management is widely appreciated in ail the related sectors.

It has been realized the need of such system is vital still there is lack of professional technical management as well leadership to materialize the concept. Adhikari's study can be useful to address social security base e-services management issues. One of the significant use of his research application is use of personal ID to uniquely identify

the contributors nationwide and can be integrated various personal data so that, the management of e-services becomes effective and efficient.

iv) **Khadka, Ashis (2004),** has conducted a research study entitled **"*MIS and its application in HMG/DANIDA*".** According to him HMG/DANIDA, Natural Resource Management Assistance Programme (NRAMSAP), is bilateral program which has been helping in various components such as Community forestry. Soil Conservation. Gender Equity, Watershed Management, institution Capacity Building and Intensive Management. It works through formal and informal partnerships with communities. NGO, Civil Society, Government and private sector. It also cooperates with other international, national and national development agency. The Study is mainly focus on the management information system of HMG-N/DANIDA. NARMSAP- a system which handle the database, provides computing facilities to the end-users and gives a variety of decision making supportive tools to the endures of the system is focused on MIS in present context. Here Khadka has made an attempt to study and analyse current information, flow of information, and data in various departments and decision making process. Further than that Khadka raised a question statement of problem as "Is MIS significant tools for effective management of a real and complex organization such as DANIDA/ NARMSAP?". Hence, the thesis has put an effort to go into the root of the problem of providing information, management of information, purposeful use of information, and correctness of the information. He has also attempted to provide an effective information collection system and recommended some areas where the management should address with help of available information.

The specific objectives mentioned in his study are:

- To study and examine the present practice and prevalence of management information system in DANIDA/NARMSAP.

- To examine practice of maintaining information system in DANIDA/ NARMSAP
- To analyze the effectiveness of MIS in DANIDA/ NARMSAP
- To identify need and importance of MIS in DANIDA/ NARMSAP
- To provide recommendations for the betterment of MIS if it is needed.

His major findings are as follows:

- The information system in DAN1DA/NARMSAP is based on both manual as well as computer based information system.
- There is effective use of computer in each and every organization function as well as departments.
- Almost all the department in DANIDA/NARMSAP use computer and information system based on computer. The use of computer is for decision making, statistical analysis, clerical work. accounting and forecasting, information generation based on the information provided by computer.
- All the departments have been keeping detail information about their transaction and performance.

As far as researcher identified, Mr. Khadka's research is successful in finding out the objective mentioned in his study. However, it lacks the appropriate recommendation for the better future usage and implications of the system.

2.8 Research Gap

Most of the master's degree thesis is contemplated in case study approach of public organizations. Most of the above thesis is about importance of MIS in different organization and some thesis belongs to health systems of different organization. The research output does not show the inside or outside the limitation of organization to implement and also it doesn't show the availability resources in the market.

Therefore there is no specific research made towards telemedicine and electronic health in hospital sector. But in this thesis there is a detail research analysis, design and development for the telemedicine and explains benefit, challenges and limitation of telemedicine and e-health in developing countries like Nepal. Hence there is a clear gap between the previous study made and the proposed study. Therefore, this may be the first research made on the topic.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Introduction

Research Methodology refers to the various sequential steps adopted by a researcher while studying a problem with certain objectives in mind. It is the overall framework of the research. It is the process of arriving at the solution of problem through planned and systematic dealing with the collection, analysis and interpretation of facts. The methodology includes:-

3.2 Research Design

Researcher should make plan of the study before understanding the research work and that plan or blueprint for study is called research design. Research Design presents a series of guideposts to enable the researcher to progressive in the right direction in order to achieve the goal. It is a plan, structure and strategy. It is the arrangement of condition for collection and analysis of data on a manner that aims to combine relevance to research process with economy in procedure.

There are many ways to carry out the research. Most type of research is carried out according to how much the researcher knows about the problem before starting the research. The research will be exploratory, explanatory and descriptive.

3.2.1 Exploratory Research:

Robson (2002) describes that exploratory research is valuable means to find out 'what is happening, to seek new insights, to ask questions to assess phenomena in new light, to generate ideas and hypotheses for future research. Zikmund (2000) on the other hand, defines an exploratory research as a study conducted to clarify ambiguous problems. A better understanding of the problem is required to do the research. According to Dane (1990) sometimes exploratory research might be very complex and the purpose of the exploratory research is to conduct the research process itself. According to Samouel (2003) exploratory research is used to develop better understanding and when there is a little theory to guide predictions. Moreover better understanding of customer causes better decision making power and better recognition of market opportunities for companies.

Zikmund (2000) further states that exploratory research is usually conducted with the aim that subsequent research will be needed to provide with conclusive evidence. It is a primary step that is useful to ensure a rigorous and conclusive future research study will not begin without a proper understanding of the problem. It diagnosis the different dimensions of the problem so that successful research project will be on hands. This research helps us to identify the problem and identify information needed for future research.

3.2.2 Descriptive Research:

Descriptive research is a process of accumulating facts for adequate information. It is a type of survey study which is generally conducted to assess the opinions, behaviors, or characteristics of a given population and to describe the situation and events occurring at present. Dane (1990) states that descriptive research involves assess the phenomenon more fully in order to differentiate and define it from the other phenomena. It confines the flavor of an object, a person, or an event during the time of data collection.

Descriptive research seeks to establish the answers to who, what, when, where and how? Accuracy is the prime part of importance in the descriptive research. In contrast to

exploratory research descriptive studies are mainly based on previous understanding of the nature of research problem. And the main objective of descriptive research is to provide a description of various phenomena by breaking them into component parts.

3.2.3 Explanatory Research:

The goal of the explanatory research is to develop a precise theory that can be used to explain the empirical generalizations. The main focus of this research is to explain about cause and effect relationship, explaining what causes produces, what effects. Yin (1994) According to Zikmund (2000) it is a research usually conducted in order to identify the effect and cause relationships among different variables where by the research problem has been already narrowly defined.

Dane (1990) claims that it involves testing a cause effect of relationship between two or more phenomenon. It is used to verify whether or not an explanation is valid or to verify which of the two or more competing explanations is or valid. The purpose of experimental research is to investigate possible cause-and-effect relationships by exposing one or more experimental groups to one or more treatment conditions and comparing the results to one or more control groups not receiving the treatment.

The research purpose and research questions of this thesis indicate that this study is more descriptive and little bit exploratory. As telemedicine is a new area of interest, among the health sector and also our interest is to describe the area of research and later we would begin to explain the collected data in order to find out the differences and similarities, therefore descriptive and exploratory research is suitable for this study.

3.3 Research Approach

This section focus on the ways in which the research work will be approached, Research can be approached in various ways such as Deductive versus inductive, qualitative and quantitative this would be explained first followed by the reasons of this study's approach.

Qualitative and Quantitative

The research approach is often either qualitative or quantitative. The main characteristic of quantitative research is selectivity and distance to the object of research. In contrast qualitative approach is subjective in nature and is characterized by the nearness to the object of research. Qualitative research does not focus on numbers but on words and observations, stories, visual portrayals, interpretations. Both approaches have their strengths and weaknesses and neither one of the approaches can be held better than the other one. Mostly the research approach depends on the research purpose and associated research questions.

A quantitative approach implies the search for knowledge that will measure, describe, and explain the phenomena of our reality. It is often formalized and well-structured and data is quantitative and is usually associated with science mode of research, which is obtained from samples and observations seeking for relationship and patterns that can be expressed in numbers rather than words.

The qualitative method focuses on acquiring reflective knowledge and understanding of the studied object and to further add or investigate, interpret, and understand the phenomena by the means of an inside perspective. Qualitative methods are often related to case studies, where the aim is to receive information and thereby obtain a deep understanding of the research problem.

As a result of above discussion, the research questions posed will provide answers that cannot be quantified or measured in numbers. Therefore this study is based on qualitative research approach. Moreover, since the purpose of this thesis is to gain better understanding of telemedicine in health sector, a qualitative study is the method that suits the researcher best.

3.4 Research Strategy

Depending upon the type of research questions, strategy should be selected and basically there are five types of research strategies such as experiments, surveys, observations, pilot study and case studies. The basic five types of research strategies are as follows:

3.4.1 Experiments

Use of experimentation allows us to explore changes in one variable such as productivity, at the same time by controlling one or two other variables. It controls circumstances so that one or more variables can be operated to test a hypothesis.

As we do not have control over the behavioral events, experiment is not a suitable research strategy in this study. At the same time as the aim of this study is not to answer that, how many, or how much questions even survey would not be appropriate strategy. Because of qualitative nature of this study, a survey will not be appropriate because of its quantities character.

3.4.2 CASE Studies

A case study is a fairly intensive examination of a single unit viz. a person, a family, an institution, a commodity, a district or any single event. It is an approach, which views any social unit as a whole. It is a way of organizing social data so as to preserve the unitary character of the social object. The major benefit of the case study is that whole organization can be explored.

Case study is an approach for conducting research work, which entails an empirical examination of a definite event within the context of the real world. This is an approach which not only produces solutions to how, why, and what questions.

3.4.3 Observations

Zikmund (2000) claims that in many situations the return of the research project is merely to record what has been observed? The important advantage of the observation techniques is that it records the behavior without relying on the reports from the respondents. Observational methods are often non-reactive because the data which is collected is discrete and passively without respondents involvement.

3.4.4 Pilot study

A pilot study or survey is a preliminary study conducted on a limited scale before the original studies are carried out in order to gain some primary information, on the basis of which the main project would be planned and formulated. Pilot test are useful for testing a new instrument, learning more about the sample and for checking the procedure of the methodology on a small scale.

With the focus at qualitative research as a general approach the focus now, turn to the research strategies available to collect the data. Each strategy has its own return and disadvantages depending on following three conditions. Gain a better understanding of the benefits of telemedicine health professional and patients in hospitals. Finally as this study is focused on contemporary time, strategy chosen for this study is the case study.

a. The type of research question posed.
b. The extent of control an investigator has over actual behavioral events.
c. The degree of focus on contemporary, as opposed to historical, events.

Thus according to Yin (1994) a case study is a comprehensive description and analysis of single situation. In case studies the purpose of the research is to seek conformity

between the results and the theory. Thus it helps to identify other similar events to the result that can be generalized after further studies.

As we have chosen qualitative approach, therefore we are going to get the information from multiple case studies. Additionally to support the choice of the case studies we have conducted research from two different banks, by looking at the different issues and this enabled us to draw to the general conclusions.

3.5 Sources of Data

Data is the foundation of all research studies. Data could be obtained from several sources as per necessity of the research work. Potential sources of data are used for the purpose of the study. These are collected from different articles and journals published by health related professionals. In addition to above, supplementary data and information are collected from relevant institution and authorities such as Dhulikhel Hospital and OM Hospital and Research Centre.

Similarly various data and information collected from the websites of Dhulikhel hospital and OMHRC as well as many other organization concerning telemedicine and other related articles. The sources of data collection were viz.:

a) Primary Data:

The data collection work in this research activity is less in volume but important by nature. Every respondent were, briefly told about the purpose and the nature of this study before the interview. The nature of the research being a new and complicated the question answer session was made interactive so that the respondent could select the option after understanding the objective of the question.

b) Secondary Data:

Data collection from primary sources was insufficient. So according to necessity of research study, relevant secondary data has been widely used while preparing report. Further, the secondary data have been taken from Annual Reports and Web site of Dhulikhel Hospital and OMHRC as well as many other organizations related to telemedicine, related articles, master degree thesis etc.

3.6 Data Collection Method

It is very complex and difficult for data collection. There are different source of evidence that can be focused for data collection for case studies. The different evidences are direct interview, documentation, direct observation and participant observation.

Due to the fact that this research is qualitative and not a quantitative case study, here is not any utilization of archival records as a source of evidence. Direct observation and participant observations are also ruled out as possible sources of evidence got this study, due to limitations regarding time and financial resources. Furthermore, this study does not need insights into cultural features and technical operations, and therefore no need to use physical artifacts as a source of evidence. This leaves with two sources of evidence, interviews, and documentation.

Based on our research questions and the research area we would like to go for primary data collection methods. Person can be interviewed in many ways like meeting him face to face or an interview on the telephone. Face to face interview is best suitable kind of interview in our context. We would conduct face-to-face interviews with the bank employees and the customers from both the banks. The benefit of going for a face-to-face interview is that interviewee has a freedom of expressing his views.

In this research, the type of interview that was used was personal interview, before the interview, the organizations were briefly told about the purpose and the nature of this

study. During the interviews we have followed the interview guide and also asked few other questions and as part of our study we also recorded the interview. By conducting personal interviews researcher as interviewers could explain the questions asked in a way that was understandable for the respondents and hence, receive detailed answers within a limited time. In our research study we have used free response interview with open-ended questions, so that the interviewee has the free choice of words and can express the opinions freely, because their opinions and the views will have a great importance for the outcome of this study.

For the case studies, both the primary and secondary data collection methods are used in this study. As mentioned above personal interviews were conducted as data collection method. This is a primary data collection method, which provided with deeper evidence, secondary data such as press releases and organizational background gathered from the organizations Web Sites, served as a compliment to the personal interviews, Furthermore, secondary data was collected and used for the background information regarding the topic of Telemedicine and organizations background. The secondary data sources have been web sites, academic articles, newspaper articles, and books relevant to the topic. In relation to the constructed validity of this study, the researcher has multiple sources of evidence, interviews, and documentation to collect data. Furthermore, notes were used when conducting the interviews. The collected data at the interviews was translated into English. This data was sent back to the respondents to exclude misinterpretations. In addition, this study builds upon existing theories related to research questions, and follows this base throughout the study. Hence, the data collected on the research questions are derived from this base.

3.7 Population and Sample

The entire number of hospitals and medical institutes providing health services will be the population. The sample is selected on the basis of simple random sample. It is impossible to collect data from each and every potential unit so small number of units, a sample is chosen to represent the relevant attribute of the whole set of unit. Due to the fact that

samples are not perfectly representative of the population from which they are drawn, the researcher cannot be certain that the conclusions will generalize to the entire population. Based on the research question we have chosen Dhulikhel Hospital and OMHRC as our sample. The reason for selecting these hospitals as our cases is because they are reputed hospitals in Nepal and it was easy to gain access into the hospital. We would like to see how telemedicine is used by the hospital to provide medical services in rural areas, its effectiveness and challenges faced by telemedicine.

3.8 Presentation and analysis of data

The main aim analyzing data is to treat the evidence fairly, to produce compelling analytical conclusions, and to rule out alternative interpretations. Data analysis involves turning a series of recorded observations into descriptive statements. When writing qualitative data analysis the focus is on data in the form of words. Analysis of the study has followed three steps i.e. data reduction, data display and data conclusion drawing and verification. This reduction of the data helps to sharpen, sort, focus, discard, and organize the data in a way that allows for final conclusions to be drawn and verified. Data can be reduced and transformed through such means as selection, summary, paraphrasing, or through being subsumed in a larger pattern. Data displays is the second major stage that the researcher need to go through. This stage includes taking the reduced data and displaying it in an organized form and compressed way so that conclusion can be more easily drawn. As with data reduction, the creation and use of displays is not separate from the analysis, but a part of it. Conclusion drawing and verification is the third and final stage of the data analysis. It is in this stage that the researcher starts to decide what the different findings means. Noting regularities, patterns, explanations, possible configurations, causal flows, and propositions does this.

The analysis of this study has followed the three steps data reduction, data display and conclusion drawing and verification. The data reduction and the data display are combined in the data analysis chapter, and rest in the last chapter. Beside these explanations, the current system approach of the organizations' Telemedicine service will be presented using

tools like Data Flow Diagrams, and Entity-Relationship Diagrams. These tools are not used for the analysis of data collected but the main objective is to gain better understanding of Telemedicine and concentrate on the research question.

3.9 Data Analysis Tools and Techniques

The data collected from secondary as well as primary sources are sorted and only the related data are considered. They are further examined in relation to the objectives. According to their pattern, available data is presented in the Data Flow Diagrams (DFD) and Entity Relationship Diagram (ERD).

3.9.1 Data Flow Diagram (DFD)

A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system but it does not show program logic or processing steps. A data flow diagram can also be used for the visualization of data processing (structured design). It is common practice for a designer to draw a context-level DFD first, which shows the interaction between the system and outside entities. This context-level DFD is then "exploded" to show more detail of the system being modeled.

With a dataflow diagram, users are able to visualize how the system will operate, what the system will accomplish, and how the system will be implemented. Dataflow diagrams can be used to provide the end user with a physical idea of where the data they input, ultimately has an effect upon the structure of the whole system from order to dispatch to restock how any system is developed can be determined through a dataflow diagram. A data flow diagram illustrates the processes, data stores, and external entities in a business or other system and the connecting data flows. The four components of a data flow diagram (DFD) are:

- External entities / terminator / sources / sinks (represented by oval or square).
- Process (represented by circle or rounded square).

- Data flows (represented by arrow ahead).
- Data stores (represented by two parallel lines, sometimes connected by vertical lines).

DFD Object Symbols:

Table 3.1: DFD object symbol and description

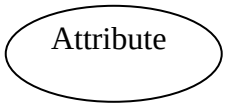
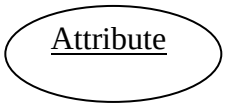
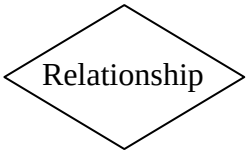
Object	Symbol	Description
External Entity		An external entity is a source or destination of a data flow which is outside the area of study. E.g. customer, government Agency, Supplier, Accounting department, Marketing Department.
Data Flow		Data flow shows the flow of information from its source to its destination. A data flow is represented by a line, with arrowheads showing the direction of flow. Information always flows to or from a process and may be written, verbal or electronic. Each data flow may be referenced by the processes or data stores at its head and tail, or by a description of its contents.
Data Store		A data store is a holding place for information within the system. It is represented by an open ended narrow rectangle. Data stores may be long-term files such as sales ledgers, or may be short-term accumulations: for example batches of documents that are waiting to be processed.
Process (Activity Function)		The process shows a transformation and manipulation of data flows within a system. Depending upon the level of diagram, it may represent whole system in a context level diagram (0 level diagrams) or a business area, process, function, etc in lower levels.

3.9.2 Entity Relationship Diagram

An entity-relationship (ER) diagram is a specialized graphic that illustrates the interrelationships between entities in a database. ER diagrams often use symbols to represent three different types of information. Boxes are commonly used to represent entities. Diamonds are normally used to represent relationships and ovals are used to represent attributes.

ERD Object Symbol:

Table 3.2: ERD object symbol and description

Object	Symbol	Description
Entity		An entity is an object or concept about which you want to store information.
Attribute		Attributes are the properties or characteristics of an entity.
Key attribute		A key attribute is the unique, distinguishing characteristic of the entity. For example, an employee's social security number might be the employee's key attribute.
Multi-valued attribute		A multi valued attribute can have more than one value. For example, an employee entity can have multiple skill values.
Relationship		Relationships illustrate how two entities share information in the database structure.

CHAPTER IV

SYSTEM ANALYSIS, DESIGN AND DATA PRESENTATION

System analysis, design and data presentation is the major chapter of this research which present empirical data collected from two hospitals perspective. As this is the major part of the study, it helps to conclude the study through major findings, vital issues and recommendation.

4.1 Case Study of Dhulikhel Hospital

The data collected are presented in the interpreted form to build up an interpretive case study. The findings are related to the infrastructural development and the state of the art telemedicine technology at the hospital under study; users perspectives on the usefulness and appropriateness of the technology; and strategic plan to further sustain the telemedicine system.

4.1.1 Infrastructural Development of Telemedicine – at Dhulikhel Hospital

4.1.1.1 Radio communication

During the year 2002 Dhulikhel Hospital initiated wireless walkie-talkie radio based communication treatment in order to establish contact with the outreach centres and to provide quality health services to those patients in rural areas who cannot physically come to the hospital regularly for treatment. The setup was primarily installed in two outreach centres, namely Bahunipati Health Centre and Bolde Phediche Health Centre; and two radio setups were available in the hospital, one in guard's room and another in Director's office. Wireless radio was also available in the ambulances in order to communicate while on the way. The repeater station for transmitting the radio frequency signal to the outreach centres was placed in

Palanchowk. The reason for choosing this site was accessibility of the radio frequency to both the outreach centres.

The radio communication helped in managing the patients' health through direct consultation with the doctors in the hospital. Whenever there was some emergency situation or confusion at either of the rural outreach centres, the paramedics used to seek help from the hospital. The message was first received at the guard's room and the responsible doctor was informed immediately by the attending guard. Then the doctor used to advice treatment or referral accordingly via radio placed in Director's room.

Though the wireless radio brought the hospital and the staff at outreach centres in direct contact from time to time as well as helped many patients in managing their treatment, the communication process was a bit time consuming since the doctors had to go to the place where radio was situated. This service did not last long and halted in the year 2005 due to security reasons as well as recurrent technical problems. At that time, due to the nation's political situation, communication through wireless radios was not allowed. Apart from this, there used to be problem in the repeater station frequently because of lightning. The maintenance cost was very expensive, since the technician needed to be hired from outside the nation and the impaired part was to be imported.

4.1.1.2 Mobile Phones

The mobile phone services then came into action. Nepal Telecommunications Corporation (NTC), the leading and largest telecommunication company of Nepal launched Global System for Mobile Communications (GSM) mobile services in the year 1999. Within few years the development in the field of telecommunication became so rapid that the mobile service became available at cheaper cost in most of the regions of Nepal. Almost all the outreach staffs and the specialist or consultant doctors at the hospital have access to private mobile phones. The paramedics at outreach centre used to call the respective doctor directly in need and ask for the required management or suggestions.

4.1.1.3 CDMA Phones

To ease this communication method, Code Division Multiple Access (CDMA) mobile phones by NTC were made available at all the outreach centres and special hotline mobile numbers are distributed at all the departments in the hospital since 2008. The purpose of installing CDMA phones as an alternative to GSM mobile phones at outreach centres is that it has better network coverage in rural areas of Nepal than GSM mobile service. In addition, volume-based internet can be accessed through the CDMA phones at a speed of 153 kbps (Kilobyte per second) at reasonable price of approximately 25 paisa per 100 kb (Kilobyte). The CDMA phone can be connected to a computer and thus internet can be accessed.

Other than consultation via telephone, the hospital also planned to initiate email based **store-and-forward consultation** for dermatology cases. To fulfil this purpose, Canon Digital IXUS 80 IS' digital camera and Pentium 4 desktop computer were provided to the outreach centres. In order to receive internet signals, receiver is installed at Bahunipati Health Centre and Bolde Phediche Health Centre. The store-and-forward based email consultations for dermatological cases are done through this internet connection. Since internet is available only in above mentioned health centres at the moment, the computer at other outreaches are being used to keep electronic records of medicine stock at stores and other administrative works.

4.1.2 Teleconsultation

For telephone consultation, the paramedics call in the hotline number of respective department and the on-call doctor attends the call and advices accordingly. If the on-call doctor is busy then the paramedics are free to call other doctors of the department in their private mobile phones.

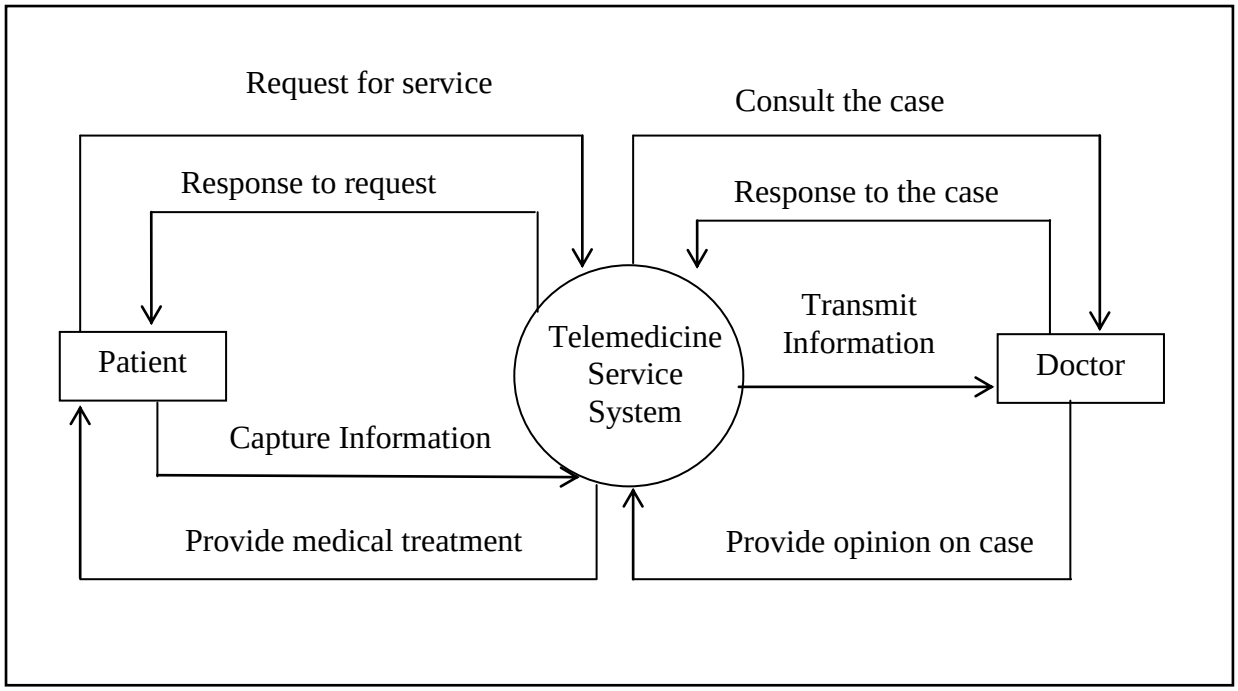
The Department of Community Programmes conducted training to all the staff at outreach centres, in order to make teleconsultation and store- and-forward services run successfully. Basic training on working with computer and simple programs like WORD, photo editing etc., internet and email were given at first phase. After this training, the word "telemedicine" was introduced in the hospital. Currently,

telephone consultation is practiced more often than the store-and-forward method, since internet is not available in all the outreach centres except Bahunipati Health Centre and Bolde Phediche Health Centre.

4.1.3 Current DFD of Dhulikhel Hospital

a) Context level diagram

Figure 4.1: Context level diagram of Dhulikhel Hospital



The context level diagram of Dhulikhel Hospital is described below:

i) Patient and Doctor are the external entities of Telemedicine Service System.

ii) At first the patient makes request for telemedicine service.

iii) The severity of the case is consulted with the doctor.

iv) According to the severity of the case, doctor decides whether to conduct telemedicine service or not.

v) Now, patient is informed whether their request is declined or accepted.

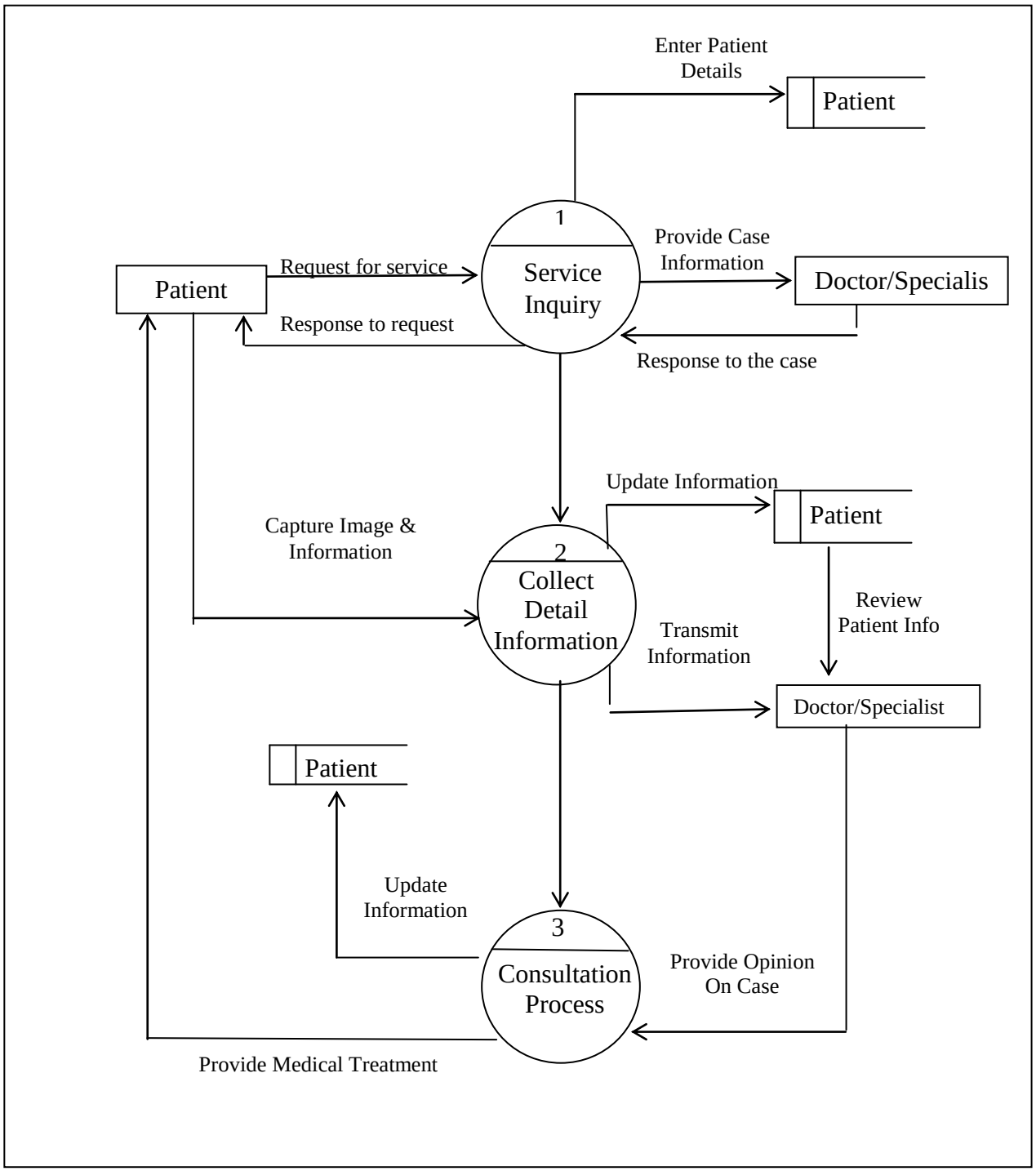
vi) Once the request has been accepted the information is captured. The information is in the form of image.

vii) Then the captured information is transmitted to the doctor.

viii) After analysing the information doctor gives his opinion.

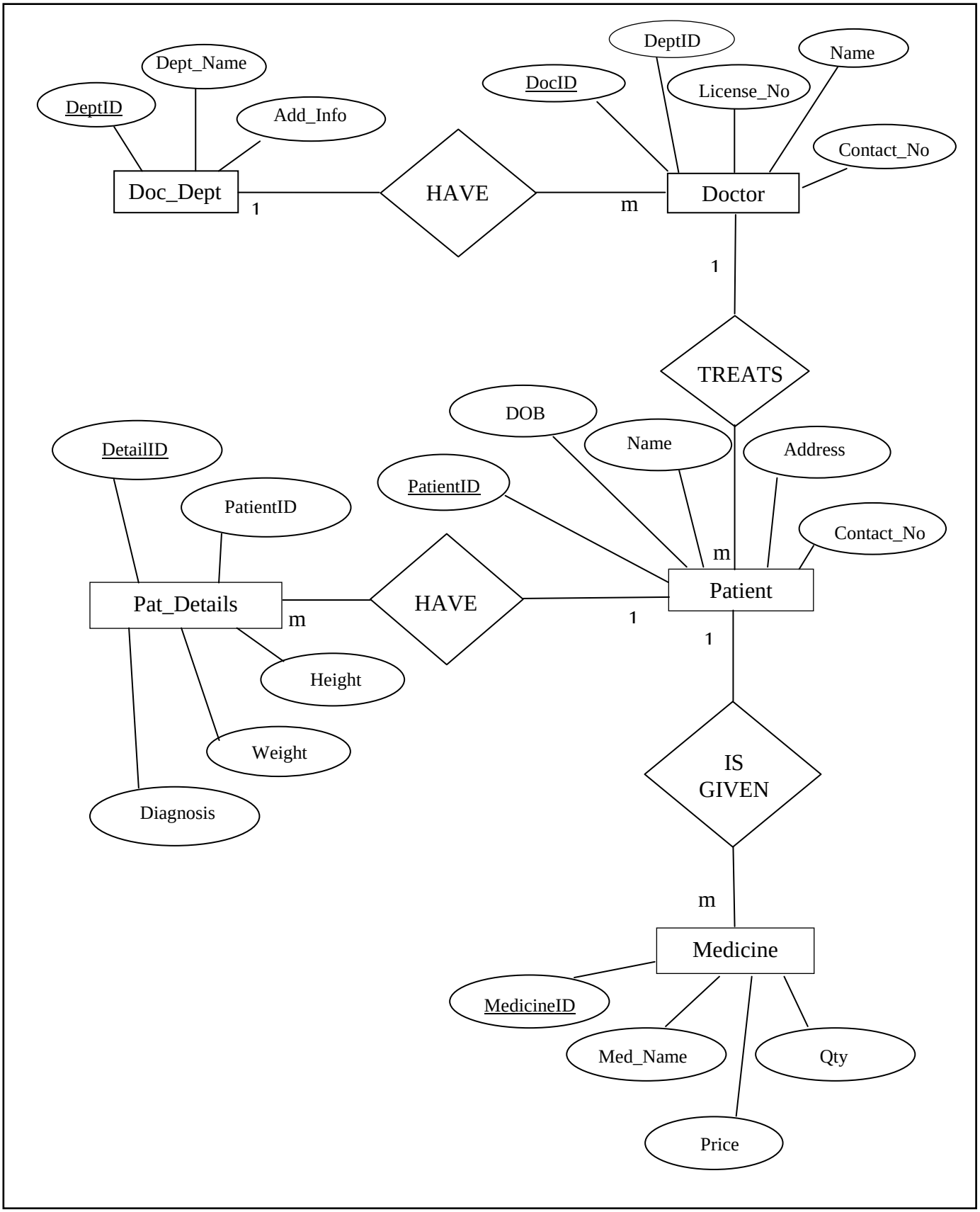
b) High Level Diagram

Figure 4.2: High level diagram of Dhulikhel Hospital



4.1.4 Current ER-Diagram of Dhulikhel Hospital

Figure 4.3: ER- Diagram of Dhulikhel Hospital



4.1.5 User's perspective on Telemedicine

According to this study, the users of the telemedicine services are the paramedics and the consultant doctors, but the one who gets direct benefits from it is the patient in rural areas. The consultants, paramedics and staff from Department for Community Programmes have found the telephone consultation and store-and-forward method via CDMA technology to be very helpful during management of emergency and life-threatening cases as well as dermatological cases at outreach centres.

4.1.5.1 Potential Benefits

According to the study it is clear that telemedicine has proven to improve the health condition in the rural areas. It has been able to provide quality health services to the rural patients who have no alternative other than spending time in travelling to the hospital for hours and worsening the case without any preliminary management. Even a simple communication media, i.e. telephone has been very supportive in providing specialists care to those patients while being on their own place (as far as possible), or if the treatment requires further access to hospital then proper first aid management for safe transfer of patient as advised have helped in stabilizing the patient condition and quick recovery.

With the advancement in technology and infrastructural development in health sector, telemedicine has become a need in rural areas of country like Nepal, where the basic infrastructures such as roads and easy access to health centres have not developed properly. Even if the patients are taken to the nearest health centres, the specialist doctors are still lacking that might result in improper management and sometimes death. Though referral is must in severe cases, a telephone consultation with specialists at hospitals will be beneficial for the patient as well as paramedics working in rural health centres. The patient gets a recommended treatment or first aid prior to further management, whereas the paramedics obtain education, knowledge and confidence for managing similar cases in future as soon as the patients are brought to the health centre.

4.1.5.2 Paramedics as "go-betweens"

According to the study it is believed that the patients are satisfied when the paramedics call the doctors at hospitals. The informants agree that the telephone consultation not only improves the relation between health workers and the patient, in addition it also assists in convincing the patient for better treatment options. Consulting through a telephone can sometimes be difficult, especially when a paramedic has to summarize medical history and symptoms as described by patient in few minutes to doctor. This can sometimes lead to misinterpretation or wrong diagnosis, though it does not happen so often. The patient usually describes his symptoms in the local language. This language barrier can also cause misinterpretation of the symptoms. Translating exactly what the patient says to medical terms can be problematic. But most of the informants believed that, there are no more language barriers now days. The paramedics have good knowledge regarding medical terms and practices in rural health centres and since telemedicine is a team work between paramedics and doctor, they will find the possible way out.

4.1.5.3 Socio-technical Hindrances

Poor network and low connectivity are the common technical hindrance at the outreaches centres during bad weather the paramedics find it difficult to contact the doctor. Due to poor connectivity, there is disturbance in two way communications and the voice is unclear. In such cases, immediate referral is the only option left with them.

Apart from this,staff turnover" has been traced out to be the major barrier to telephone consultation or store-and-forward method. Only setting up a technology is not sufficient to get the desired result. The person using the system should have a good understanding of "how it works" and "how it fits into the work practice", otherwise it will stop functioning.

The Department for Community Programmes had organized trainings for the outreach staff on telemedicine. Initially the store-and-forward method was running successfully, but after the staffs changed, the service halted. Furthermore, the Health Officer adds that unless the new staffs understand the overall process of telemedicine it is difficult to work with it.

4.1.6 Future plan for sustainability

The health workers reacted positively towards their interest in teleconsultation. All the paramedics agreed that teleconsultation has helped a lot in their work practice and patient management has become easier than before when there were no such facilities. The doctors said they were also giving priority to teleconsultation since it has proven to be life saving in severe cases and they are happy to provide such facilities over distance through phone.

They find it rewarding because depending on what the paramedics describes about the condition of patient, the doctor has to diagnose as well as suggest for treatment and almost all the diagnosis were accurate and the paramedics were able to manage under their guidance.

4.1.6.1 User's Expectation

For making the teleconsultation run smoothly and efficiently, it has been felt the necessity of a separate division under Department of Community Programmes to handle such consultants. It will be difficult to contact on-call doctor when he/she is busy with other patients at hospital. Though the doctors usually calls back after they are free, but during the interval the situation of patient can deteriorate. With agreement to this the doctors further added "24 hour service" can be provided within the new formed division by allocating the teleconsultation job on a rotation wise duty to General Practitioner (GP), and if GPs require assistance from specialists they can be contacted. The Health Officer has different view on this. Appointing a GP just for telemedicine services only seems to be difficult currently but can be done in the long run when number of consultation increases and patients support it.

4.1.6.2 Videoconferencing

With such expectations, the users" are also interested in internet based live communication methods. Some health workers have opinion that it"s the time to step up with the service, i.e. from telephone consultation to videoconferencing where they can communicate face to face. On the other hand, on the present context of

Nepal it is not feasible to establish a videoconferencing setup at all the outreaches due to socio-technical problems like load shedding, limited access to internet, limited manpower and resources.

The hospital administration is extremely positive towards videoconferencing. A study on the use of computer and internet based telemedicine has already been done, which proved to be very expensive. It costs around NRs. 1.5 -2 million for a single videoconferencing setup and it is not worth to put in all outreaches. The hospital can manage to invest the first time expenditure, but the running and operation cost mostly in rural areas was found to be expensive, that can be a problem in future. There is no other alternative than establishing high speed internet based telemedicine services in the long run, in order to link rural health centres with Dhulikhel Hospital and also to link Dhulikhel Hospital with its international centres and partners.

Presently a feasibility study is under process to establish a videoconferencing setup at the hospital to link with international centres. It has been reported that the setup will be established within a year. After that, the hospital has to explore other funding sources to link the outreach centres through video communication service.

4.1.6.3 Slow and Steady Progression

In context to Nepal, people cannot adjust easily with technology. We have to plan stepwise, because if the users don't know about telephone consultation and basic software, they cannot perform well with live communication and advance software. Stepwise development in telemedicine and those basic requirements (such as training, building relationship and understanding between users) which are normally omitted during implementation phase should be taken into consideration.

Accordingly, the Department of Community Programmes is working currently to develop the ongoing telemedicine services in a structured way. A separate staff has been appointed to look after the services. Evaluation of hotline mobiles; training; and staff appraisal have been planned as the next step for the smooth continuation of teleconsultation.

It is also very important for time to time training on computer applications, handling of computer, internet, emailing, photo editing and teleconsultation services. Training is very important to understand how technology works in health management process, and if proper training will be given to them then the telemedicine services will run more smoothly.

4.2 Case Study of OM Hospital and Research Centre (OMHRC)

OMHRC is located at Chabahil, Kathmandu-the capital city of Nepal. There are about 400 employers in the hospital, including over more than 50 health personnel. Launched with the motto "*we care for you*", OMHRC was first established as a 8-bed nursing home in 1990 as OM Nursing Home, which then turn into a 150-bed hospital in 2002. The main objective of the hospital is to provide diagnostic, preventive and curative services through a group of dedicated professionals and services. The hospital provides modern clinical services at competitive rates, provides training to health professionals and research information to the medical world. The concept of the hospital has been to provide reliable diagnosis and health care of the highest quality under one roof so that it would save patient's time while providing confidence to the patients for the services they acquire.

4.2.1 OM Telemedicine Centre

The Telemedicine Consulting Centre at OMHRC was established on 2004, and was named OM Telemedicine Centre. It is the first telemedicine centre in Nepal, which came as a service extension of the hospital to meet the new health care demands and to provide quality health care to general public. The main purpose of establishing telemedicine centre was to provide patients with specialist care when needed.

The Om Telemedicine Centre is a 20x12 ft. room, spacious for telemedicine equipments as well as 4 to 7 persons. It is equipped with one set of videoconferencing equipment – one television (SONY-29 inches), one web camera (Polycom VSX 7000), one microphone, one set of desktop computer and printer/scanner, and an Integrated Service Digital Network (ISDN) modem and a media converter for broadband internet connection. The electric supply is available 24 hours, backed up by Uninterruptible Power Source (UPS) and generator.

OM Telemedicine centre is headed by Department of IT. It is responsible for support and maintenance of hardware, software management, email and internet, recording and maintaining hospital database such as patient registration, library , preparing seminars and meeting that needed IT support, and auditing. It is currently working to implement hospital information system (HIS), providing computing and internet service to each department of the hospital and training to use computer and software for various purposes, including telemedicine. The department is also solely responsible for telemedical work. It is responsible for carrying out telemedicine link and as support staff to doctors and patients. One IT personnel has to be present throughout the telemedicine consultation.

4.2.2 Telemedicine Linkage with Apollo Hospital

OMHRC collaborated with Apollo Hospitals for telemedicine linkage. Apollo Hospitals Group is one of the largest hospitals. The telemedicine linkage was formally inaugurated by honorable Health Minister Mr. Ashok Rai and H.E Shri Rakesh Sood (Indian Ambassador to Nepal) on November 6, 2004. Through the telemedicine linkage, the OM Telemedicine Centre at OMHRC is linked to the Telemedicine Specialty Centre (TSC) at Apollo Hospitals, New Delhi (India). OM Telemedicine Centre serves as a Client Station whilst the Apollo Hospitals, New Delhi (India) serves as a Server Station in India, which is also one of the Asia's largest and most trusted healthcare providers.

By networking with Apollo Hospitals, the Om Telemedicine Centre has been mainly providing the following services:

i) help and confirm diagnosis
ii) plan treatment
iii)make cost effective investigations
iv)provide quality and cost effective health care
v) provide acute interventional plan in case of a medical emergencies
vi) organize, advice, and assist in conducting lectures, trainings and seminars

4.2.3 Rationale for Initiating Telemedicine Service

Apollo Hospitals (India) is the largest and pioneer group of hospitals in India. A large number of Nepalese people visit Apollo hospitals and around India for treatment. It is not always feasible for the patients to visit India for follow up due to the geographical distance and cost. The telemedicine linkage would reduce the need to transfer patients to a site of medical expertise and decrease in the relocation of medical specialists to the patient. This is one of the main reasons why OMHRC and Apollo Hospital collaborated for networking via telemedicine.

It would make health care facilities better organized and less costly, ensuring quality service to the patients. It also ensures more efficient and effective use of medical and technological resources, which would result in enhanced diagnostic and therapeutic quality of care while opening up new possibilities for continuing education or training for isolated or rural health practitioners, and creating new opportunities for technical expertise, and to learn and practice new technology for IT personnel and doctors/consultants at OMHRC.

4.2.4 Telemedicine Consultation

At OMHRC, telemedicine consultation follows routine procedure. At first, patients who want to use telemedicine consultation request for the service and sometimes doctors ask the patients if they are willing to use telemedicine consultation. Depending upon the condition of disease and the severity of the case, doctor (specialist) decides under certain condition. Mostly telemedicine consultation is requested by the patients who have already done treatment at Apollo Hospital, India and who cannot afford to go to India for follow up treatment. So, it is mostly used for the follow up treatment however, it is the doctors who decide the need.

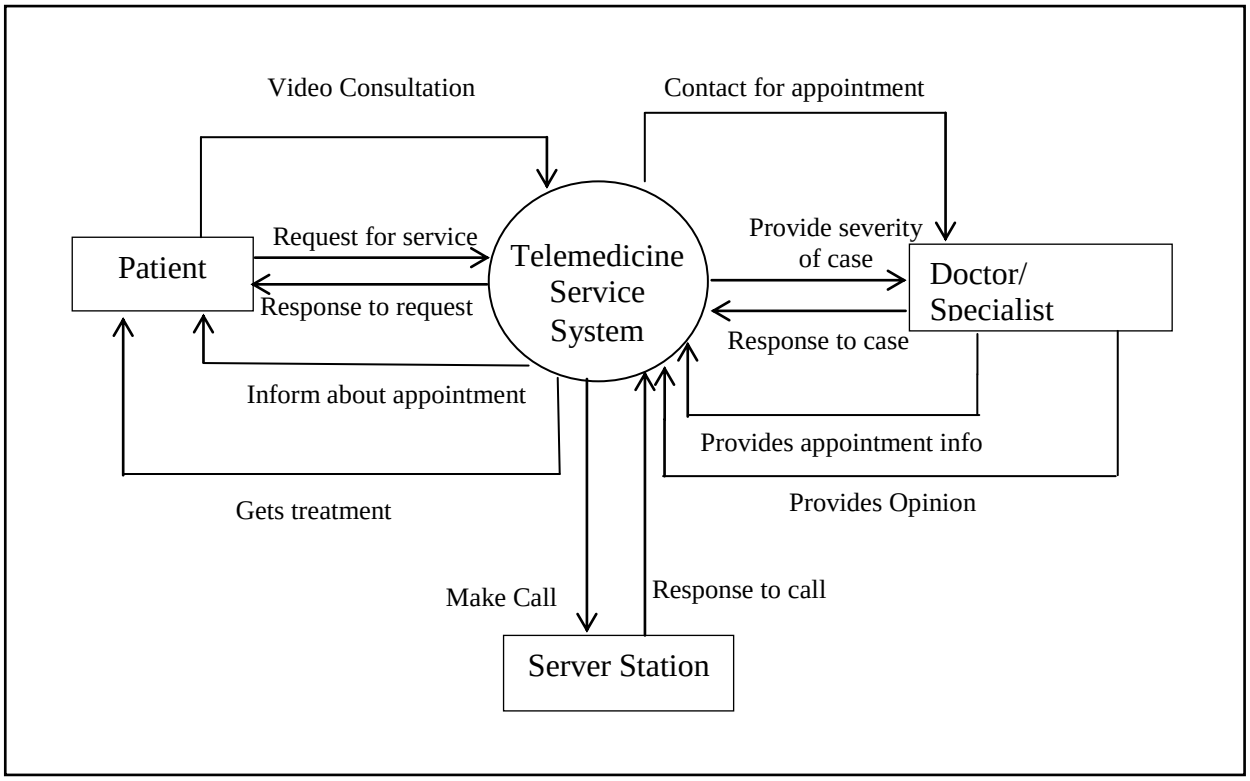
Once the patient is selected, a requisition is made with the concerned doctor (Specialist) at the Apollo Hospital, mostly via emails and occasionally by telephone, for an appointment to carry out the consultation. After the date and time of

consultation has been fixed by the Specialist at the Apollo Hospital, the patient party is informed as well as the Medical Officer and Consultant at OMHRC. They are requested to be present at the telemedicine centre (the Client Station) at least 10-15 minutes prior to consultation. After all of them have gathered at the centre, a telephone call is made to Server Station (Apollo Hospital) to make sure all the technical aspects are sound at both ends. After an assurance that everything is fine, a video consultation is then carried out. However, if something goes wrong during the consultation, the next schedule is then fixed among the concerned groups. Video consultation usually lasts for 30-45 minutes, and involves usually three personnel in addition to the patient and/or accompanying patient member - IT staff, Doctor and the Consultant.

4.2.5 Current DFD of OMHRC

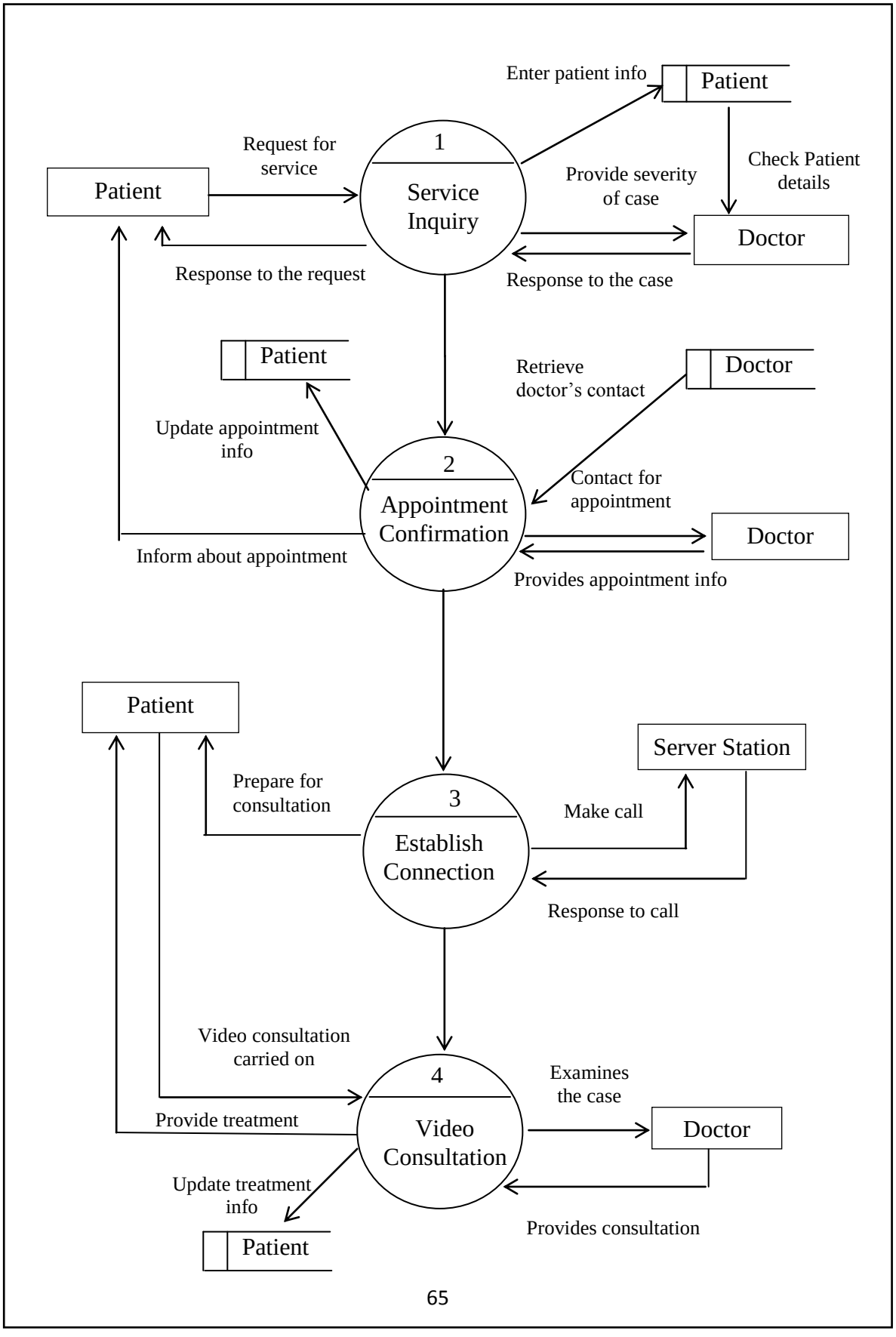
a) Context level Diagram of OMHRC

Figure 4.4: Context level diagram of OMHRC



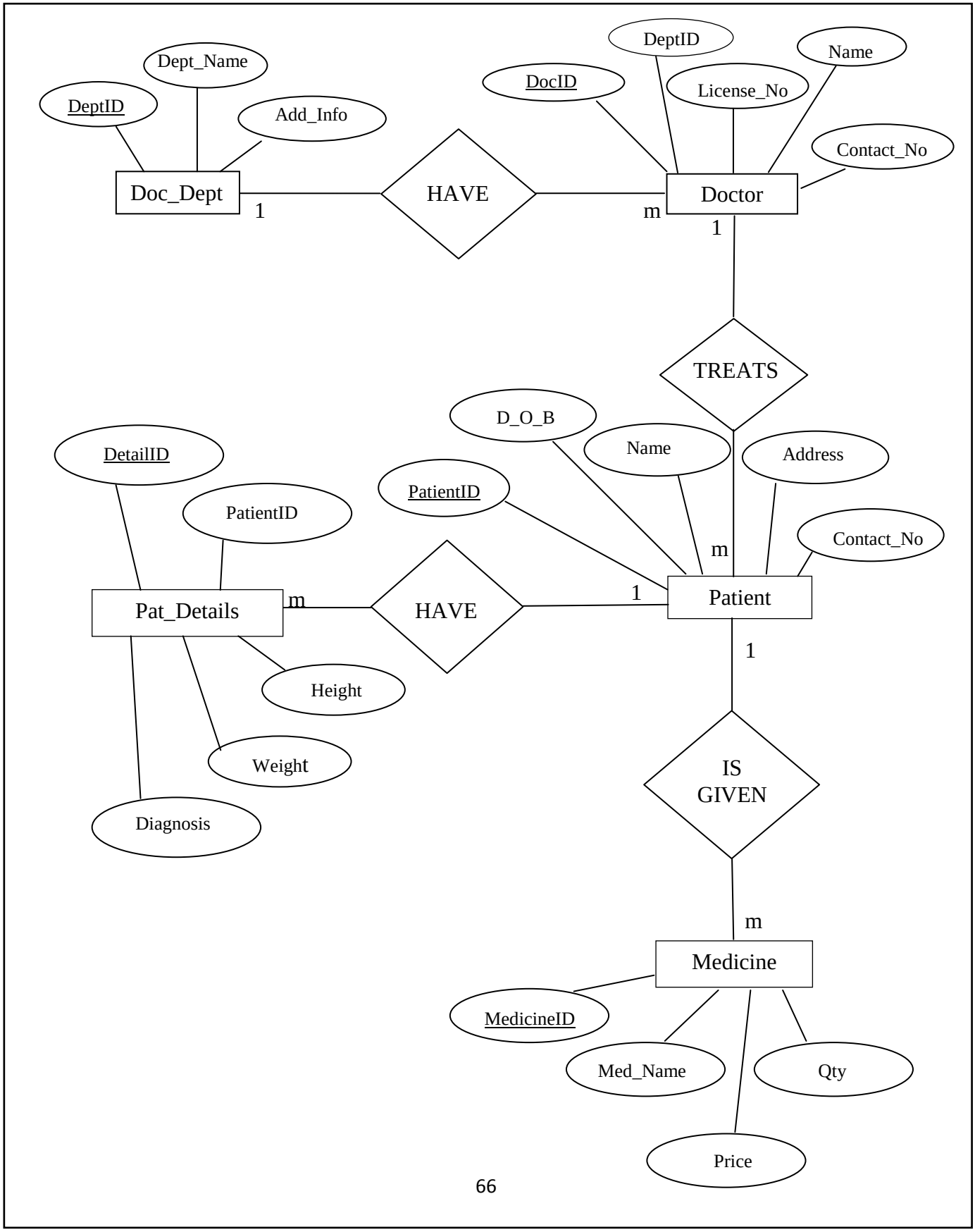
b) High Level DFD

Figure 4.5: High level diagram of OMHRC



4.2.6 Current ER Diagram of OMHRC

Figure 4.6: ER Diagram of OMHRC



4.2.7 User's Perspective on Telemedicine

The user's perspectives to the use of telemedicine at OMHRC have been preferentially their experiences which we have accounted for. It ranged from experiencing technology to building career to increasing competencies at one hand while satisfaction level is accounted on the other. In this study, we have tried to know their level of satisfaction with telemedicine through the informants view.

4.2.7.1 Potential Benefits

Patient's response has been very supportive toward the telemedicine and their satisfaction is growing which is one of the reasons for offering the service. Their satisfactions may be increasing because most of the patients who come for telemedicine consultations are follow-up patients of Apollo Hospitals and they find it more practical than going to India for the treatment. For them, traveling costs as well as living costs are saved. However, for those patients other than the follow-up, their interests have not been as predicted.

4.2.7.2 Challenge to Professional's

Doctors are positive with the use of technologies but are unaware of their inability which makes some of them egoistic. The doctors are willing to use telemedicine depends on their experiences with IT and using computers. The doctors (especially young) are affirmative and trained with basic IT skills, but experienced doctors lack knowledge in IT, which is a concern for telemedicine future. There are issues of people being egoistic and technological downturn. For example, ego may have dual meaning – first due to supremacy where people think that they can do on their own and second, feeling of inferiority due to less or no knowledge of the subject and awkwardly showing off.

For some, telemedicine may be a career building opportunity. In the context of Nepal, telemedicine is a new technology which is still out of reach for many rural Nepali populations. For the professionals involved in technical field, every use of

technology will enhance their technical carrier and telemedicine help them to build their career.

Nepal is geographically difficult to access, and most health providers and doctors being centralized to cities, enables telemedicine to foster. Technology matters but not without users, and since it's about distance, doctors are not able to reach the patient as per the political situation of the country, and thus doctors do agree that technology would be helpful to broaden their expertise. According to the informants, the doctors are satisfied with the use of telemedicine service; however, they need formal training in IT skills, at least basics of IT, and knowledge in ICT.

4.2.8 Telemedicine Halted

The users' attitudes towards telemedicine seemed to be positive in different aspects such as experience and opportunities and equally emphasized on training and expertise to broaden their concepts and utilize for people's good. Despite this fact, telemedicine was not in operation – telemedicine was halted, why? What went wrong? The obvious reasons were related to funding, as these finding will illustrate:

i) Funding was the Key

Funding is an important aspect of technological deployment. While funding enhances development, it also assures sustainability and future use. It can be both internal and external. In case of Om Telemedicine Centre, initially, the funding was solely internal, i.e. the OMHRC provided the entire budget to run the telemedicine program. The cost of setting up the Telemedicine Centre was around Nepali Rupees (NRs.) 500,000. Around NRs. 40,000 per month was issued as a budget for running telemedicine program.

However, it was realized that OMHRC alone cannot take upon the financial burden, owing to high cost for connectivity and other associated expenses. The consequence was that the telemedicine program could not run smoothly. Then, OMHRC and Apollo Hospitals both agreed for a deal to share the expenses together as well as the income from the program. According to the deal, Apollo Hospitals was to provide expenses related to the connectivity, apart from the technical expertise. Thus, in this

case, funding through external source was the key for continuing use of telemedicine.

What this prospect indicates is that external funding is a major part of development processes in Nepal and sustainability thereof. The continuing section will reflect more on this issue, and will be discussed more in the discussion section.

ii) Sustainability and the Funding Dilemma

One of the major problems of any development project in Nepal is about its sustainability. Usually, after execution of donor support, the program also gets terminated due to lack of resources (Pradhan, 2002). This is what had happened in the case of telemedicine program at OMHRC. Telemedicine consultation was temporarily halted according to the informants. Om Telemedicine Center is not an independent actor when viewed in financial terms. The criticality is that of interdependency and partnership. Since, Apollo has withdrawn from this partnership; no further telemedicine consultation has been carried out at Om Telemedicine Centre. It is observable that the service had been closed.

The importance of funding is well documented in several literatures in relation to technological transfer, its implementation and use. Issues related to funding have also been depicted as successful and unsuccessful parameters to advocate the sustainability of technology and its growth. Nepal is a poor country, and in many instances, cannot afford to pay for technology. Even if it manages to pay, sustainability is always a barrier. In case of OMHRC, the hospital is well established in the context of Nepal, but small in relation to its counterpart (Apollo). OMHRC, however, can start the service, but the cost of using the service would be very high. It would, in turn, be implicated to the patient, which they are not going to pay.

Now, OMHRC is looking for other sources of funding such as the ITU (International Telecommunications Union) and more importantly thinking of utilizing internal resources. However, how much time would take is still unknown. Nevertheless, progresses are underway. Funding is a complex issue and is different to different

actors. For example, while it is more a service provision for OMHRC, it may be financial benefits for Apollo or *vice-versa*. The complication of external funding is always implicated to the donors, since they are never static; however, the level of impact is less than the receiver. In this case, since Apollo has withdrawn hands from the project, OMHRC seems helpless to rerun the program and patients are deprived of the service. Nevertheless, it is trying other way round and planning to start the service sooner as far as the events are favorable.

4.2.9 Key Challenges

In this case, major challenges related to telemedicine had been identified, in addition to funding and payment discussed in earlier sections. They are related to technology procurement, internet connectivity, and lack of technical expertise among others.

i) Procurement & Dependability

Nepal is a developing nation; economically poor and land-locked. Therefore, Nepal has to be dependent on other countries for many of its developmental work. Technological growth and development is slow and limited, which makes the country further dependable. This is to relate that we do not have technology of our own and thus, most of the time; we have to procure from outside world. For instance, telemedicine is the western property, which is well disseminated now over the world. Seemingly, for a country like Nepal, all the necessary technological equipments required for telemedicine program have to be procured from other countries.

Purchasing and procurement of telemedicine equipment were challenging part. These equipment are not available in Nepalese market, except for the television part. All other items had been purchased and procured from India. India is a neighboring country and has open border with Nepal. Relatively, buying from India is cheaper than from other parts of the world and at the same time is efficient. It is efficient in the sense that it easy to replace damaged or malfunction equipments or to order their parts or order a new one. Also, they provide technical assistantship. However, it is

still expensive due to customs and duties that have to be paid for importing such equipments.

ii) Connectivity and its Cost

Connectivity is one of the biggest issues when comes to internet usage. Nepal is one of those countries which do not have regular electricity supply, and where broadband connections are still underway. Internet connection is slow, expensive and limited, and mainly confined to major cities only. Rural penetration is almost negligible.

Connection speed is crucial in real-time consultation, the higher the speed, more lively the consultation. The telemedicine program at the OM Telemedicine Centre started with 128 Kbps dial-up connection. With this limited connectivity, it was difficult to carry out real-time consultation. The connection was slow and often disturbed (disconnected time-to-time). On the other hand, it was also difficult to assure the doctor and the patient regarding its use.

The hospital has to pay high cost for connectivity, which the OMHRC cannot afford to pay alone. Collaboration was a key to implement telemedicine service successfully. Now, since there is dispute between partners, the telemedicine service had to be stopped.

iii) Lack of Expertise

With the introduction of telemedicine program in 2004 came more responsibilities and duties, and with only limited staffs, it was difficult to carry out telemedical work and administrative work at the same time. With low number of staffs, telemedicine just became an added duty.

Telemedicine program came with added duties, which is simply difficult to manage. Had there been more staffs dedicated according to specific jobs, smooth operation would have been likely to be carried out. Recruitment on the other hand, takes time and unless the management sees that it is worth employing new staff, recruitment seems far away. As such, IT department has shortage of IT personnel. With only few

IT staffs, it is difficult to carry out administrative function, core IT jobs and telemedicine. For instance, one IT person has to be involved when telemedicine consultation is being conducted, leaving behind the other IT personnel on administrative jobs which is not sufficient. Since it is mandatory that at least one IT personnel be present during telemedical consultation, it is more administrative jobs that are affected, along with increased workloads pressure to the IT staffs.

iv) Telemedicine Consultation Fee

For each telemedicine consultation at OM Telemedicine Centre, patient has to pay the fee of NRs. 3100 per session, each lasting 30-45 minutes. The fee was higher than the general consultation fee, which is around NRs. 250-500. For a majority of Nepalese people, the amount for telemedicine consultation is very high when compared to normal consultation. These fees were only the source of income and have to be equally shared between the OMHRC and Apollo Hospitals. The fee is structurally based on expenses of the telemedicine department such as salary to staffs, payment to internet service provider (ISP), as well as to Apollo Hospitals and other related expenses. The number of patients coming for telemedicine consultation in a month is not well enough to compensate the expenses, despite increasing level of patient satisfaction.

There is an income deficit at one hand, and high expenses on the other, which makes the cost of service high. In case of OMHRC, doctors are dedicated to use the service, and also they are equally satisfied though they are not reimbursed for their work. However, this issue may raise a concern among users as telemedicine will be put more on practice.

v) Marketing

Marketing or advertisement is a valuable tool to foster product growth and enhance its use. It not only helps product promotion, but also helps the product to reach people far out. However, in health sector, the concept of marketing is different; and it cannot be used for commercial purposes except for health promotion.

The concept may differ among different communities and countries. In Nepal, marketing of product accountable for public health is forbidden for business purposes unless it is done for health promotion. Marketing is a challenging aspect for telemedicine development in the country; nevertheless, there are other ways of doing it.

Marketing is not only about making money but this fact was not completely ignored and emphasized more on social activities to promote telemedicine such as conducting seminars, going remotely, and raising awareness. Nonetheless, marketing of telemedicine is challenging in the context of Nepal due to geographic limitations, available human resources and institutional capacity in this field.

4.3 Promoting Telemedicine

Some important areas have been highlighted for promoting telemedicine in Nepal. They are related to **infrastructure development, policy implementation, building competencies and creating opportunities for growth.**

The government should play a major role to diffuse telemedicine in the country by not only bringing out policy but by acting accordingly. In Nepal, policies are just in a piece of paper and part of political speech. It should be much more than that and the government needs to bring forward clear-cut vision and policy regarding use of ICT technology such as telemedicine.

Education and training is a prerequisite to good work force. Lack of expertise and inadequate human resources can impede any developmental work. Telemedicine, being new to medical field (in Nepal), requires users to be at least familiar with the equipments and working procedures, along with basic IT knowledge or training. It has now been realized that modern doctors need some IT knowledge to keep with the pace of information era.

Since telemedicine is new to Nepalese context, it will take time to have specific outcomes such as training modules or courses in telemedicine. Nevertheless, people

have to be motivated for it. Moreover, there should be more activities on publicizing about telemedicine. Majority of Nepalese do not know what telemedicine is, and even doctors or other health professions are unaware of it.

Developing infrastructures in the first hand is very important in the case of Nepal, also is equally challenging in Nepal. We should think on developing infrastructures which is really important on the first place like transport, telecommunications, and electricity. However, it is also the biggest problem in our country. It is the infrastructures for slow ICT development and which makes the country dependable to other resources while admitting political influences in their development.

The main problem is we do not have enough infrastructures and enough human resource in our country also, we lack vision for growth. We are not just economically poor but governmentally "poor". Political instability and insecurity also created havoc to active participation by private organizations to invest in technology acquisition, while the government failed to effectively implement policy and provide support to private institutions.

4.4 Major Findings

The major findings of this study are summarized as below:

Telemedicine is a tool to provide quality healthcare services through the use of ICT in those places where delivering day-to-day specialists care is troublesome. These developments did not occur overnight but took a long period of time to adjust into the medical field. During this transition period, several ups and downs were observed and finally reached to a stable state.

It covers wide range of medical specialists such as dermatology, gynaecology, emergency department etc. and supports the healthcare providers, doctors, paramedics and patients for diagnosis, treatment and education purposes. The number of users is not limited since the consultation can take place between any doctor and paramedic as per the need. Alongside, the technology (computer) has also been used for administrative purposes and keeping records of medicine stock along with the consultation.

Despite of the extreme need of healthcare delivery through telemedicine in rural areas of such nations, infrastructural development is rather slow. Telemedicine in Nepal is in emerging phase. As seen in above cases, telemedicine is being practiced through telephone consultation and store-and-forward techniques, which initiated long time ago in the developed nations.

Telemedicine provides better quality health services in remote areas where availability of specialist doctors round the clock is not possible and it might require several hours of travel for the patient to come to the hospital as seen in the outreach centres. The problem is that the basic infrastructure required for installing telemedicine technologies are not developed constantly throughout the nation; thereby raising the digital divide between remote and urban areas.

The health professionals and the organizational members are very interested to build up a highly organized telemedicine infrastructure but currently they can't do so. The main problem is with poorly developed basic infrastructures like roads, electricity, telecommunication and internet availability. Because of this the installation of telemedicine technologies at the rural areas (where telemedicine has become a need nowadays) is very expensive and beyond the capability of the organization.

CHAPTER V
SUMMARY, CONCLUSION AND RECOMMENDATIONS

In this chapter summary of whole research and conclusion will be drawn from the findings in order to answer to the research questions posed in the first chapter. First of all findings will be presented on each research question and are followed with specific conclusions. Finally, recommendation for the bank and for further research will be provided.

5.1 Summary

The literature review suggests that telemedicine is a tool to provide quality healthcare services through the use of ICT in those places where delivering day-to-day specialists care is troublesome. It is not a new concept in context to developed countries, where telemedicine technologies and ideas emerged around a century ago. From then till now telemedicine has undergone series of developments from telephone and TV based telemedicine to real-time videoconferencing system. These developments did not occur overnight but took a long period of time to adjust into the medical field.

On the other side, development of telemedicine in the developing countries has not been so rapid. Despite of the extreme need of healthcare delivery through telemedicine in rural areas of such nations, infrastructural development is rather slow. Telemedicine in the developing countries is in emerging phase. As in this research work we have done case study of telemedicine in Dhulikhel Hospital and OMHRC. In Dhulikhel Hospital telemedicine is being practiced through telephone consultation and store-and-forward technique, which initiated long time ago in developing countries whereas in OMHRC telemedicine was practiced through video

conferencing. Telemedicine at OMHRC is not limited to one specialty or one professional conduct. During its linkage to Apollo Hospitals, telemedicine consultation had been used for diagnosis and treatment for various types of illnesses, for seeking professional advices pertaining to different medical treatment strategies and communication purposes. The purpose of this study was to gain better understanding of benefits of Telemedicine in health sector, its sustainability and the need of telemedicine in rural areas in Nepal.

The data is collected by interviewing employees from hospital and patients in order to get quality information. In general, we believe that the respondents provided us with the relevant information, which balanced the quality of the research questions. Taking the above into consideration, below we are discussing the findings and conclusions regarding research question with respect to the potential of our empirical data.

5.2 Conclusion

The advancement of technology and its use in medical practice have given rise to a new dimension in the healthcare service. Telemedicine has thus been able to provide quality healthcare facilities in those rural areas from where access to the hospital is time consuming. Telemedicine has proved its advantages both in developed and in developing countries. But the pace at which telemedicine is developing is different in both the cases. Developed countries initiated telemedicine long time ago, whereas in developing nations telemedicine is just emerging and is in primary phase.

The main reasons for this difference are underdeveloped infrastructures like access to electricity, telecommunication facilities along with less friendliness to ICT tools. Another reason for this underdevelopment is the economic condition. Developing nations have several other priorities where investments are to be made, and in such cases spending huge amount of money on telemedicine technologies may be a doubtful question, irrespective of the fact that the rural areas of these nations are the main places where benefits of telemedicine can be in the higher level.

According to this study at OMHRC and Dhulikhel Hospital, problems such as frequent power cuts, limited access to internet and lack of IT knowledge are the hindrances to telemedicine. The health professionals (both doctors and paramedics) have now understood what telemedicine is and how it can help to solve the medical problems at the rural health centers and along with it there expectations with telemedicine has also gone high. Their main interest is to have consultation via high speed internet based videoconferencing system, which in current context is not feasible to install in most of the rural areas. Though funding from external sources are quite possible for installation of the system where feasible, but the situation after this funding stops is still the dilemma.

In such cases, sitting quietly and doing nothing is not the solution. Telemedicine does not only mean videoconferencing, there are several other ways in which specialist care can be delivered to the area in needs. The findings from this study suggest that even a simple telephonic consultation during emergency situations or in confusion can help to save life of many patients, provided that there is a reliable technical link, good relationship between the health professionals and interests in conducting consultation in such way.

Achieving sustainability with telemedicine is another big challenge, mostly in developing countries. Failing to continue after a huge investment has been made will be unethical in such domain. Therefore proper strategic movements should be made from the very beginning. This study recommends that copying what others have done may not work in every situation. Rather starting with the available technologies and resources and practicing it in a structured way will generate positive results. Thus for developing countries like Nepal, it will be appropriate to initiate with the basic available technologies, provide timely training to the users, build relationship between them; and then slowly gain the momentum as the users become used to with the integration of technology in their regular work practice and the condition for advancement is favorable.

5.3 Recommendation

The main purpose of the study was mainly to understand and describe telemedicine and its benefits within a specific area of research. The main objective of our research was to achieve a better understanding of telemedicine by answering research questions. This was only possible with the help of theories presented by different researchers in this field. By discussing the research questions, we have tried to improve our understanding of telemedicine.

Telemedicine is open and everyone can use it once it is implemented irrespective of who the actors are, for example, it can include people, technological components or organizations. Thus, new features and technologies can always be integrated into existing telemedicine base. As such, openness also creates opportunities to improvement. Since telemedicine started at OM Hospital and Dhulikhel Hospital, the number of users had increased – more doctors are trained to use it, patient's satisfaction is increasing, and technological components are constantly being upgraded to meet the need.

Chronic institutional weaknesses and severe financial constraints at both the national and local level pose formidable barriers to the delivery and utilization of health services. Private sectors should be welcomed to participate to compete in the development processes. Similarly, a system is required to properly mobilize national and international organizations to get best out of them for socioeconomic development of the country.

Moreover, there is lack of skilled or trained manpower – acute shortage of doctors, nurses and health workers, IT expertise – in Nepal. Similarly, migration (brain drain) and urban-centered localization of expertise creates further problem of inequities in rural and city areas as well as at the national level. Health workers, who serve most

of the population, are isolated from specialist support and up-to-date information. Telemedicine may be a very useful tool in this regard, for sharing information, planning, and treatment of patient. Therefore, there should be provision for education, training and specialization, and motivation for human resource development as well as to manage skilled human resource capable of adopting new technology and opportunity. However, it also requires motivating people to work in remote communities by enabling and empowering them.

Health facilities are extremely poor in remote communities. Transportation infrastructure is poorly developed, which ultimately hinders ICT growth and expansion, particularly in rural and remote areas; thus, contributing a direct and negative impact on health system. Similarly, electricity supply is the biggest problem in Nepal as it is involved directly with the livelihood of the people. There is electricity cut off (short supply) on a daily basis of about 8-14 hours. Connectivity is a radical element of ICT applications like telemedicine. While several literatures have argued that cost of information and communication technologies is decreasing, in the context of Nepal, it is expensive and limited. So, all these factors should be improved for implementation of telemedicine in rural areas.

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