UiT The Arctic University

Telemedicine to Support Health Care Delivery in Nepal: A case study in Kathmandu Model Hospital

TLM-3902
Master's Thesis in Telemedicine and E-health

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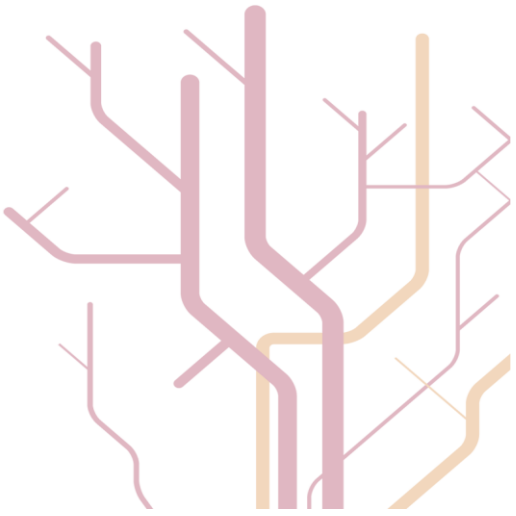
Date: 15. August 2013



Acknowledgement

I would like to acknowledge the support and encouragement from everyone who made my thesis possible.

I am very grateful to my supervisor Prof Rolf Wynn for his guidance. Thank you very much for being patience with me throughout the process. I would also like to thank my other professors and lecturers from the Department of Telemedicine and e-Health who taught us. Also sincere thanks to Au Judy Yu-Ying for cordial help.

I would also like to thank Dr Saroj Dhittal, Chief of Telemedicine Program in Kathmandu and Dr Mahabir Pun, President of E-networking and Research development for helping me with my fieldwork in Nepal. I am also very grateful to the staff at Kathmandu Model Hospital, Manmohan Memorial Community Hospital, Nangi Clinic and Women;s Centre and Nepal Research and Education Network. You all have inspired me with your work and contribution, and I am very thankful for it.

I would also like to thank my family and my relatives for being my support system. I would also like to thank my classmates and friends in Tromso who made my stay smooth and easy, despite being miles away from home.

Abstract

The use of information and communication technology (ICT) in healthcare termed as Telemedicine has acted as a tool to improve access and quality in healthcare. In developing countries where a majority of the population resides in remote areas with no essential health care facilities, telemedicine seems to be a solution. Telemedicine has the potential to not only improve access but also to improve health care delivery by supporting or assisting the rural practitioner or local health care provider through ICT.

This study was conducted in Kathmandu Model Hospital (KMH) in Nepal in order to have a better understanding of the role of telemedicine in health care of Nepal and find ways to improve telemedicine programs by identifying challenges and issues. A qualitative, interpretative case study approach was used for this research. The research was also guided by theories in telemedicine and information infrastructure.

The findings indicated that telemedicine services provided by Kathmandu Model Hospital has increase access to expertise consultations in remote outreach centers including in KMH. The study also shows that telemedicine can empower and support health practitioners by providing trainings and assistance. However, challenges such as a lack of adequate information infrastructure and lack of training of users leading to underuse of technologies were also found. Despite such challenges telemedicine in KMH is an example that health care delivery can be improved and health care practitioners can be empowered by using simple available technologies for basic telemedicine applications such as teleconsultation and tele-education.

Keywords: Telemedicine, Tele-education, Teleconsultation, Information and Communication Technology, Information Infrastructure

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Table of Contents

Acknowledgement ..... **i**
Abstract ..... **ii**
List of figure ..... **vi**
List of Table ..... **vii**
List of Abbreviation ..... **viii**
Chapter 1:Introduction **1**
1.1 Background **2**
1.1.1 Statement of problem **2**
1.1.2 Telemedicine: A solution **3**
1.1.3 Telemedicine Implementation in Nepal **4**
1.2 Motivation for the Research **6**
1.3 Objectives of the Study **6**
1.4 Significance of the Study **7**
1.5 Research Approach and Research Site **7**
1.6 Organization of Thesis **7**
Chapter 2:Theoretical Framework **9**
2.1 Introduction to Telemedicine **10**
2.1.1 Definitions **10**
2.1.2 Telemedicine, Telehealth and e-Health **11**
2.1.3 Communication Methods in Telemedicine **12**
2.1.4 Telemedicine Applications and Purposes **13**
2.1.4.a Clinical 13
2.1.4.b Non-clinical 13
2.1.5 Development of Telemedicine and Telemedicine Technologies **13**
2.1.6 Challenges of Telemedicine **16**
2.2 Telemedicine in Developing Countries **17**
2.3 Information Infrastructure **20**
2.3.1 Component of Information infrastructure **22**
2.3.2 Characteristics of Information Infrastructure **22**
2.3.2.a Enabling shared and open 23
2.3.2.b Heterogeneity 23
2.3.2.c Installed Base 23
2.4 Information infrastructure for Health Care **24**

Chapter 3:Materials and Methods **26**

3. Research Settings **27**

3.1 Nepal: Country Profile **27**

3.1.1Administrative Division **27**

3.1.2 Geography **28**

3.1.3 Political Status **28**

3.1.4 Society **29**

3.1.5 Telecommunication **29**

3.1.6 Health system **30**

3.1.6.a Health Policy 30

3.1.6.b Health Budget 31

3.1.7 Health Indicators **31**

3.1.8 Health Workers **32**

3.1.8.i Registered Health workers (2010-2011) 32

3.1.8.ii Human resources for health in Public and Private Sector 2011 32

3.1.9 Public and Private Health facilities and Institution **33**

3.2 Research Sites **33**

3.2.1 Kathmandu Model Hospital **33**

3.2.2 Outreach Centers **34**

3.2.2.1 Manmohan Memorial Community Hospital 35

3.2.2.3 Nagi Clinic and Women's Center 35

3.3 Research Method **36**

3.3.1 Main research question **37**

3.3.2 Introduction to Research methodology: Quantitative and qualitative Research **37**

3.3.4 Interpretive Qualitative Research Approach in Information System **40**

3.3.5 Qualitative Interpretive Research Approach and its' Rational to Case Study **41**

3.3.6 Research Design **42**

3.3.7 Site Selection **43**

3.3.9 Participant Selection **45**

3.3.10 Methods of data collection **47**

a. Interviews 47

b. Observation 47

3.3.13 Tools used for Collecting Data **48**

3.3.14 Methods of Data Analysis, Interpretation and Validation **48**

3.3.15 Ethical Consideration **50**

Chapter four: Results **51**

5. Findings from the Case Study **52**

4.1 Objectives of Telemedicine in Kathmandu Model Hospital **52**

4.2 Stakeholders and Partner Institutes **53**

4.3 Telemedicine Application **57**

4.3.1 Teleconferencing **57**

4.3.2 Internet based CME/Tele-education **58**

4.4 Telemedicine Technology and Equipment used **59**
4.5 Usefulness: The role of telemedicine in the Kathmandu Model Hospital **62**
4.5.a Teleconsultation **63**
4.5.b Tele-education (internet based CME) **65**
4.6 Financing and Cost in Kathmandu Model Hospital and the Outreach Centers **68**
4.7 Challenges of Implementing and Operating Telemedicine Program **69**
5. Discussion **77**
5.1 Telemedicine Model **77**
5.2 Identifying Information Infrastructure **79**
5.3 Understanding information infrastructure **80**
5.3.1 Enabling shared and open **80**
5.3.2 Heterogeneity **81**
5.3.3 Installed Base **81**
5.4 Identifying and Addressing Information Infrastructure Issues **82**
5.5 Future Perspectives **84**
5.6 Recommendations **85**
5.6.a Information Infrastructure Planning and Development **85**
5.6.b Collaboration with Government **85**
5.6.c Readiness of the information infrastructure **86**
5.6.d Business Model: Approach to Sustainability **87**
5.7 Researcher's Perspective/Experience **89**
5.8 Scope, Strength and Limitation of the Research **90**
Chapter six: Conclusion **92**
6. Conclusion **93**
References **94**
Appendices **102**

List of figure

Figure 1: Telehealth and Telemedicine applications…… 15
Figure 2: Map of Nepal……28
Figure 3: Telephone penetration rate……..30
Figure 4: Kathmandu Model Hospital……34
Figure 5: Manmohan Memorial Community Hospital…… 35
Figure 6: Map of Nepal Locating Nangi…….36
Figure 7:Underlying philosophical assumption…….39
Figure 8: Research design stages…… 43
Figure 9: On the way to Nangi from Beni Bazaar…… 45
Figure 10: Representation of Stakeholders and partner institutes for telemedicine……. .54
Figure 11: Villages connected to Kathmandu Model Hospital for Telemedicine Service…….. 56
Figure 12: Health workers in Nangi Village…….. 57
Figure 13: Internet based CME provided by Sung Wen Kim, MD, Prof surgery from Seoul National University, Bundang Hospital on Minimally Invasive Surgery in the management of Breast Cancer…… ……58
Figure 14: Polycom VSX 800…….. 60
Figure 15: Logitech webcam and speakers…… 60
Figure 16: Routers, monitors and other devices…… 61
Figure 17:Using tree to place antenna grid……. 62
Figure 18: Register for recording patients treated through telemedicine……64
Figure 19: Participants from Different Countries and Organizations Attending CME Provided from the Operation Theatre in a Korean Hospital ……..67
Figure 20: Telemedicine Model…… 78

Figure 21: Telemedicine as an Information Infrastructure…….. 79

Figure 22: Assembled computer in wooden box and new computer on right at present……..... 82

Fig 23: A Successful Telemedicine Model…….. 88

List of Table

Table1: Delivery option…….12
Table 2: Health Indicators…… 32
Table 3: Registered health worker……32
Table 5: Pubilc and private health facilities…… 33
Table 6: Features of quantitative and qualitative methodology…… 38
Table 7: List of Informants. ……. 46

Table 8: Comparison of travel and out patient department cost among the research site……. 69

List of Abbreviation

ADSL	Asymmetric Digital subscriber Line
CDMA	Code division multiple access (CDMA)
CME	Continuous Medical Education
ENRD	E- Network and Research Development
ICT	Information and Communication Technology
IS	Information System
ITU	International Telecommunication Union
KMH	Kathmandu Model Hospital
MBBS	Bachelors of medicine bachelors of surgery
MDG	Millennium Development Goals
NCWC	Nangi Clinic and Womens' Center
NREN	Nepal Research and Education Network
NWNP	Nepal Wireless Networking Project
OBCSDP	Opportune Breast Cancer Screening and Diagnosis Program (OBCSDP)
VSAT	Very Small Aperture Terminal
UPS	Uninterrupted Power Supply
WHO	World health Organization

Chapter 1:Introduction

1.1 Background

"Health is wealth"

This proverb certainly signifies the importance of health as being one's wealth. Therefore people take care of their health and tries to maintain it with the help of health care service providers. In this era where politicians are initiating " health for all" strategies to provide essential health care to people, in most cases especially for people living in remote areas and under poverty access to health care is difficult due to geographical isolation, shortage of medical professionals and increasing cost of medical care. To bridge this gap of health inequality, information and communication tools and technologies are being used. In developed countries the ICT has been used in health to improve better accessibility and availability to quality care over the years. Similarly in developing countries the usage of ICT has shown potential to increase access to basic health care.

My research was carried out to study the current Telemedicine Program in Kathmandu Model Hospital (KMH), to get an overview of telemedicine services in Nepal and understand its role and potential role to support delivery of healthcare in order to improve health care service. However this research does not cover the efficacy of the telemedicine project. More about health care problems in Nepal, possible solution to it, objective and motivation of the study is discussed in sections below. Along with that it attempts to highlight issues and challenges of Telemedicine Programs of KMH.

1.1.1 Statement of problem

Nepal is one of the South Asian countries with an ancient historical background, rich cultures and is home to a population of 30,430,267[1]. Nepal is gifted with diverse geographical features ranging from the highest altitude of 8848m to 70m, with the Himalayas, hills and plain lowland areas. The population of Nepal is scattered across different geographical areas, the majority of population have rather settled in rural geographical areas where providing basic health care services remains a substantial challenge. The

mountains and hills in Nepal further complicate the availability and accessibility of health services. In fact barrier created by the mountains and hills also impede several developmental initiatives such as transportation, education and communication. As a result majority of the population are isolated from basic but essential health care.

Besides the topography of Nepal, another major problem in the healthcare sector of Nepal is shortage of doctors. The doctor: patient ratio in Kathmandu is 1:800, while in the hilly and remote area is 1:3000[2]. In remote areas, though there are health care institutions, there are no proper medical professionals. Nepal, just like other developing countries has been experiencing a shortage of medical professionals. There is also an uneven distribution of very few medical professionals- majority of medical professional including specialists are concentrated in urban areas. The majority of people living in rural and remote areas barely get access to essential or specialist medical care. As a result, every year hundreds of people die from preventable communicable disease like diarrhea and typhoid. In some instances, rural people have to walk for many hours or day to nearest urban health centers.

Access to both primary health care and specialist care, equity, quality and cost effectiveness are key issues even in developed countries[3]. However, the development of modern communication and information technology, and integrating it in health care, the process termed as "Telemedicine" has changed the methods of treatment. These technologies have shown greater potential in addressing the above global health issues[3] by making health care accessible to larger population and improving the quality of care.

1.1.2 Telemedicine: A solution

Today telemedicine is rapidly developing application in clinical health where medical information is transferred through communication mediums such as telephone and the internet for consultation and remote examination[4]. In developing countries where there are an inadequate number of healthcare professionals, telemedicine seems to be effective in providing health care to underserved and isolated populations.

Telemedicine can solve many of the problems faced by Nepal and could help in providing basic minimum health care and health information to all the people across Nepal. Telemedicine can provide virtual presence of the physicians or specialist at the rural healthcare sites via telemedicine technology and processes. Hence, along with specialist care it can also provide medical information and education to the health workers at rural sites. The other benefits include training for remotely located health workers and decreasing professional isolation among medical professionals.

With the aim of improving access and quality of health care in Nepal, a number of governmental and non-governmental organizations have started to run telemedicine programs, which are discussed below.

1.1.3 Telemedicine Implementation in Nepal

In 2004, Healthnet Nepal conducted a pilot project for telemedicine in Nepal that was funded by the ICT R&D Grants program for Asia[5]. The objective was to test the potentials of telemedicine- based on the store and forward principle for still images captured through digital cameras in the areas of pathology, dermatology and radiology[5, 6]. The project was conducted in three region of Nepal, the Eastern, the Western and the Central Region. They also developed software for uploading the patients' data. The project lasted for two years and their findings state that they found no difference between the diagnosis through store and forward method using pictures and textual data and the conventional method[6].

The author noted that more studies are needed of the clinical efficacy of telemedicine projects[6]. At the same time they also emphasized on further evaluation on competence of healthcare professional about information technology and provide trainings to them on usage of such technologies for telemedical activities[6].

Every year many Nepalese patients go to India for special treatment. So to end the burden of travelling and to provide quality care, Om Hospital and Research Center collaborated with Apollo Hospital in India in 2004 and started their telemedicine program[7]. The doctors and specialist in Om Hospital and Research Center were able to seek assistance for diagnosis, treatments plans, and also carry out lectures and

presentation between the two institutes[7]. However this service has been halted presently due to financial issues.

Similarly, Dhulikhel Hospital has started a telemedicine service to communicate with the outreach center ran by Dhulikhel Hospital and provide quality health care. They initiated a walkie-talkie radio- based communication system linking Bhunipati Health Centre and Bolde Phediche Health Centre[8, 9]. Walkie-talkie was also available in the ambulance to communicate while on their way to hospital. However, the service has been replaced by Code division multiple access (CDMA), phone due to a better network coverage and cost effectiveness[8].

In 2011, the Government of Nepal, the Ministry of Health and Population started a telemedicine program. The project connected Patan Hospital with 25 other regional hospitals, and according to Dr Mingmar , the focal person for the rural telemedicine program, the project cost was approximately 20 million Nepalese rupees , with the aim of providing specialist care to patient across the country[10]. The authorities had aimed at extending the service to other regions in the future. The equipment used for these program were computers, cameras, scanners, a software for recording a patient's data such as x-ray, lab tests etc. For connectivity they used Ku-Band VSAT technology[10].

Initially the program allocated specialist for tele-consultation for two hours every day every day. At the same time they also operated a toll free line (1660-01-23455) for patients to talk to a doctor about their health queries[10]. When I visited in November 2012, there was a medical doctor 24 hours a day in the central hospital in Patan. The toll free line had been very busy since it's re-inauguration by one of the Minister. The VSAT (very small apperature terminal) used for the internet service was being replaced by ADSL (Asymmetrical Digital Subscriver Line) in the remote areas hence the video conferrencing service was put on hold for the time.

The other organization that is believed to be a pioneer and a front-runner for telemedicine in Nepal is Nepal Wireless Networking Project in association with NREN[11]. In 2006, they were able to connect Om hospital in Pokhara with a health post in Nangi Village[11]. Since then they have connected 10 remote health posts and hospitals with a central hospital called Kathmandu Model Hospital (KHM). KHM provides

teleconsultation to the health workers in remote areas and also provides tele-education sessions on a regular basis.

Apart from these organizations there are other such as Pokhara Manipal Medical Hospital[12], NayaHealth[13], Tilganaga Hospital[14], DI skin Hospital [15] that have started telemedicine services. The main objective of these programs has always been to provide quality care to patients either by collaborating with their outreach centers or collaborating with the international organizations

1.2 Motivation for the Research

I had always been interested in telemedicine since my bachelors study. Having born in a country where healthcare facilities are inadequate, I thought telemedicine could help people many people specially residing in village to gain basic primary healthcare. With a hope to explore more about telemedicine I took a Masters in Telemedicine and e-health. I wanted to do my research in the context of Nepal so that I could have a better understanding of the telemedicine programs in Nepal.

Not much is known about telemedicine in Nepal, even though there are international journals and articles citing successful implementations of telemedicine programs. Most of the articles are on pilot projects. Very little is written about information technologies used and processes of operation for telemedicine programs. Hence, in my research, I tried to explore more about the information infrastructures and processes and strategies for implementations by conducting a case study in Kathmandu Model Hospital, one of the front-runners for telemedicine services in Nepal. More about Kathmandu Model hospital and its telemedicine programs are discussed in research setting and findings, respectively.

1.3 Objectives of the Study

The objective of my research is to study about telemedicine programs and its implementation in Nepal. The research is carried out in Kathmandu Model Hospital to study the role of telemedicine to support health care. The specific objective was to study scope and the challenges of telemedicine program.

1.4 Significance of the Study

The research will provide information about current established telemedicine programs in Nepal. It is also expected that the research would provide basic information about the current telemedicine applications in Kathmandu Model Hospital and its' outreach center with important aspects such as its' role in health care, technologies used, issues surrounding telemedicine to the interested parties, seeking collaboration or planning telemedicine implementation.

1.5 Research Approach and Research Site

I decided to do an interpretive case study, focusing on telemedicine project in Kathmandu Model Hospital. Furthermore, I carried out studies in two outreach centers of KMH as well, Manmohan Memorial Community Hospital (MMCH) and Nangi Clinic and Women's Center (NCWC). The methodologies and information on the research site will be presented in the later chapters.

1.6 Organization of Thesis

Chapter 1 sheds light on the background of the study by first stating the problems and suggesting possible solution to them. It further represents some background information about the telemedicine program in Nepal. Then it discusses the motivation, objectives and significance of the study with the research approach used in the research site. Further it briefly outlines the contents in further chapters.

Chapter 2 deals with theoretical framework of telemedicine, its application and technologies; its history and challenges. The chapter deals with telemedicine in developing countries. It also deals with information infrastructure and its characteristics.

Chapter 3 describes the materials and methods used for the research. It gives an overview of Nepal, its social, economic and political profile. The chapter introduces the research sites Kathmandu Model

Hospital, Manmohan Memorial Community Hospital and Nangi Clinic and Women's center. It states research questions, explains the interpretive research methodology used and its relevance to the study, and also explains the methods used for data collection and interpretation for the study.

Chapter 4 presents the findings of the study. It briefly explains the status of telemedicine in Kathmandu Model Hospital and its contribution to Nepal, its telemedicine application, technology used, stakeholders involved and challenges to the implementation.

Chapter 5 contains discussion of the findings of the study. It also draws the correlation between the findings and the theory of the information infrastructure. It discusses the implications of the study, future prospective, researcher's perspective, recommendations and limitations of the study.

Chapter 6 concludes with the summary of the study and its findings.

Chapter 2:Theoretical Framework

2.1 Introduction to Telemedicine

Tele is derived from Greek word for "at distance" and" Telemedicine", was coined in the 1970s, and meant, "healing at distance"[3]. It also signified the use of ICT in health sector to increase access to care and medical informations[3]. Since many years from then clinicians, health service researchers, technologists and other have been investigating the use of modern advanced telecommunication and computer technologies to improve healthcare, an effort to combine mainstream and innovative information technologies has resulted in modern telemedicine technologies[3, 15].

2.1.1 Definitions

Since telemedicine was first coined in 1970, many authors have defined telemedicine. Some of the definitions are given below:

.

In 1971, Bird defined telemedicine as[16]

" *Practice of medicine without the usual physician patient confrontation… via interactive audio-video communication system".*

Similarly Bashshur [16] listed six elements for telemedicine care:

1. Geographic separation between provider and recipient of information
2. Use of information technology as a substitute for personal or face-to-face interaction
3. Staffing to perform necessary functions (including physicians, assistants, and technicians)
4. An organizational structure suitable for system or network development and implementation
5. Clinical protocols for treating and triaging patients, and
6. Normative standards of behavior in terms of physician and administrator regard for quality of care, confidentiality, and the like.

Telemedicine is basically the use of electronic information and communication technologies to provide and support health care delivery from a distance. After reviewing 104 definitions for telemedicine in study conducted in 2007. The WHO described telemedicine broadly as[3]

"The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities"

The WHO also listed four elements that are relevant to telemedicine which are as follows[3]:

1. Its purpose is to provide clinical support.
2. It is intended to overcome geographical barriers, connecting users who are not in the same physical location.
3. It involves the use of various types of ICT.
4. Its goal is to improve health outcomes.

2.1.2 Telemedicine, Telehealth and e-Health

The evolution of telemedicine and its delivery and advancement in modern technologies has also led to the development of new terminologies such as tele-health, e-health and others leading to confusion in identifying what type of service fell under what term [17.] Sometimes the terms are used interchangeably as well[17].

Telemedicine is the provision of healthcare services, clinical information, and education over a distance using telecommunication technology as defined by Maheu, while he defined e-health as ''*all forms of electronic healthcare delivered over the internet, ranging from informational, educational and commercial "products" to direct services offered by professionals, non professionals, business or consumer themselves*"[19] E-health differs from telehealth and telemedicine by not being professional- centric.

Similarly the American Nurses Association has also defined telehealth as
"*The removal of time and distance barriers for the delivery of healthcare services or related healthcare activities."*

However, the WHO has used the terms telemedicine and tele-health synonymously and interchangeably in their report despite stating that telemedicine is restricted to service delivery by physicians only, while tele-health signifying services provided by health professionals in general, including nurses, pharmacists, and others[3].

The other terms that are being proposed are health telematics, health informatics, telecare, cybermedicine and many more.

2.1.3 Communication Methods in Telemedicine

Telemedicine can be classified into two basic types according to the way information is transmitted[20, 17].

2.1.3.a The real time method/ synchronous: When the information is exchanged immediately such as through video conferencing allowing clinicians to see, hear, examine and counsel patients for diagnostic and therapeutic purposes.

2.1.3.b Store and forward methods/asynchronous: When the information is being shared at different time or stored and transmitted to a consultant who can receive and interpret when convenient.

The examples of types of data and transmission methods are illustrated in the table below

Transmission methods / Data type	Synchronous	Asynchronous
Audio	Telephone Audioconferncing	Voicemail
Video	Videoconferencing	Video/audiostreaming
Data	Instant messaging Shared electronic white board	Paging, Fax, Email, web pages, web messages store and forward, Web format

Table 1: Delivery Option[17]

2.1.4 Telemedicine Applications and Purposes

The application of telemedicine or purpose of communication of medical information can be categorized under two main categories:

2.1.4.a Clinical

As classified by Committee on Evaluating Clinical Applications of Telemedicine[20], the clinical applications include

1. Teleconsultation for initial urgent evaluation and diagnosis
2. Supervision of primary care and provision of specialist care through teleconsultation
3. Telemonitoring to gain access to patients in critical condition and patients with chronic diseases
4. Robotic surgery where the robots are guided to perform surgery

Hence, clinical applications involve consultations and sharing information about patients and their care.

2.1.4.b Non-clinical

The nonclinical application include

1. Internet-based professional medical education and continuous medical education
2. Telemedicine used for patient education such as online self help
3. It could advantage public health by making easy access to underserved populations and also has potential to raise health awareness in the public
4. It would make easy for researcher to carry out researches because of the easy availability of information and easy access
5. It could also help in administrative purposes like record keeping via electronic patient records and helps in regulating and improving the availability of clinical and non-clinical information

2.1.5 Development of Telemedicine and Telemedicine Technologies

As mentioned earlier, the definition for telemedicine have evolved a lot in the past years and there are also newer terms. These changes are due to the evolution of communication technology and information technologies[17].

In 1876 when Alexander Graham Bell invented the telephone, it marked the invention of modern technology that changed the traditional methods of communication and medical advice were given over telephone[22]. However the first literature formally addressing the application of technology for medical use appeared in Radio News Magazine as "Radio Doctor" around 1924.Later in 1959 videoconferencing was used for two-way interactive transmission using television in United States in the University of Nebraska[21].

The concept of information technology emerged after the invention of the computer by Konard Zuse around 1936[22]. When computers became more readily and easily available, health information system developed subsequently. The computer networks and applications provided a framework to link hospitals together in the cyber world[22].

Information can travel across all over the world in a fraction of second via the internet. The origin of internet dates back to 1962 by J.C.R. Liclider at MIT documented as "galactic network"[22, 23]. He envisioned globally connected computers forming a network through which everyone had access to data from any site. Since then the internet has revolutionized the computer and communications world with its worldwide broadcasting capabilities[21]. It has an ability to carry different data across single transmission medium which has helped support telemedicine in many areas such as[21]

I. Reliability: quality of service (QoS) assurance.
II. Information Sharing: medical web pages online.
III. Audio: tele-consultation, physiological sounds.
IV. Still Images: X-ray, scans, medical images.
V. Video Images: tele-conferencing, Internet based medical education.
VI. Databases: electronics patient records, standardization of protocols
VII. Vital Signs: ECG, EEG analysis and storage.

The developments of wireless communication technology such as GSM, Satellite and many others have also allowed the flexible deployment of telemedicine applications[23]. While wired communication is more reliable and cheaper for a short distance, wireless communication provides higher mobility and its network covers larger area without having to carry the burden of wires ad cables[23, 21]. The rapid advancement of

such wireless communication has lead to newer information infrastructure that have greater potential to support advance health care services such as emergency telemedicine, remote monitoring, electronic patient record, and other clinical fields[21] as shown in figure 1.

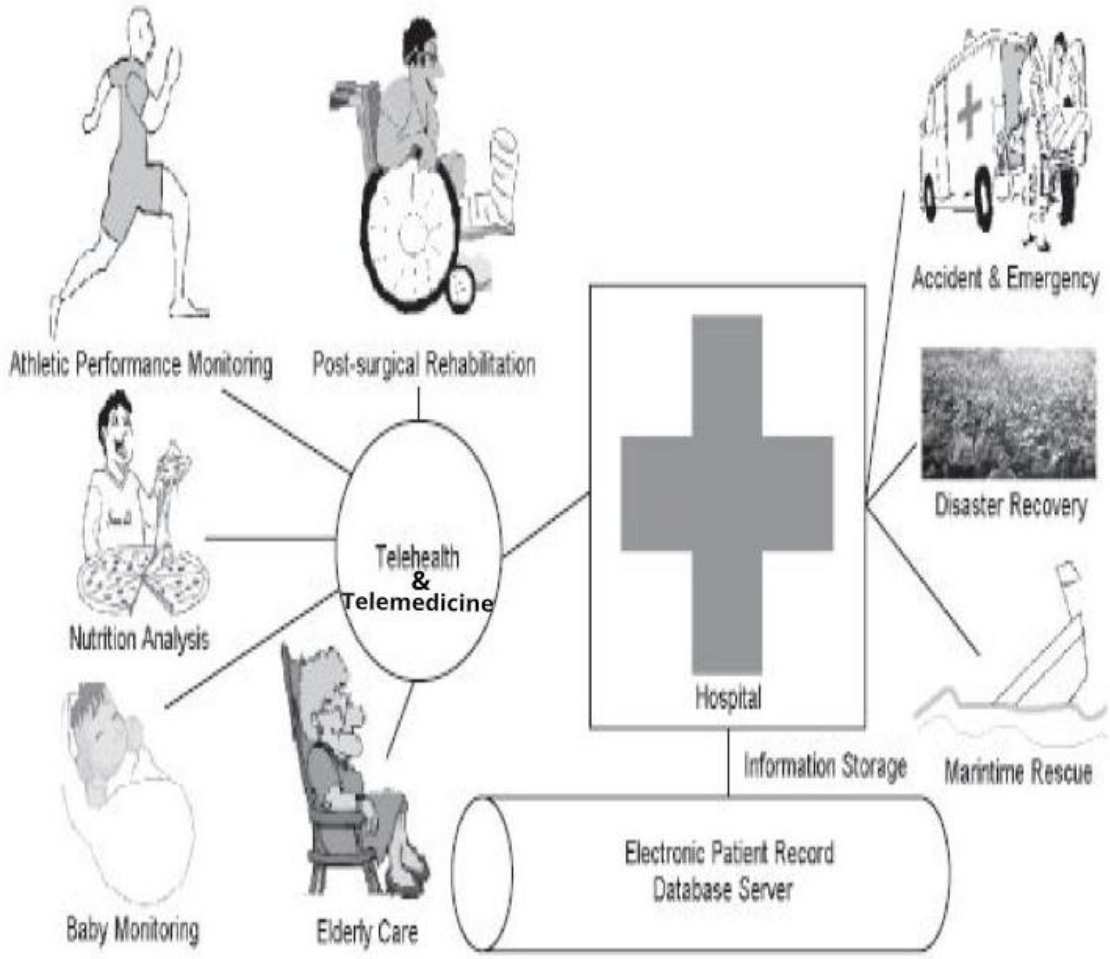

Figure 1: Telehealth and Telemedicine applications[21] (complied)

A telemedicine service could be as simple as using the telephone for consultation between patients and clinicians, while it could also be sophisticated process like tele-surgery where surgeons receive visual and

tactile information from other sophisticated technologies to guide robotic instruments to perform surgery. Today Telemedicine covers almost all aspects of healthcare, changing the traditional method of face-to-face methods. It has also covered our daily life healthcare activities with the help of portable technologies like smart phones or notebook computers.

2.1.6 Challenges of Telemedicine

Although telemedicine has shown and proved potential benefits it surely has a limitation of its own. The barriers to telemedicine are[3]:

- **Equipment and infrastructure**: The equipment and infrastructures like optical fiber, satellites, bandwidth etc. used for telemedicine are highly expensive to afford for a developing country. One of the most difficult problems would be to install and operate these machines and equipment.
- **Technology Acceptance**: The other major problem is the acceptance of technology by the users. Many studies have showed that the technology gets rejected because users are unable to use it. Even in industrialized country its end users can be unsatisfied with the technology they use. The high cost and rapidly changing technologies could be blamed for such a relative slow acceptance among the end users[24].
- **Privacy**: The issue over who can get access to the patient's electronic record or other medical information is an important topic among telemedicine service providers. There are cases of leakage of patients's data due to breach of security and loss of storage devices, hence significant parts of such systems involved ensuring security of data [21].
- **Regulatory concerns**: Regulatory concerns such as licensing issues and accreditation requirements are barriers to telemedicine. Telemedicine is supposed to be practices beyond boundaries, however the law for different states or country can be different [25, 26].
- **Reimbursement**: Since the ICT infrastructures are expensive, they require strong funding or reimbursement. Since government or non-government organizations fund most of these programs, once the funding stops it becomes hard for the program to continue[25, 26].

- **Standardization**: Policy makers and administrations, seeking to protect consumers while responding to market place demands for telemedicine interventions are beginning to call for both clinical and technological standards[26]. The lawmakers are calling for the development of guidelines for telehealth and telemedicine practice in order to protect patients from malpractice and reduce liabilities[26]. The standardization of clinical medical communication process is also important for interoperability or intercommunication between medical devices and information system. Lack of such interoperability can hamper the transmission of data as well as data accuracy and completeness[27].

2.2 Telemedicine in Developing Countries

In the industrialized world, telemedicine has been in use for many years and there is an increment in such activities. And today even developing world is taking such initiatives in healthcare.

A review done by R Wotton for telemedicine for developing countries showed that the potential uses of telemedicine in the developing world are similar to those in the industrialized world, that is for educational and for clinical purposes[28]. Wotton outlined some reasons why developing countries should implement telemedicine. According to Wotton, since developing countries have large rural areas and relatively few health care staff, telemedicine could help to provide access as well as deliver health care to larger populations residing in remote areas[29]. Wotton also noted the most useful telemedicine application in developing world possible telemedicine applications in developing countries was tele-consultations and tele-education between major hospitals and remote hospitals.

In a review of telemedicine in developing countries, the WHO noted that people in remote areas could get specialist care therefore reducing the medical referrals to off-site facilities and hence reducing the need for patient to travel[3]. The review further noted that telemedicine could provide patients with early access to better health care through consultations. Similarly another secondary advantage of telemedicine is that it motivates practitioners to remain in rural areas by providing professional support and opportunities for internet based continuous medical education (CME).

In recent years, India has had some successful telemedicine initiatives. Through telemedicine India has been able to provide health treatments, health education and preventive health care to people in remote areas. The Apollo Hospital Group, one of the largest private hospitals in the world has started remote telemedicine centers that links villages via satellite for specialist care. The Apollo hospital has also expanded its service in Bangladesh, Nepal, and many states in India[30]. Similarly, the Online telemedicine research Institute in Gujarat, India has been operated in several states with application development and manufacturing capabilities in health care[30]. Its role was significant during the earthquake in 2001 that left thousands dead and many more wounded and homeless. Within a day it was able to establish satellite phone links, set up necessary medical equipment and a full-fledged telemedicine service was used for consultations in pathology, radiology and cardiology between district hospital and earthquake region[30].

In 2007, Mongolia used telemedicine for promotion of maternal and newborn health while addressing the gap health care providers[3]. After the implementation the maternal mortality rate and referral to urban hospital decreased. The project also decreased the isolation between the rural health worker and urban health worker by fostering collaboration between them. The success of the project was credited to hands-on training models based in local practices and the knowledge of local health practitioners[3]. Similarly Mexico implemented The Opportune Breast Cancer Screening and Diagnosis Program (OBCSDP) to reduce breast cancer mortality. This program collaborated with other organizations and was able to overcome a shortage of radiologists and has subsequently helped in ensuring access to preventative breast cancer screening and diagnosis for rural and remote residents[3].

A few journals have also been found in the case of Nepal describing successful telemedicine pilot projects. Nethealth carried out a simple store and forward telemedicine service for pathology, dermatology, and cardiology. The result was that there was no difference in diagnosis through image followed by textual information as compared to the conventional method of diagnosis [31]. A case study on telephone management of sever wasp sting in remote places showed that the local health worker (in Bahunipati Helath Centre) was able to save lives by consulting the doctor in the city hospital (Kathmandu Dhulikhel Hosital). The study highlights the fact that the consultation reduced medical cost and travel expense to

city[32]. The study also emphasized promoting mobile phone technology for telemedicine since it had better accessibility and covered in remote areas[32].

Opportunities to improve health care from telemedicine are great. However there are more barriers to telemedicine in developing countries than in developed countries. Even basic infrastructures like electricity and internet are not available in many remote areas, making telemedicine implementation more difficult. Similarly, other barriers like lack of trained manpower, lack of technology, high cost of infrastructure, and a lack of policy governing telemedicine services could be barriers for implementing telemedicine services technological breakdown, lack of maintenance, high cost of operation and lack of resources, lack of users' knowledge and interest are barriers for operating and sustaining telemedicine projects. As has been argued in Wotton's article, the question still arises, would it be worth to invest resources in modern health technologies instead of conventional public health measures such as providing medical supplies, clean drinking water or proper sanitation? [29]

However, despite the fact that telemedicine services are costly, and there are many issues related to implementation, the advantages surely outweigh its cost. In fact, it has been said that telemedicine has more impact on developing countries than developed countries[32]. Researchers from the International Telecommunication Union (ITU), the organization that supports telemedicine services in developing countries, believes that there is a desperate need of establishment of telecommunication facilities in such facilities deprived area. Telemedicine can establish links between the health care practitioners and communication between those health care providers can improve medical education for isolated practitioners, which also enables exchange of vital information about endemics and preventive measures[33].

In the developing world, where disease is prevalent, doctors are scarce, and health care infrastructure is inadequate, telemedicine is an innovative solution that connects the developing world to the resources of the developed world. Telemedicine implementation for health care can be made successful by having an appropriate use of technologies, resources and procedures such as policies and protocols or guidelines.

2.3 Information Infrastructure

The emergence of information and communication technology has transformed the way people work. ICT is used in the work to make work easier, faster and efficient, but beside that it is also changing our work nature[34]. Computers do most of the work these days in every field science, mathematics, and business, demanding the users to learn techniques to deal with it. The "information work" has become the dominant mode of work in industrialized economies[34].

The increase in popularity of such information systems promoted the establishment of the term “Information Infrastructure”. Ole Hanseth defined information infrastructure as "a shared, evolving, open, standardized, and heterogeneous installed base"[36]. The study about information infrastructure leads to better understanding of information systems. Hence today the researchers conducting an empirical study on information system (IS), are deeply looking at the infrastructure of systems and organization[37].

People envision infrastructure as a system of substrate such as pipes, electrical power plant, and railroads lines. However infrastructure could mean different things to different people and the envisioned infrastructure for one can be invisible to another group of people[37]. For example the cook considers the water system as working infrastructure integral to making dinner while for the city planner or the plumber, it is a variable in a complex planning process or a target for repair[38]. Infrastructure is something that emerges for people in practice; connected to activities and structures hence one should ask when is an infrastructure not what is infrastructure[36]. As Star and Ruhleder puts it, infrastructure is a fundamentally relational concept, becoming real infrastructure in relation to organized practices. It is something that emerges for people in practice, connected to activities and structures [38].

Star and Rulheder[38] mentioned 8 dimensions of infrastructure:

- **Embeddedness**- Infrastructure is "sunk" into, inside of, other structures, social arrangements and technologies.
- **Transparency**- Infrastructure is transparent to use (serves its purpose)

- **Reach or scope**- This may be either spatial or temporal since infrastructure has reach beyond a single event or one-site practice
- **Learned as part of membership**-Strangers and outsiders encounter infrastructure as a target object to be learned about and they get used to it as they start using it.
- **Links with conventions of practice**-Infrastructure both shapes and is shaped by the conventions of user's experience or practice.
- **Embodiment of standards**-Modified and shaped by scope and sometimes-conflicting conventions.
- **Built on an installed base**[12]-It grows on the existing base or technology.
- **Becomes visible upon breakdown**-The normally invisible quality of working infrastructure becomes visible when it breaks (for example when there is power cut off, the system stops)
- **Is fixed in modular increments, not all at once or globally**- since infrastructure is complex and tangled to each other with different perspective, it is difficult to change and adjust at once hence takes time and negotiation.

The term "information infrastructure" refers loosely to digital facilities and services usually associated with the Internet: computational services, help desks, and data repositories to name a few. Infrastructure typically exists in the background, it is invisible, and it is frequently taken for granted [39, 40].The work of infrastructure and its maintenance is itself often that of undervalued or invisible workers[37]. The design of infrastructure itself can make its effects more or less visible, as a consequence it become difficult to trace and politics are easily buried in technical encodings[39, 35]. The methods to make it more visible have also been given by Star, which is practical method such as observing during a moment of breakdown and conceptual methods such as "infrastructural inversion" by Bowker[39, 40]. Infrastructure inversion is a method to recognize the depths of interdependence of technical networks and standards, the work of politics and knowledge production[41].

2.3.1 Component of Information infrastructure

The term "information infrastructure" (II) has been increasingly used to refer to integrated solutions based on the now ongoing integration of information and communication technologies. It has been used in relation to information technology to denote basic support systems like operating systems, file servers, communication protocols, printers, etc. We can say that infrastructures are underlining base or foundation for the generation, communication and storage of information in an organization. While dealing with information infrastructures, it is important look at the whole array of organizational forms, practices, and institutions that accompany, make possible, and alter the development of new technology, their related practices, and their distributions[39].

The National Information Infrastructure (NII) of the United States recognizes four major elements, namely, (1) the information itself, (2) applications and software, (3) network standards and transmission nodes, and (4) the people (vendors, users, operators, and service providers) [35]. This shows that 'information infrastructure' has a broader meaning and includes more than just the wire and machines such as technologies to transmit, store, access, and display voice, data and image.

On a broad term, "*Information infrastructure covers all kinds of technologies, all kinds of use and area and involves lots of political, social, organization, human aspects and issues – all these issues interact, they are interdependent and intertwined*"[35]. Information infrastructure for telemedicine service includes policies and processes, social organizations making policies and supporting the service such as telecom and hospitals, human elements such as doctor, nurses, technicians and even donors and vendors. And all these factors contribute to the gathering, processing, communicating and storing of the medical data or information.

2.3.2 Characteristics of Information Infrastructure

Understanding information infrastructures requires a holistic perspective since an infrastructure is more than the individual components [35]. When often these infrastructures are invisible and are not considered, new approaches are required to understand these imbrications of infrastructure and human organization.

Establishing a working information infrastructure is a highly complex socio-technical task which includes: designing communication standards, testing and adapting these to a wide range of different use situations, and ensuring that the standards are developed according to the bureaucratic procedures of international standardization bodies[42].

Hanseth and Monterio[35] have listed characteristics of Information Infrastructure which are discussed below

2.3.2.a Enabling shared and open

The infrastructures are designed to support a wide range of activities and are open to new fields of applications and activities. Infrastructures are open in nature meaning that there are number of users and stakeholders and vendors. II also interacts with other systems inside the community as well across the organization. Hence IIs are shared and the integration and sharing is possible by developing standards and protocols for its use.

2.3.2.b Heterogeneity

II envisioned is meant to include more than just the physical facilities to transmit, store, process and display, voice, data and images or a pure technology. Infrastructures are heterogeneous, encompassing technological components, humans, organizations and institutions that are connected and inter-related through layering, linking local related networks and integrating independent components, making them interdependent.

2.3.2.c Installed Base

According to Hanseth, an infrastructure is never developed from scratch; it is built from an install base[36]. The existing infrastructure, the installed-base, influences the design of new components and the evolution of the infrastructure. The infrastructure built this way would allow better interoperability between the new and old system. Developing II as ‘installed base cultivation’ captures most aspects of infrastructures.

Similarly. Star and Ruhleder have identified three orders of issue caused by the information infrastructure[38], and further have written that the system fails if these issues are not addressed. The three levels of issue are:

- **First Order Issue**: First order issues are often those that are most obvious to informants, as they tend towards the concrete, and can be addressed by equally concrete solutions. For example the issues related to the installation and use of the system, which includes finding out about it, figuring out how to install it, and making different pieces of software work together. It generally involves issues related to money, space, information, training etc. First order issues, however, are not limited to "start-up," but recur over time as work patterns and resource constraints shift (and thus perhaps a by-product of second or third order changes).

  These first order issues can be addressed by providing training as well as information to all the users and stakeholders respectively before launching any new design.

- **Second Order Issue**: The second order issue is either the result of unforeseen contextual effects or as collision of two or more first order issues. The problems are related to the design and use or designer or user. So, proper funding, training and co-operation among the actors can address these issues.

- **Third Order Issues**: The third order issues are inherently political or involve permanent disputes. The third order issues can be resolved by creating new subspecialties, new requirements for the disciplines or profession, new criteria for the conduct and evaluation of work and new reward structures.

2.4 Information infrastructure for Health Care

Hanseth and Monterio[42] introduces health information infrastructure as an information infrastructure within the health care sector. According to the authors, there are two main types of transmission of form-like

information and multi- media information. Illustrations of the former include, laboratory orders and reports exchanged between general practitioners, hospitals or labs and (other) laboratories, admission and discharge letters between general practitioners, specialists, and hospitals, exchanges of prescription from general practitioners to pharmacists. The latter type include: telemedicine services, that is, computer based services which usually include real time multi-media conferencing systems supporting a physician requesting advise from another physician at another institution; access to data bases and Web servers containing medical information; and PACS (picture achieve systems for X-rays) systems.

Health organizations today increasingly have to deal with a complex integrated portfolio of information systems supporting many different cross-organizational practices, and thus a heterogeneous array of users. Health information infrastructures are also developed on the installed base as other information infrastructure and hence inherent the strength and limitation of base (infrastructure) that are taken into account while designing the health information infrastructures.

Chapter 3:Materials and Methods

3. Research Settings

3.1 Nepal: Country Profile

Modern Nepal was created around in the mid 1700s when a number of independent states were unified as a single nation. The official name is Sanghiya Loktantra Ganatantra Nepal meaning Federal Democratic Republic of Nepal. Kathmandu is the capital of Nepal[43].

3.1.1Administrative Division

Nepal is divided into development regions:

I. Eastern Development Region
II. Central Development Region
III. Western Development Region
IV. Mid Western Development region
V. Far western development Region

Nepal is further divided into14 zones, 75 districts, 58 Municipalities and 3915 village development committees.

Figure 2: Map of Nepal (http://www.venturenepal.com/nepal-resources.aspx)

3.1.2 Geography

It is a landlocked country situated between India and China. It covers an area of 147,181 square km with land constituting 143,351 square km and water constituting 3,830 square km and Nepal can be divided into three mountains, hilly and lowland "Terai" region accounting for 35%, 42% and 23% respectively[1, 44]. It has eight of the world's highest mountains including the world's tallest Mount Everest while the lowest elevation point is Kanchan Kalan with 70m[44].

3.1.3 Political Status

After a nationwide election in 2008, the newly formed Constitution Assembly declared Nepal as a federal democratic republic and abolished the monarchy system[1]. In August 2011 Baburam Bhattarai of UPCNM became Prime Minister. After the Constitutional Assembly (CA) failed to draft constitution, he dissolved the CA and called for new election. Later in 13th of March 2013 a cabinet meeting chaired by former Prime

Minister Baburam Bhattarai endorsed a decision by other major political parties to form a new election government. In 14th March 2013 Khil Raj Regmi was appointed as a new Prime Minister for a short time period to oversee the election that had been scheduled to be held in 21st of June[45] **however the date of election has now been postponed to 19th November 2013.**

3.1.4 Society

According to World Fact[1] the total population of Nepal is 30,430,267 with highest population density of 4,416 persons per square km in Kathmandu. The male literacy and female literacy has reached 73% and 48.3% respectively. The GDP growth was estimated to be 4.3% in 2012. The increment has been due to growth in remittance, agricultural products and tourists.

3.1.5 Telecommunication

According to the survey by the Nepal Telecom Authority (NTA) for march and April 2013, telephone users accounted for 3.14 % while 66.96% were mobile phone users and the remaining other with limited mobility shown in figure 3[46]. However Nepal had only 25.23% Internet subscribers[46].

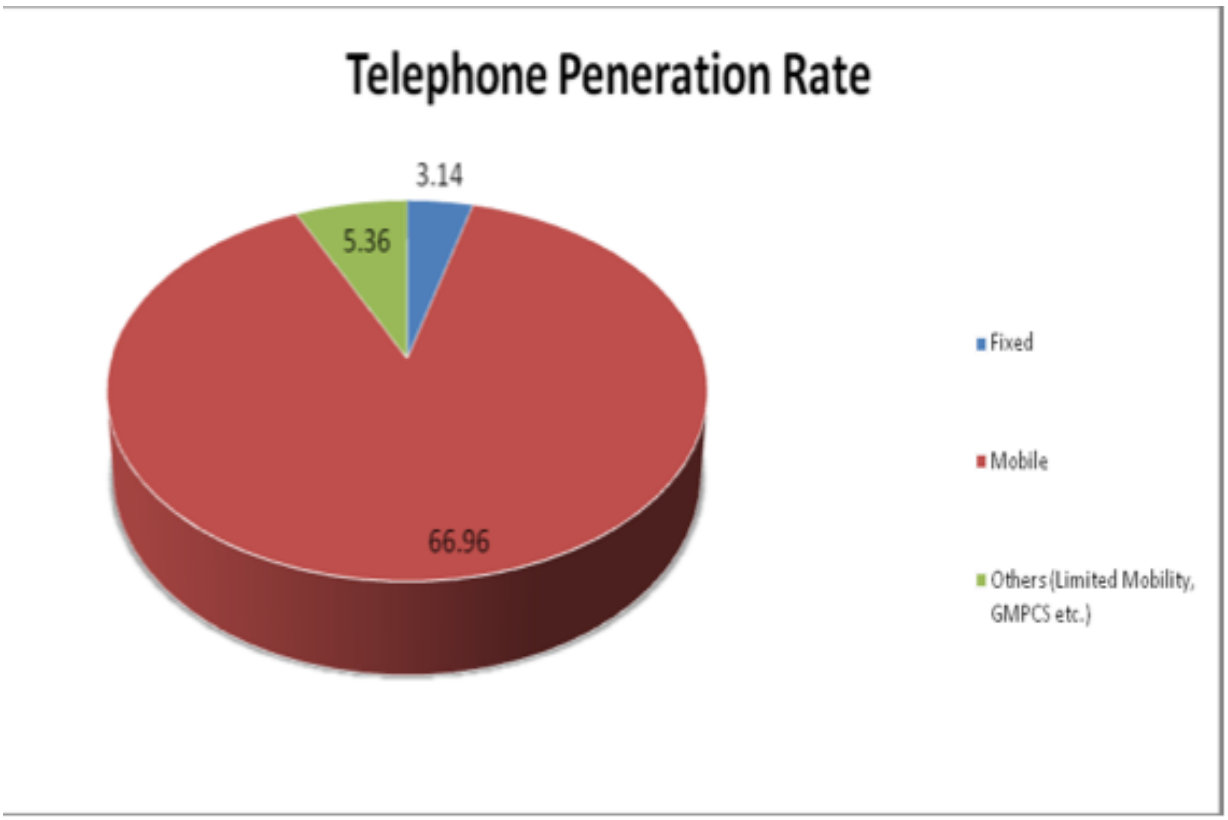

Figure 3: Telephone penetration rate (source http://www.nta.gov.np/en/mis-reports-en)

3.1.6 Health system

3.1.6.a Health Policy

The Ministry of Health and Population launched The Nepal Heath Sector Program Implementation Plan (NHSP-IP 2004-2009) to improve the health status of the people of Nepal through increased utilization of essential health services and to improve the quality of the heath care service with emphasis on the poor and vulnerable and people living in remote areas[47].

Likewise, NHSP-IP II (2010-2015) was launched with further refinement of earlier plans, it aims to improve key maternal and child health indicators such as maternal mortality, total fertility rate, neonatal, infant, and under five mortality rates, contraceptive prevalence rate and percentage of underweight children[47].

Recently, the Population Perspective Plan (PPP 2010 -2012) has also been formulated to support the implementation of policies by focusing on the specific sectorial program areas related to the population such as poverty reduction and sustainable development[47].

3.1.6.b Health Budget

Ministry of Health and population has a budget of NPR 27.3 billion (275 million US $) for fiscal year 2012 and 2013[48]. Despite such investments in health care, the most recent data from the Nepal National Health Accounts suggests that the government contributes less than a quarter of the total health spending, while out-of-pocket payments (OOP) contribute almost 60 percent of the total health spending while foreign grants and loans are the second largest source of public funding for health care[49].

3.1.7 Health Indicators

The table of health indicators below has been compiled form a report by the Ministry of Health and Population [50].

S.No	MGD/Impact Indicator	Recorded value		Target 20
		2009	2010	2015
1.	Life Expectancy at birth	66	67	
2.	Infant Mortality Rate(per 1000 live birth)	41	41	32
3.	Under-5 mortality rate (per 1000 live births)	50	50	38
4.	Maternal Mortality Rate (per 1000 live births)	229	229	134
5.	HIV prevalence among pregnant women aged 15-24 years	NA	0.49	0.35
6.	Malaria annual parasite incidence (per 100)	NA	0.15	Halt and reverse trend
7.	Prevalence rate associated with TB	NA	244	210

	(per 100,000)			
8.	% Safe drinking water	NA	80.4	73
9.	% With access to sanitation	NA	43	53
10.	Birth attended by skilled heath workers (MGD indicator)	33	36	60
11.	Birth in health facility	NA	28	NA

Table 2: Health Indicators

3.1.8 Health Workers

3.1.8.i Registered Health workers (2010-2011)

S.No	Categories	Number
1.	Consultant	2000
2.	MBBS (Bachelors of medicine bachelors of surgery)	10194
3.	Nurses and ANM (Auxiliary Nurse Midwife)	34417
4.	Other health professionals	42473

Table 3: Registered health worker (Source: HRHSP 2011-2015)[51]

3.1.8.ii Human resources for health in Public and Private Sector 2011

S.No	**Cadre**	**Public Sector**	**Private for profit sector**	**Total**
	Sanctioned			
1.	Doctor	1,447	6888	8335
2.	Nurses	6553	NA	6553
3.	Paramedics	7559	NA	7559
4.	Public health workers	4289	NA	4289
5.	Alternative medicine (Ayurveda)	785	NA	785
6.	Admin & support	7137	NA	7137

7.	Total	27770	6888	34,658

Table 4: Human resource distribution in public and private sector
(Source:HuRIC 2010,DOHS 2010, and Nepal Ayurveda Medical Council 2012) [51]

3.1.9 Public and Private Health facilities and Institution

S.No	Facility	Number		Available beds
		Rural	Urban	
1.	Public Hospital	16	79	7637
2.	Public Primary Health care	214	0	642
3.	Public Health Post/Sub Health Post	3816	0	0
4.	Medical college	0	20	10576
5.	Mission Hospitals	6	2	612
7.	Total	4064	194	24088

Table 5: Pubilc and private health facilities (Source: MoHP 2010) [51]

3.2 Research Sites

The research was conducted in Kathmandu Model Hospital while I also visited two outreach centers that were connected with Kathmandu Model Hospital and will be introduced in this chapter.

3.2.1 Kathmandu Model Hospital

Kathmandu Model Hospital is one of the reputed hospitals in Nepal, ran by the Non- Governmental Organization the Public Health Concern Trust (phect-Nepal)[51]. Kathmandu Model Hospital is located in the center of Bagbazaar, in the center of the town.The hospital was established in 1993 as a referral clinic from surrounding communities with 18 beds and in 2003 the capacity was increased to 125 beds[52] and 452 staff.

Figure 4: Kathmandu Model Hospital

The organization believes in the principle that the health service the service should not only aim at curing disease but also removing human sufferings. The organization should make health service available to all the people of Nepal .[52]The Hospital provides curative and diagnostic service and started telemedicine services to improve the health care service in Nepal.

3.2.2 Outreach Centers

The purpose of my visit to the outreach centers was to closely observe telemedicine processes between a central hospital and the outreach center. Of the two-outreach centers, one was near to Kathmandu while the other was in the rural area; the two respective health organizations are listed below

1) Manmohan Community Hospital
2) Nangi Clinic and Women's Center

3.2.2.1 Manmohan Memorial Community Hospital

Manmohan Community Hospital (MMCH) a self-governing community based hospital located in the southern region of the Kathmandu District. It was established in 2004-2005. MMCH is a 15-bed hospital with 22 staff[53]. It is a community as well as Government funded organization.

Figure 5: Manmohan Memorial Community Hospital

The mission of MMCH is to improve the health status of communities in the southern region of Kathmandu through a curative and preventive health approach[53]. The Annual report for 2009 and 2010 shows that there were 22137 patients visiting the hospital. The hospital covers approximately 80,000 populations from more than 6 nearby villages[53].

MMCH started a telemedicine service from the end of 2009. It was started in order to provide specialist care to patients by collaborating with one of the major hospital in Kathmandu[54].

3.2.2.3 Nagi Clinic and Women's Center

Nangi Clinic and Women's Center is located in the Nangi village. The Nangi village is located in the western part of Nepal. The elevation of Nangi village is about 2,260m (7,345 ft and it takes around 6 to 9 hours to hike or a 3-4 hour drive from the nearest bus stop in Beni (nearest city from Nangi) [55].

Figure 6: Map of Nepal Locating Nangi[55]

It has a population of around 800, and the villagers belong to the ethnic community called Pun. There are two medical staffs, a Health Assistant and a Midwife providing health service to the villagers from Nangi, Tilkot and Ramche. They are responsible for operating the telemedicine service.

In 2006, NCWC was connected to Om Hospital in Pokhara[56] to assist health workers in Nangi , however presently it has been connected to Kathmandu Model Hospital.

3.3 Research Method

This study was done to understand different actors such as humans and technologies and their interrelationship and processes that had the same goal to improve health care service in Nepal. Moreover this study was guided by following research questions.

3.3.1 Main research question

What types of telemedicine programs are implemented in Kathmandu Model Hospital?
What is the current state of telemedicine program in Kathmandu Model Hospital?
How is telemedicine supporting health care delivery in KMH and outreach centers?
What are the challenges of implementing and running the telemedicine program?
What are the future perspectives of telemedicine in Nepal?

3.3.2 Introduction to Research methodology: Quantitative and qualitative Research

There are two basic ways to carry out social research, quantitative and qualitative social research[57]. As Bryman[58] defines

"Quantitative methodology is routinely depicted as an approach to conduct social research, which applies a natural science, and in particular a positivist approach to social phenomena"
According to Cohen[59], quantitative research is defined as social research that employs empirical methods and empirical statements. He states that an empirical statement is defined as a descriptive statement about what "is" the case in the "real world" rather than what "ought" to be the case[59]. There are four approaches of quantitative methods, descriptive, correlation, cause –comparative and experimental[60].

Creswell[61] defines qualitative methodology as an approach, useful for exploring and understanding a social phenomenon such as a social or human problem, based on building complex, holistic pictures, formed with words, views of informants and conducted in natural settings. In order to study about this phenomenon, the researcher asks participants broad, general questions, collects the detailed views of participants in the form of words or images, and analyzes the information for description and themes. From these data, the

researcher interprets the meaning of the information drawing on personal reflections and past research[62]. However, the structure of the final report can be flexible and displays the researcher's biases and thoughts[62]. There are four approaches to qualitative research, phenomenology, case study, ethnography and grounded theory[63]. Qualitative research penetrates to the deeper significance to the topic being researched allowing an interpretive, naturalistic approach to its subject matter and gives priority to what the data contribute to important research questions[6].

Steps in research process	**Quantitative/positivist methodology**	**Qualitative/interpretive methodology**
Identifying a problem	Descriptive/explanatory	Exploratory/understanding
Reviewing the Literature	Major role Justify problem	Minor role Justify problem
Specifying a purpose	Specific and narrow Measurable and observable	General and broad Participants' experiences
Identifying participants	Random sampling process	Participants are selected for a purpose
Collecting data	Pre-determined Numeric data Large numbers	Emerging protocols Text and image data Small number
Analyzing and interpretation of data	Statistical Comparisons/predictions	Text analysis Larger meaning of findings
Outcome and evaluation	Standard and fixed Objective, universal and unbiased	Flexible and emerging Subjective, socially constructed and biased

Table 6: Features of quantitative and qualitative methodology[61,]

3.3.3 Qualitative Interpretive Research

Gephart[66] classified the qualitative research paradigm into positivist, interpretive or critical stances.

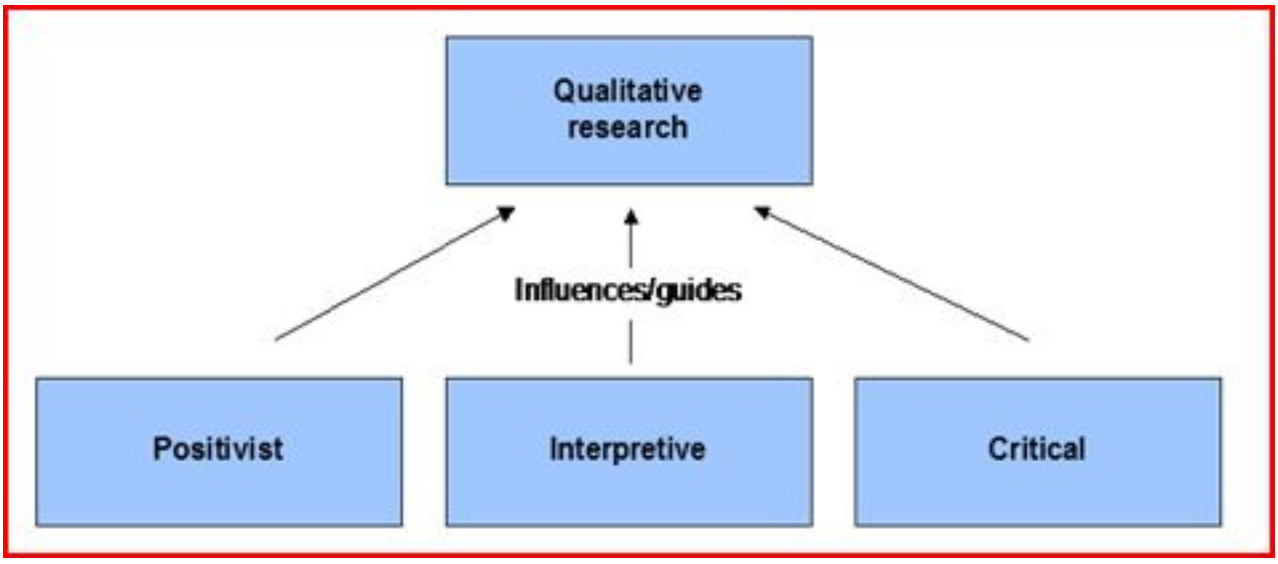

Figure 7:Underlying philosophical assumption[69] (http://www.qual.auckland.ac.nz/)

a. Positivist: It states that social reality is objective, independent of theoretical explanation and can be tested while the researcher should be a detached value free observer for the object of the study[67].

b. Interpretive: According to Meyer[67] social reality is social construction and access to this reality is through language, consciousness and common shared meanings. Walsham[68] also explains that interpretive theories do not approve or disapprove hypothesis or theories, but rather judge on the abilities of the research to explain the relationship between the factors constituting the social setting and these can be derived only by in-depth examination of the phenomenon and processes. Gephart argues that interpretivist assumes that knowledge and meaning are result of interpretation; hence knowledge is dependent on human thinking and reasoning[66]. Therefore, interpretive study depends on the ability of the researcher to collect data and, his/her ability to interpret the collected data and represent it.

c. Critical: The critical paradigm focuses on identifying and challenging the ordinary and traditional methods of research. It challenges the established social practices and considers the complex relationships between human interests, knowledge, power and form of social control[70]. The critical researcher brings current situation or scenario to light by focusing on the oppositions, conflicts and contradictions in contemporary society. The research seeks to be emancipatory i.e. it should help to eliminate the causes of alienation and domination[69].

3.3.4 Interpretive Qualitative Research Approach in Information System

There has been an increase in the interest of interpretive research in information system (IS) over the past few years. Interpretive research in IS assumes that our knowledge of reality is gained only through social constructions such as language, consciousness, shared meanings, documents, tools and other artifacts[71]. It is good for in-depth access to people, issues, and data, and enables observation or participation in action, rather than merely accessing opinions as is the case in an interview-only study[72].

The interpretive qualitative research can help the researcher to understand human thoughts and actions in social and organizational contexts and has the potential to produce deep insight into information systems phenomena, which includes its development, and management[71]. In interpretive research, researchers are viewed as a "key instrument" one which is "calibrated" first through training in theory and methodology and then through experience[73].

The interpretive research can be conducted and evaluated by following a set of principles given by Klein and Meyer [70.]

1. The fundamental principle of the hermeneutic circle: This principle suggests that all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they form. This principle of human understanding is fundamental to all principles.

2. The principle of contextualization: It suggests that a critical reflection of the social setting and historical background of research setting is required, so that people can see how the current situation has emerged.
3. The principle of interaction between the researcher and the subjects: It requires critical reflection on how the research materials such as data were socially obtained through the interaction between the researcher and participants.
4. The principle of abstraction and generalization: It states that abstraction and generalization which requires relating the idiographic details revealed by the data interpretation through the application of principles one and two to theoretical, general concepts that describe the nature of human understanding and social action.
5. The principle of dialogical reasoning: It states that the research requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings with subsequent cycles of revision.
6. The principle of multiple interpretations: It states that interpretive research requires sensitivity to possible differences in interpretations among the participants, whose interpretation or narration for same setting or event varies.
7. The principle of suspicion: The research requires sensitivity to possible "biases" and systematic "distortions" in the narratives collected from the participants.

3.3.5 Qualitative Interpretive Research Approach and its' Rational to Case Study

In a qualitative case study the researcher explores the case or any other entity bounded by time and activity such as a program or an event and collects detailed information through a variety of data collection procedures over a period of time. It is basically a record of the researcher's observation on the individual's activities or experiences[74]. In qualitative research the empirical study is based on case studies, in-depth open-ended interviews, surveys and observations[71]. Through these steps, qualitative research allows understanding of relationships, interactions and effects of the system on users and organization.

The interpretive approach of qualitative studies are best suited for understanding sociotechnical phenomena[72, 75]. Also the interpretive case study is flexible, does not have a set design and is guided by researcher's focus of the study[77]. Interpretive research is determined by observation and interpretation. These data are interpreted to construct meanings and theories by drawing some interference or matching between the information obtained and abstract patterns[78].

This study is on delivering health care through technology, which aims to explore and increase the understanding of the telemedicine program being operated in one of the major hospital in Nepal and its role in health care service. To understand the telemedicine project, to identify and understand process or event, infrastructure, process owner (i.e. who operates telemedicine technologies and provides service), their relationship and perception towards technology used, I chose a qualitative interpretive case study paradigm for my study.

3.3.6 Research Design

The research design is a planned structure that guides the researcher throughout his research. This research is divided into three stages for this project.

The first stage includes the generation of a suitable title of interest for thesis and constructing a research question. It also includes theories and information gathering. This stage includes gathering information regarding telemedicine programs, benefits and challenges, along with the information about the telemedicine programs in Nepal, in order to find an appropriate research site for conducting my case study.

The second stage involved conducting fieldwork in Nepal after carrying out site selection. This stage focuses on interviewing people and observing their processes. The third stage includes data analysis by interpreting the data gathered from the fieldwork and finally delivering answers to the research questions.

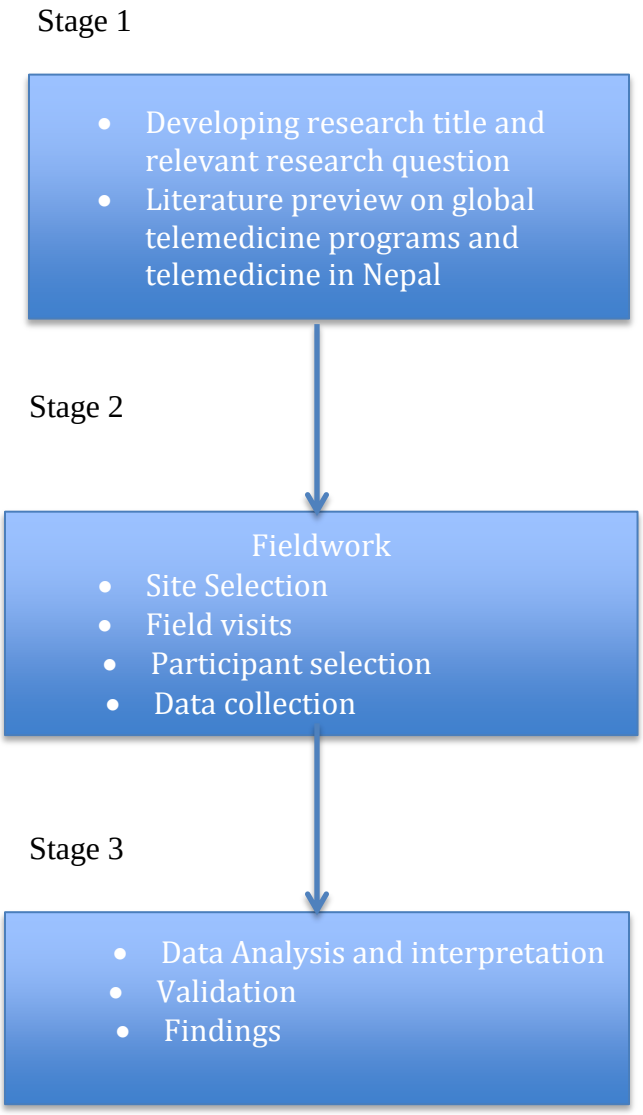

Figure 8: Research design stages

3.3.7 Site Selection

I gathered some information about the telemedicine programs in Nepal while I was in Norway. I also contacted a few of the organizations asking if they would let me carry out my research. Among the few

only two of the focal persons responded. One accepted my proposal while the other suggesting that I carried out my elsewhere since their project was in an early stage.

When I went to Nepal I contacted both focal persons from these two organizations (despite being rejected from one of them) and visited both organizations. I carried out informal interviews with concerned authorities in order to select my site for research. After gaining some insight into both telemedicine projects, I finally decided to carry out my research in Kathmandu Model Hospital, as they were pioneers in the field of Telemedicine in Nepal.

I also visited two outreach centers, Nangi and Pharping. I selected these two on the basis of their distance from the Hospital; Pharping is one-hour drive from KMH while travelling to Nangi takes two or more days from Kathmandu.

3.3.8 Gaining Access to the Site

To get access to the organization, I signed up for voluntary work for Mahabir's Centre for Wireless Connection (MCWC) (a sister organization of Nepal Wireless project). I contacted one of the board members for Mahabir's Center for Connection while I was in Norway and explained to him my interest in telemedicine and if they had any opportunity for me to volunteer for them. I was advised to contact them when I returned to Nepal.

I contacted them right after I travelled to Nepal, I met Mr Mahabir Pun and was advised to meet Dr Saroj Dhittal, Chief of Telemedicine Program in Kathmandu Model Hospital. After meeting both the team leaders I got a formal approval to conduct my interview and observations in Kathmandu Model Hospital.

I was also advised to visit two outreach centers Nangi Clinic and Women's Centre (NCWC) in Nangi and Manmohan Memorial Community Hospital (MMCH) in Pharping. It was easy to travel to MMCH in Pharping, However to travel to Nangi I took a bus halfway and then took a local jeep from Beni to Nangi and had to walk 6 hour to return from Nangi to Beni since there was only one jeep in the morning. The

road from Beni to Nangi is one of the most dangerous roads so only one or two vehicle runs once in a day and the road is closed during summer season as it becomes slippery.

Figure 9: On the way to Nangi from Beni Bazaar

3.3.9 Participant Selection

Since my research was on the telemedicine program, as a whole from its implementation to operation including future outlook, I had to interview the focal person for the program. After knowing that Mr Mahabir Pun and Dr Saroj Dhittal ware responsible for the technical operation and the clinical operation for the telemedicine program respectively, they became my main source of information.

The other informants were specialist and other medical officers who participated in internet based CMEs and provided teleconsultation to the health workers in rural areas and technical and administrative personnel contributing to telemedicine program The list of informants is listed below in the table 7.

S,No	Key Informant	Responsibility
1.	Chief of Telemedicine program	Clinical aspect for Telemedicine Program/ Moderator of internet based CME/ Teleconferencing
2.	Team leader of NWNP, Vice chairman NREN	Technical Aspect for Telemedicine program
3.	Consultatnt A	Teleconferencing/Moderator for internet based CME
4.	RegistarA	Teleconferencing/ Moderator for internet based CME
5.	Resident A	Participant for internet based CME
6.	Resident B	Participant for internet based CME
7.	Resident C	Teleconferencing/ participant internet based CME
8.	Chairman of Community Hospital in Pharping	Initiator and administrative coordinator for telemedicine program
9.	Nurse A	Teleconferencing and participant for internet based CME
10.	IT informant A	Provides technical services
11.	IT informant B	Provides technical services
12.	IT informant C	Provides technical services
13.	Administrative Staff A	Responsible for administrative work

Table 7: List of Informants

3.3.10 Methods of data collection

Before beginning to collect data it is very important for the researcher to have knowledge and a clear idea about the project and on how to get answer to the research questions. Robson[57] mentions that after deciding on the focus of the research, the research question to which the researcher seeks answers, and the overall strategy and methodology appropriate for getting those answers must be given a thought by the researcher. After that it is important to identify the participants and critical situations or settings in order to apply the data collection methodologies. It is essential that we choose the right people a tthe right time, and to ask the right questions or observe the right people at appropriate settings[57].

a. Interviews

There are three fundamental types of research interviews: structured, semi structured and unstructured[57].

Semi structured interviews consist of key ideas about the areas to be explored and allow researchers to gain insight of that area in more depth[57, 79]. The flexibility of this approach also allows for the discovery or elaboration of information that is important to participants but may not have previously been thought of as important by the research team[57]. Hence for this project I used the semi structure format as it provided flexibility to think about what to ask and ask what I had not planned initially.

In the research site, I observed the telemedical activities in KMH and the staffs involved. I interviewed them during their work. Since they were all very busy, I provided them some questions on topics regarding their perspective on the program and requested them to answer on a form (kind of testimonials). This was further followed by another discussion session for more elaboration. However in the outreach center I was able to sit down with the interviewees and interview them.

b. Observation

As mentioned earlier the other method of data collection employed for this study is observation. Observation helps to understand the organization, its process be it social or technical, the users relationship

with the technical infrastructures, settings, a natural .The obvious technique is to watch what they do, how they use tools, record that in some way, describe them and analyze and interpret what the researcher have observed[57]. Observation provides researchers with methods to observe nonverbal expression of feelings determine the interaction and communication process, during various activities[80].

And there are two approaches[57, 79] to observational methods. Participant observation[3, 6]in which the observer becomes a participant; it is used in flexible design which follows ethnographic approach. Similarly other type is non-participant observation in which the researcher or observer observes the process and people by taking a detached stance.

I acted as a non-participant observer and collected my data during the ongoing teleconsultations via video conferencing technologies, which I though was appropriate considering my limited knowledge in medicine.

3.3.13 Tools used for Collecting Data

It is important to take note as soon as observation or interviews are made. If not done so the researcher may forget it or missed out on important point. Hence for noting and recording such observations and interview, a recorder has been used to record the interview as well as record myself after critical observation. However though it's reliable, some time participants might not find it comfortable to speak when they realize that they are being recorded hence a notebook was used to note down their statements. And finally all the collected data was stored in the computer for further processing or transcribing.

3.3.14 Methods of Data Analysis, Interpretation and Validation

The set of principle for conducting and evaluating interpretive studies set by Klein and Myers[71] has been followed in this study during data collection, analysis and interpretation. The set of principle followed for evaluation of the data collected in this research is explained below.

The fundamental principle of hermeneutic circle suggests that understanding the meaning of text is made by understanding the parts of text and whole text in reference to one another. In this research, data were collected different times from same person in the same settings and iterative analysis of those data in relation to each other was done.

By following the principle of conceptualization, this research has explained the historical and social background of research setting. It has also explained social problem of health inequity lead to emergence telemedicine in KMH.

The data was collected from various interviews with stakeholders. Data were also obtained from observations in the settings. This stage of data collection reflects the principle of interaction between the researcher and the subject.

Likewise the principle of abstraction and generalization was followed in which the data gathered from the study were compared with the theories used.

During data collection and analysis the theoretical preconception were acknowledged and the data were also checked if they contradicted the theories to avoid bias following the principle of dialogue reasoning.

Similarly the information provided by the interviewee has been compared against each other in other to acknowledge multiple interpretations for the same settings (as suggested in the principle of multiple interpretation).

The principle of suspicious suggests being sensitive towards biases; to avoid biasness and influences. In this study interviewee or focus group was selected from all level of work (contributing to telemedicine project), the data were compared with available documents and records. At the same time I tried to avoid bias by being aware of the possible bias and addressing it during different stages of study such as design, data collection and analysis.

Overall the data collected were read and listened over and again and the interesting points were noted down. As per the research question, pieces of information were selected and categorized. The factual information gathered were validated with the research articles, newspapers, organization website. The written testimonials also helped in validating the statements and in drawing common perspective of all the participants by comparing it to interviews that helped me in my findings.

3.3.15 Ethical Consideration

I obtained formal approval from the organization to carry out my study. The participant were made aware of who I was and what I was doing there. I also asked them if they wanted to be anonymous. Most of the informants were open and were comfortable about the interview. They cared less about the anonymity and more about wanting to tell their stories to the outside world through me. Even though complete anonymity is not possible, I have tried not to reveal names except for some cases, which was important to mention for their contribution as well as authenticity of data obtained.

Chapter four: Results

5. Findings from the Case Study

This chapter presents the information gathered from the research sites KMH, MMCH and NCWC through interviews, observations and from documents such as news articles and reports.

4.1 Objectives of Telemedicine in Kathmandu Model Hospital

Kathmandu Model Hospital started a telemedicine service in early 2008. The connection was from Kathmandu Model Hospital to Gauri Shnakar Hospital in Dolakha Distrct, which is a 140km drive from Kathmandu.

When asked about the objective of the program, Dr Dhittal, the chief of telemedicine highlights that the objective of their Telemedicine Project is to
"help in making better health care service available to remote areas by empowering local health workers through ICT implementation "
Dr Pun, another team leader, also agrees that
"The objective of telemedicine is to provide at least some health services to rural people where there are no clinics, health post and qualified health professionals and to train local health workers"
To achieve this, the local people with some backgrounds in health education are trained and assisted to treat people at remote villages according to Dr Pun.

Dr Dhittal, in a conference, also presented that their goals is to have enough bandwidth that would help to establish a meaningful communication between marginalized communities in remote areas and centrally located faculty to achieve improved health for people[83].

4.2 Stakeholders and Partner Institutes

The backbone of the telemedicine project implemented in Kathmandu Model Hospital can be categorized into two aspects: technical and clinical, as shown in figure 10. The clinical aspect represents medical information sharing, while the technical aspects constitute of storage and transmission mediums for medical data.

Kathmandu Model Hospital oversees the clinical aspect of telemedicine while E-networking Research and Development (ENRD) oversees the technical part such as internet connection to outreach centers and other national and international organizations and equipment handling. Along with ENRD other supporting partner organizations are Nepal Research and Education Network[83] (NREN), Nepal Wireless Networking Project (NWNP) (http://www.nepalwireless.com.np/), the Public Health Concern Trust (PHCT) and many other international institutes. Dr Saroj Dhittal, Chief of Telemedicine Program in Kathmandu Model Hospital and Dr Mahabir Pun, President of ENRD and team leader of NREN, NWNP are working together to improve health status as well as provide basic health care to people in remote areas by extending telemedicine programs in villages.

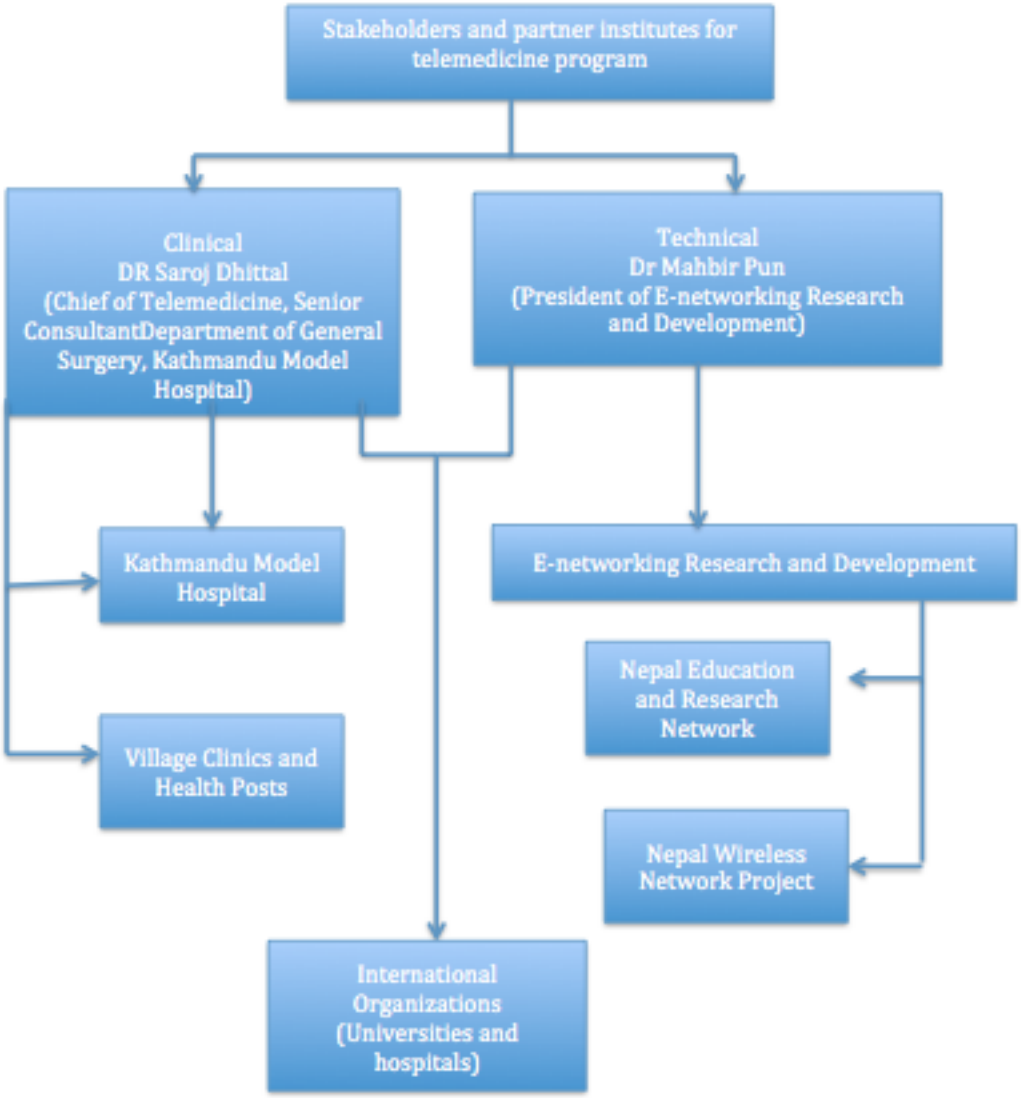

Figure 10: Representation of Stakeholders and partner institutes for telemedicine

Kathmandu Model Hospital is also a member of the Nepal Research and Education Network (NREN) that provides a dedicated network for research and education. NREN is a primary member of Asia Pacific Advance Network (APAN) (http://www.apan.net/), the umbrella research and education network in the ASIA Pacific Region. NREN is a designated network connected to the third generation of the Trans Eurasia Information Network (TEIN3) (http://www.tein3.net/Pages/home.aspx), which will be upgraded to TEIN4 soon. The objective of this network is to provide high-speed network connectivity from Europe to research and education network in Asia[83].

Over this TEIN3 network Kathmandu Model Hospital has collaborated with Bundang Hospital in Seoul, Korea. The surgeons and students in the Kathmandu Model Hospital along with other Asian countries like India, Pakistan, Srilanka, Thailand, Philippines and many other watch live surgery from Korea via telemedicine technologies and networks. Kathmandu Model Hospital has also collaborated with hospitals and universities in the United States of America and Japan for teleconsultations and tele-education [83]. Apart from these international recognized institutes there are many international and national volunteer individuals from many countries and places respectively joining hands with KMH and NRED.

At present the Central Hospital has been connected to health post and hospitals in 10 remote areas as shown in the figure 11.

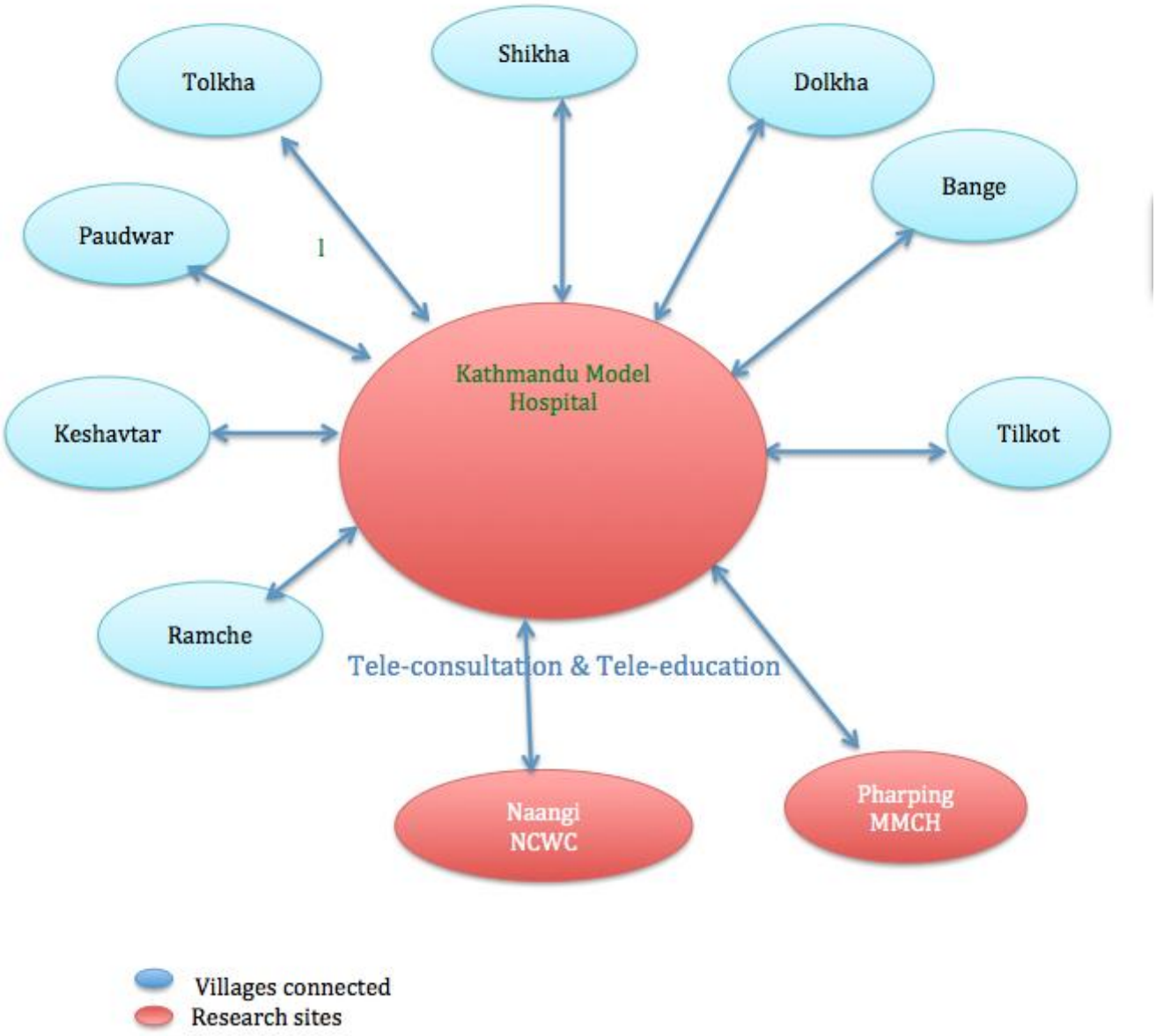

Figure 11: Villages connected to Kathmandu Model Hospital for Telemedicine Service

4.3 Telemedicine Application

Kathmandu Model Hospital employs two telemedicine applications, teleconferencing and internet based CME/ teleeducation

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4.3.1 Teleconferencing

Teleconferencing takes place over either just a phone or over videoconference. The teleconferencing takes place between the rural health practitioners and the specialist or medical officer in the central hospital in Kathmandu Model Hospital. The purpose of the teleconferencing is to provide medical assistance to the rural health workers for the diagnosis and treatment of patients.

Figure 12: Health workers in Nangi Village (http://policy.gmu.edu/currents/volume7/issue04/vol704f2.htm) and Doctor in Kathmandu Model Hospital: Videoconferencing. http://nepalitimes.com/news.php?id=14608

4.3.2 Internet based CME/Tele-education

The CME is usually provided through video conferencing between the central hospital (KMH) and the rural areas and also between KMH and other national and international medical institutes. Tele-education or internet based CME is mainly given in the field of surgery in Kathmandu Model Hospital. Hence the participants are mainly the surgeons and interns. However the trainings and classes are provided to the rural health workers on general medicine every morning from 8:15 to 9: 15.

Figure 13: Internet based CME provided by Sung Wen Kim, MD, Prof surgery from Seoul National University, Bundang Hospital on Minimally Invasive Surgery in the management of Breast Cancer.

4.4 Telemedicine Technology and Equipment used

The ultimate success of telemedicine depends on an optimum exploitation on the capabilities of advance information and communication technologies[84]. Since it takes proper understanding about the technology used and its functions in order to use it extensively. In Kathmandu Model Hospital, the technologies used can be grouped into two groups as per the purposes (teleconferencing and tele-eduction).

The equipment used for teleconsultation over videoconferencing were

- Cisco routers
- POLYCOM device and video conferencing cameras (Polycom VSX 800)
- A speaker
- A large Monitor (Haier)
- Laptop/desktop (Samsung)

They use a bandwidth of 1mbps to 10mbps for simple regular video conferencing.

Figure 14: Polycom VSX 800

http://www.dianetcom.ru/info/catalog/videokonferz/videoplycom/VSX8xxx

Figure 15: Logitech webcam and speakers

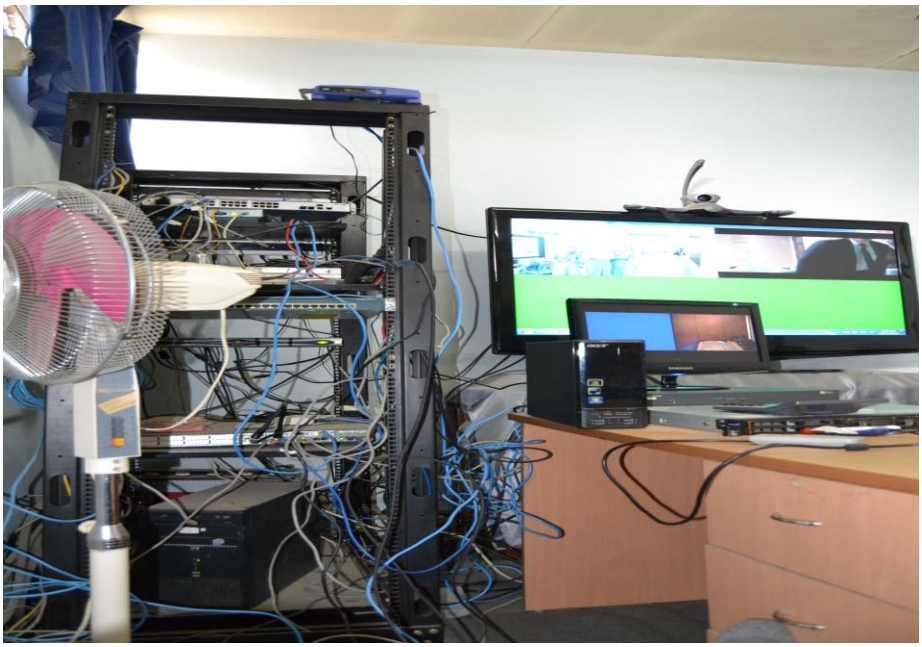

Figure 16: Routers, monitors and other devices

For tele-education or internet based CME, live videos are sent from the operation theatre from the hospital, requiring larger bandwidth to retain the quality of images and eliminate noise. Hence for CME, the transmissions for high quality video and audio are made over a digital video transport system (DVTS). DVTS (http://www.internet2.edu/communities/dvts/) uses 30Mbps-uncompressed video to provide high quality images and can be used for multicast mode allowing more than one site to participate in a single conference.

Along with 30Mbps bandwidth, for a high quality transmission data, other video-conferencing equipment used for training were

- Large monitor (Haier)
- Webcam (Logitech HD Pro)
- Speaker (Logitech)
- Laptop/ desktop (Samsung)
- DVTS Software

Other technologies used are telephones, mobile phones, digital cameras and microphones. Besides these, the Telemedicine Program uses wireless technology to connect to the remote villages. The only option to connect such remotely and geographically isolated villages is via very small aperture terminology VSAT (http://www.ses.com/4336371/vsat) but since VSAT is expensive, the remotely located Nangi Clinic and Womens' Center uses wireless radio technology for internet service. They use Motorola Canopy that uses 2.4 Ghz and 5.8 Ghz frequencies in different relay stations across the villages[85, 86] as shown in figure 17 .

Figure 17:Using tree to place antenna grid[86]

4.5 Usefulness: The role of telemedicine in the Kathmandu Model Hospital

The objective of the Telemedicine Program is to provide assistance and training to health workers, especially to the health workers in the remote areas and improve the health care service in Nepal.

4.5.a Teleconsultation

The health workers in rural areas would call at the KMH if they faced any confusion or difficulty (that is what they have been told by the Chief of the Telemedicine Program); subsequently the doctor or the specialist would be informed, for consultation over the videoconferencing equipment. Since the process is not very structured, often the health workers call doctors directly on their mobile phone and discuss the case.

Nurse A in Nangi says that she is comfortable and happy to get assistance from specialists for patients' care. She says that through Telemedicine Program she has been able to provide patients with specialist care. The patients are getting specialist consultations via the Telemedicine Program without having to travel long distances. She says that she has observed and learned that the diagnoses made through tele-consultations in NCWC and via face to face in another nearby city hospital have been similar, in some cases the diagnoses and treatment is even better. She shared

"*There was a man with a skin problem, he had hidden it for a long time from us (local people) but had managed to consult all the doctors in the nearest city. Despite that his skin problem had not been solved. One day he came to us and we arranged a tele-consulatation with a skin specialist in the hospital, the doctor wrote medication for him and later his skin problem was solved*."

She added:
" the accidental and untimely death in maternal women has also decreased much from the past years because of timely assistance in case of complications"

However she believes that there would be fewer deaths if women in their pregnancy came for regular treatment, and said the same about people with other diseases. She said

"*We could prevent so many deaths and injuries if patients came immediately after noticing slight discomfort or even had some regular check up without waiting for unbearable pain or complications to occur*."

She says that even people from nearby villages come to her clinic for treatment. As per the report, until December 2012, 80 patients have been treated over the Telemedicine Program. While the last 16 patients have been treated from mid 2010.

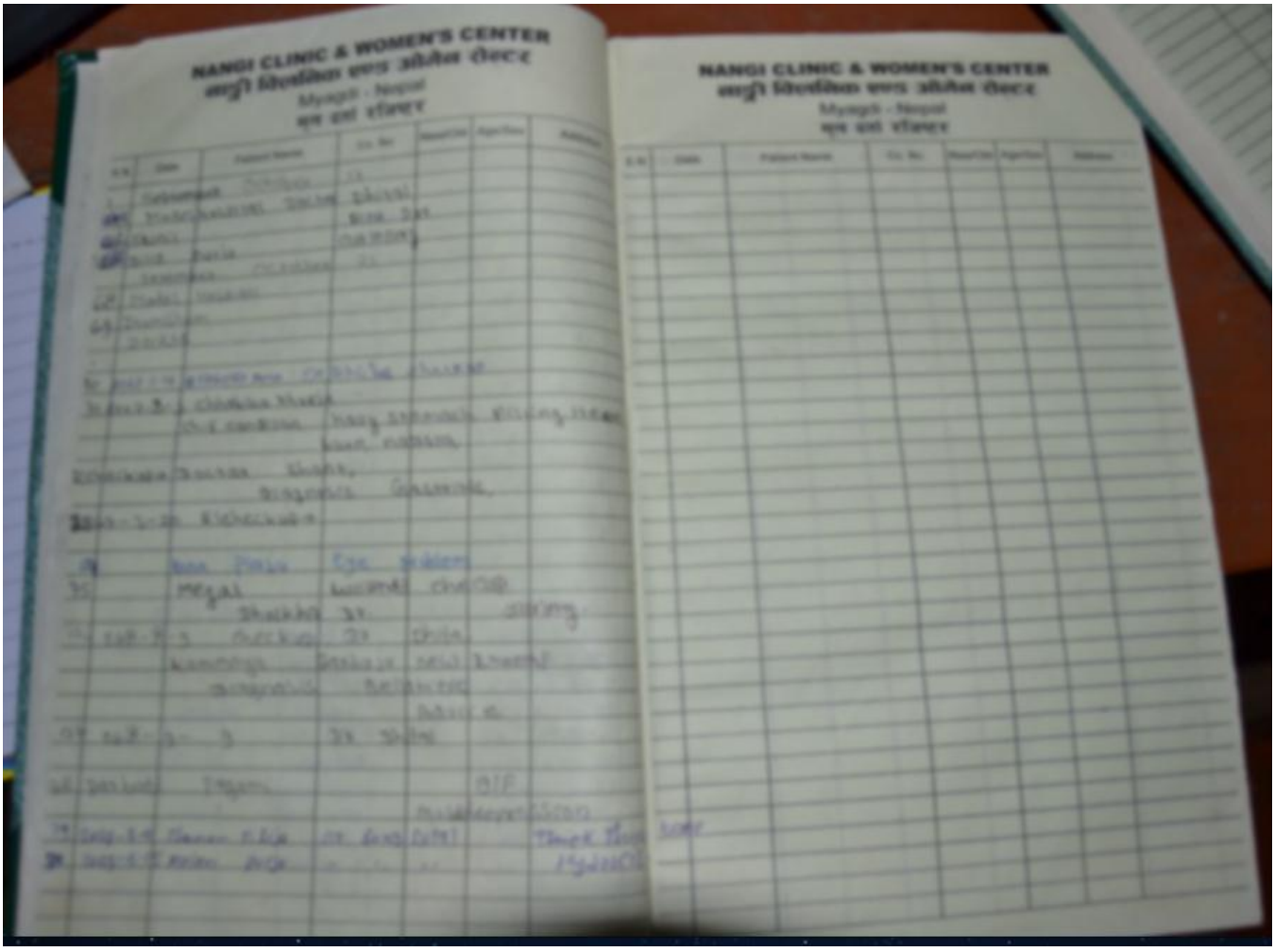

Figure 18: Register for recording patients treated through telemedicine (**picture has been blurred for patients' privacy**)

In the other outreach center in Manmohan Memorial Hospital, the staff said that the telemedicine service allowed patients to get specialist consultations without paying extra. It is also helping patients save travel cost to the city. A simple comparison of cost can be seen in Table 8. Since the hospital covers approximately 80,000 people from several villages located around Pharping, they believe telemedicine has the potential to improve the economy of the hospital.

4.5.b Tele-education (internet based CME)

Kathmandu Model Hospital is a well-equipped organization for tele-education. Tele-education or internet-based CME took place among KMH and its' remote outreach centers every day while every Tuesday, international health institutions provided CME to health professionals in KMH along with other institutes from different countries. Most of the CME were based on surgeries. The surgeons in a Korean Hospital performed a surgery, while the participants from various organizations (in their countries) watched live via telemedicine technology.

In KMH, senior consultant, Department of General Surgery (Chief of Telemedicine) along with other surgeons and interns attended the CME. The surgeon from the operation theatre in Korea narrated the procedure while answering the queries of the participants watching the operation, making it an interactive session. There were also internal discussions among the interns and the surgeon too. The Chief of Telemedicine, Dr Dhittal expressed:

" *Watching live surgery in the monitor gives the feeling of being inside the actual operation theatre and following the surgery being performed."*
He further added*" It is even better than being inside the operation theatre because we are able to watch every small detail that we might not be able to see inside the theatre. It has even become easy for us to explain the procedure to the students*. "

In addition, Dr Dhittal along with consultants, medical registrars and residents agreed that internet based CME has helped them to know about the latest techniques and technologies used in surgery. Dr Dhittal highlighted:

" *Teleconferencing has bridged the technological divide among the health professionals and quenched the thirst of innovative technology and queries through knowledge and experience sharing. It has also increased the level of understanding of the subject matter*"

He informed that the lectures have also worked as refresher trainings for the doctors and interns, since there are repetitive surgeries being performed in the Korean Hospital, which they get to watch every Tuesday.

He further adds that after starting up the Telemedicine Program, it has helped them to collaborate with various organizations from around the world and has established better relationship and communication. He also said:

"The process of *knowledge and experience sharing has strengthen the feeling of unity among surgeons* "

This was quite evident from the event, were many participants from all around the world eagerly listened and watched the surgeon performing surgery in their monitors. At the same time, there were interactive sessions where the participant asked questions and received feedbacks.
When asked about its usefulness to them, the resident A said:
"*We are able to view surgeries that are not possible in our settings and we are able to interact with reputed doctors that are leaders in their fields*."

The CME has also helped them to provide better patients care, the consultant A says:
" *There are several case where we have successfully implemented the advice provided by oncologist and the surgeons*"

Most of the participants for the CME also said that they are confident to apply surgical technique in their practices learned from it. Most of the participants feel that the quality of education and training through

internet is similar to face to face while one of them feels that there is a need to eliminate technical problems in order to have better delivery of such training sessions. Similarly resident A and B agreed that the CME should not only focus on surgeries it should focus on all fields of medicine, which would also attract medical professionals from other field of medicine.

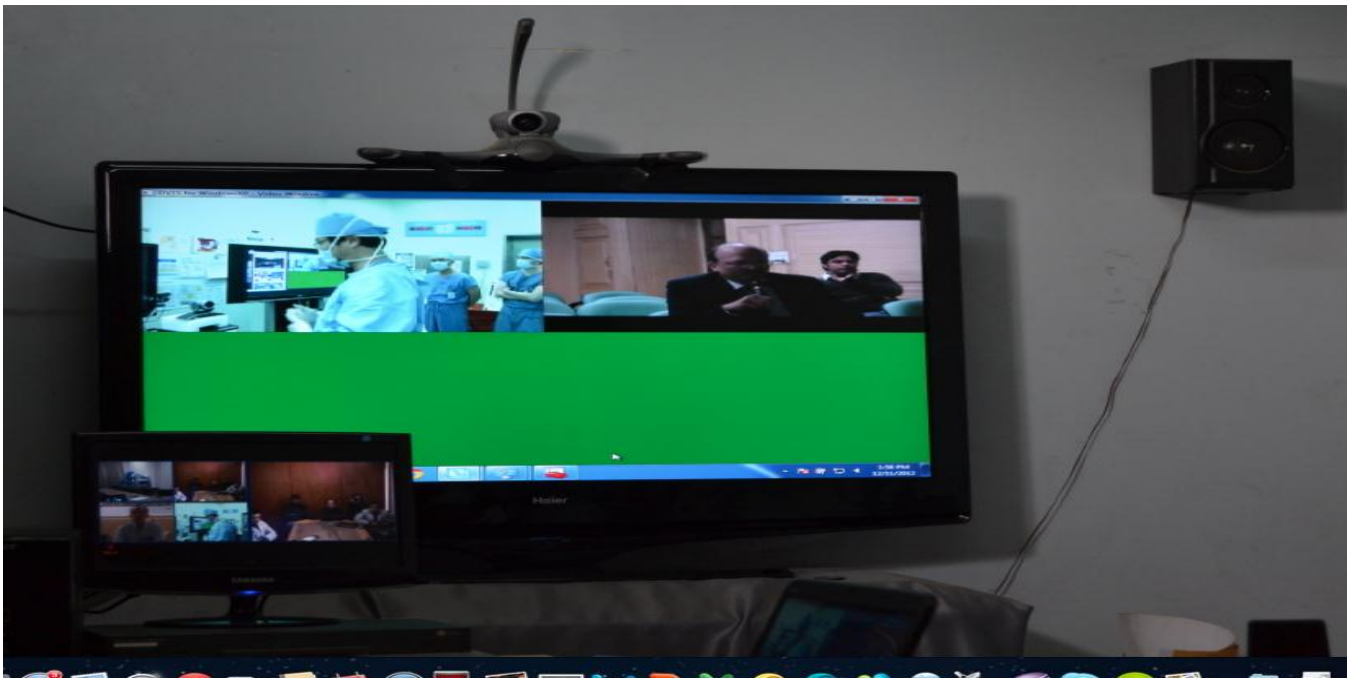

Figure 19: Participants from Different Countries and Organizations Attending CME Provided from the Operation Theatre in a Korean Hospital

The outreach centers, the daily classes from 8 to 9 am were helpful, where they were able to learn what was happening in Nepal as well as abroad. They were also happy to be able to discuss the cases with the specialists. Nurse A of NCWC said the training on women's health through the Telemedicine Program has help her provide patients with better care, increasing her health care knowledge and skills.

The consultants, medical registrars and the residents, in the Central Hospital were found to have a wider knowledge of telemedicine compared to the health care providers in outreach centers. However the perceptions of all the health professionals (interviewee) towards the program were found to be positive and they were eager to explore telemedicine furthermore. However, in Pharping MMCH, the telemedicine was

not being used as Resident C had recently joined the organization. However, I was told that the previous doctor effectively used the telemedicine service. This finding implies that it is necessary for information sharing to increase awareness among the end users' about the program.

Overall, the Telemedicine Program seemed effective in providing assistance and supporting health workers through teleconsultations, and in improving their knowledge and skills through tele-education. Also, in the outreach centers, patients were able to receive specialist care through their local health care providers.

4.6 Financing and Cost in Kathmandu Model Hospital and the Outreach Centers

Most of the equipment and technologies used in central hospital and its out reach centers are donated from foreign agencies such as ITU, Donald Strauss Foundation, some universities[85]. The staffs supporting telemedicine service were unpaid volunteers. There are national agencies that are interested in bringing telemedicine to the villages. These agencies also support telemedicine project in their village by providing funds for set up and implementation. As estimated by the focal persons, Dr Saroj Dhittal and Dr Mahabir Pun, the set up cost rounds to approximately 10,00000 Nepalese rupee (10172.90 U$$ at 1 US $= 98.3).

The telemedicine Program has also eased the patients from traveling, and reduced travel and medical costs. A comparison of the cost in the Hospital and outreach center has been shown in table 8.

Organizations / Cost	Kathamndu Model Hospital (KMC)	Manmohan Community Hospital	Nangi Clinic and Women's Clinic
Travel Cost to KMC	NA	100 Nrs (1.02 US$)	2000NRs (20.35 US$)
Travel cost to nearest city Hospital	NA	NA Nearest city is Kathmandu	NA 6-9 hours from Nangi to district hospital (transportation only in winter seasons)
Out Patient Department service charge	250NRs (2.54 US$)	20 Nrs (0.2 US $)	Free of cost
Total cost of a medical check up telemedicine service	250NRS (2.54 US $)	20NRS (0.2 US$)	Null

Table 8: Comparison of travel and out patient department cost among the research site

It is evident that the cost of basic treatment has become very much affordable to the villagers. However with this little income in KMH and MMCH (service charge is free in NCWC) that are mostly from patients (out of pocket payment), there are issues of reimbursement for organization providing telemedicine services. Many of such issues regarding Telemedicine Program are discussed below.

4.7 Challenges of Implementing and Operating Telemedicine Program

Telemedicine in Nepal is about providing health care to people in remote areas through the assistance of specialists of a major hospital. Though the concept seems very basic, the stakeholders involved in telemedicine are facing numerous problems.

The challenges of implementing a telemedicine program starts from the very geographical feature of Nepal. The Himalayan region and hilly region account for 15% and 68% of the area of Nepal respectively, making it a major barrier in the development of an information and communication network. The best way to bring the internet to the hilly and remote areas seems to be through VSAT[87]. Nonetheless, VSAT is an expensive technology and might be too expensive for developing countries like Nepal. Therefore, the lack of backbone for proper internet connectivity is one of the many major problem of implementation of telemedicine program.

Nepal Wireless Networking Project (NWNR), a partner organization of Kathmandu Hospital that provides connectivity between remote areas and the hospital, is using radio communication technology to bring wireless internet to the villages. For the purpose they have built relay stations on top of the hills to receive and transfer signals from one destination to another. These relays are powered by solar or wind power instead of electricity as Nepal lacks adequate electricity. Especially many remote areas are without electricity supplies. However, the health post in Nangi uses solar power as an alternative to electricity to run computers.

The problem of connectivity and electricity has also been a major problem even in Kathmandu Model Hospital since Kathmandu lacks a 24-hour electricity supply. The city goes through constant power cut off during dry winters forcing the hospital to look for expensive alternatives like uninterrupted power supply (UPS) and generators. While using generators partially alleviates the power outage, it still cost much more than the regular electricity supply.

The connectivity problem occasionally occurred during videoconferencing. During my observation I noticed that the quality of sound and pictures were good and adequate but still sometimes there was sudden occurrence of noise and delays in the middle of conversations. These interruptions were sometimes difficult to eliminate. Majority of the participants agreed that most problems related to telemedicine are the technical problems. The IT officer A said:

" *It is required to arrange and test the connectivity one or two hours prior to the class every time*"

This shows that the connectivity process is not smooth and easy. The bandwidth they use is not sufficient when there are larger audiences on the other end. Hence, they limit their audience to just six organizations at one time during a regional videoconferencing.

Similarly the Nurse A in Nangi said:

" *Sometimes we have emergency cases and we can't contact the doctor because of connectivity problems*"

An IT informant B in also explained:

" *The lack of power supplies to the relay, and lightening and thunder, cause relay breakdowns. And since these relays are interconnected to each other, if one relay fails the whole connection gets disturbed. This is quite a common technical problem we are facing. And to make it even worse it takes several days to fix the problem, since we don't have adequate technical people*".

Among these 10 connected villages many of them were put at halt because at some places there were technical disturbances, which they were trying to fix. And in many places there were no human resources to operate telemedicine services. The reason behind the lack of manpower is that initially the doctors or health workers show interest and work on it but when they get transferred to another place .The new health worker recruited, might not have any idea how to run it and hence putting the program to a stop.

Not only has IT informant B highlighted the technical problem in his statement but he has also shed light on of the major problems, which is, the lack of manpower. A developing country like Nepal lacks trained human resources. There were just two health workers in Nangi for population of more than 800 people (population of Nangi alone), and one of them said:

" *There are not enough health workers, and we have to look after the patients, teach at school, so sometimes its really difficult during emergency situations*."

Similarly there ware not enough doctors in MMCH. Same doctor was responsible for general out patient department (OPD) services as well as telemedicine activities in MMCH. There were no specific specialists or doctors allocated just for telemedicine service in the any of the organizations. The specialists in the hospital were involved voluntarily and were providing the service in the regular working hour. Sometimes the health workers from outreach center also call them in their private phone regardless of working hours.

Since all of the health workers were working voluntarily and no one was obliged to work for the Telemedicine Program, the Chief of the Telemedicine Project does see human resources as a potential challenge in future. He believes unless there are no policies, incentives and rewards, it will be difficult for the volunteers to provide the service in the long run.

The organization is not able to provide proper training related to telemedicine to its staff. One of the registrars said:

" *I have never consulted cases with specialist in the central hospital in my two month of service. And I believe I am very much capable of treating the patient on my own*".

Though telemedicine has been practiced in a few of the hospitals since early 2000. It still remains a very new concept to many Nepalese health workers. So there is a need for improved education and trainings regarding the telemedicine. On the other hand the customers or patients also need to be aware about it. In the case of MMCH, Pharping, which is few kilometers from Kathmandu, the informant said that patients rather went to the central hospital than get treated via telemedicine. The reason was patients' unawareness of the Program and its benefits.

The health providers in all three sites agreed that they still needed relevant training to run telemedicine programs. In outreach centers, the health workers did not mention any cases of misdiagnosis, but the consultant A in Kathmandu Hospital said:

" *There have been many cases where you don't find the exact diagnosis and we have to rely on the information provided by the other health workers. There was a case in Nangi where a girl fainted*

suddenly. The health worker contacted us and I asked her to take all the vital signs but everything was fine. Then later after further investigation I found out she fainted because of the stress, since her teacher showed disappointment towards her study progress."

He further added:
" *There was also a case in Dolakha Hospital where I suggested a particular surgery but it got complicated, later I found out that information provided by the other health staff was incomplete so I had to call the patient to Kathmandu for a recall surgery. Fortunately we were able to cure him and there were no further complications*."

He said:
" *We need someone who is trained and experienced to be able to gather information on patients and thus provide adequate information to the specialist. Not anyone with a medical background can do that*."

He also highlighted the need for protocols and the need to follow them when dealing with the patients' information or data. Hence there also seemed a need to have an electronic patient record, which the organization lacked. There were no data that were recorded in the KMH on telemedicine consultation. However in Nangi, they kept a hand written register shown in figure 18 (picture blurred) where they recorded data about the patients being treated through teleconsultations.

In MMCH, administrative informant A said that they used to have an electronic patient record, provided by a company in Bangkok, Thailand. The IT professional came from Thailand and set up the system, which was based on system in Thailand. He trained few staffs in hospital. But eventually the staffs using it started to have problem with the system because it was not suitable to their work process so they stopped using it. He added that the staffs now relates the problem with electricity and internet connectivity and avoid using it.

This shows a need for a user-friendly system and need for trainings staff for the implementation process. However, such training could be expensive and funding is a major challenge in the organization. As

mentioned above, all the staffs are serving as volunteers so it is necessary to provide them with some incentives for their effort. However, when I spoke to the both Dr Pun and Dr Dhittal, they said:

" We are working on a plan to charge around 50 NRS (0.50 US $) per patient and each side gets 50% of the total income."

This does seem to be practical but since most of the targeted customers are from remote who cannot afford and are reluctant to frequent health check ups, it might be quite challenging for them to make income out of this service for maintenance and operation and salaries for staffs.

Most people in Nepal, even the one who can afford simple medical check ups, do not go to hospitals unless they are seriously ill, posing further severe complications in some cases. The health worker in Nangi mentioned
" *We have organized many local programs and informed people about telemedicine, benefits of regular health check up specially during pregnancies but they still show up only when they have complications*''.

Nepal lacks modern information communication technologies due to financial difficulties. Most basic technologies such as computers, routers, and cameras are donated. The donors are the volunteers from around the world and other international organizations such as the World Bank, the International Telecommunication Union and many more. The organization is very much dependent on international funding and volunteers, which results in possibilities of failure once the funding stops and volunteer leaves. However the donated fund is still not sufficient, Dr Mahabir Pun says:

" *if telemedicine programs were to be run on full scale with advanced technology, then funding would never be enough to run, In spite of using the cheapest technology we still face financial crisis*".

Similarly one of the major challenges is lack of policies and rules. The Governments' health policy states, telemedicine programs should be implemented to provide health care to all the people in remote vilaages in Nepal. However, there are no rules and regulations regarding the telemedicine in hospitals; hence health professionals are hesitant to work on it or even start a telemedicine program. Dr Mahabir Pun states:

" *Since there are no policies regarding the telemedicine program, therefore hospitals and doctors are reluctant to work for telemedicine projects*."

He further adds that due to lack of policies many telemedicine programs have stopped in public health posts.

Dr Dhittal said that telemedicine is still in the early stage . However with increase implementation, legal issues may arise. So it is important for the government to make laws and regulations regarding the implementation of telemedicine programs.

Telemedicine does have larger scope for improving health care services and health care, but it needs strong support from the Government, medical and technical professionals and patients. There is also need for studying the effectiveness of the program in context of Nepal to encourage telemedicine implementation and telemedicine service improvement.

Chapter five: Discussion

5. Discussion

This section of the thesis discusses the findings in reference to the theories on telemedicine and Information Infrastructure**.**

5.1 Telemedicine Model

As mentioned in the chapters above telemedicine is the use of ICT in health facilitating the exchange of health and medical information for different purposes such as diagnosis, treatment, prevention, education and research across a distance.

Telemedicine has a great potential to improve access to the health care while empowering the health workers by sharing knowledge and information with each other. Although a study focusing on cost effectiveness interventions concluded that there is no good evidence that telemedicine is or is not a cost effective means for delivering healthcare[88]. There are also studies claiming a potential cost effectiveness of telemedicine like rural telemedicine[89], teledermatology and tele-education[90]. Therefore telemedicine seems to be advantageous for developing countries like Nepal where majority of the population live in rural areas and are underserved.

A simple telemedicine model being implemented in Kathmandu Model Hospital that assists local health service providers in health care delivery directly by assisting or indirectly by educating or training is shown in figure 20.

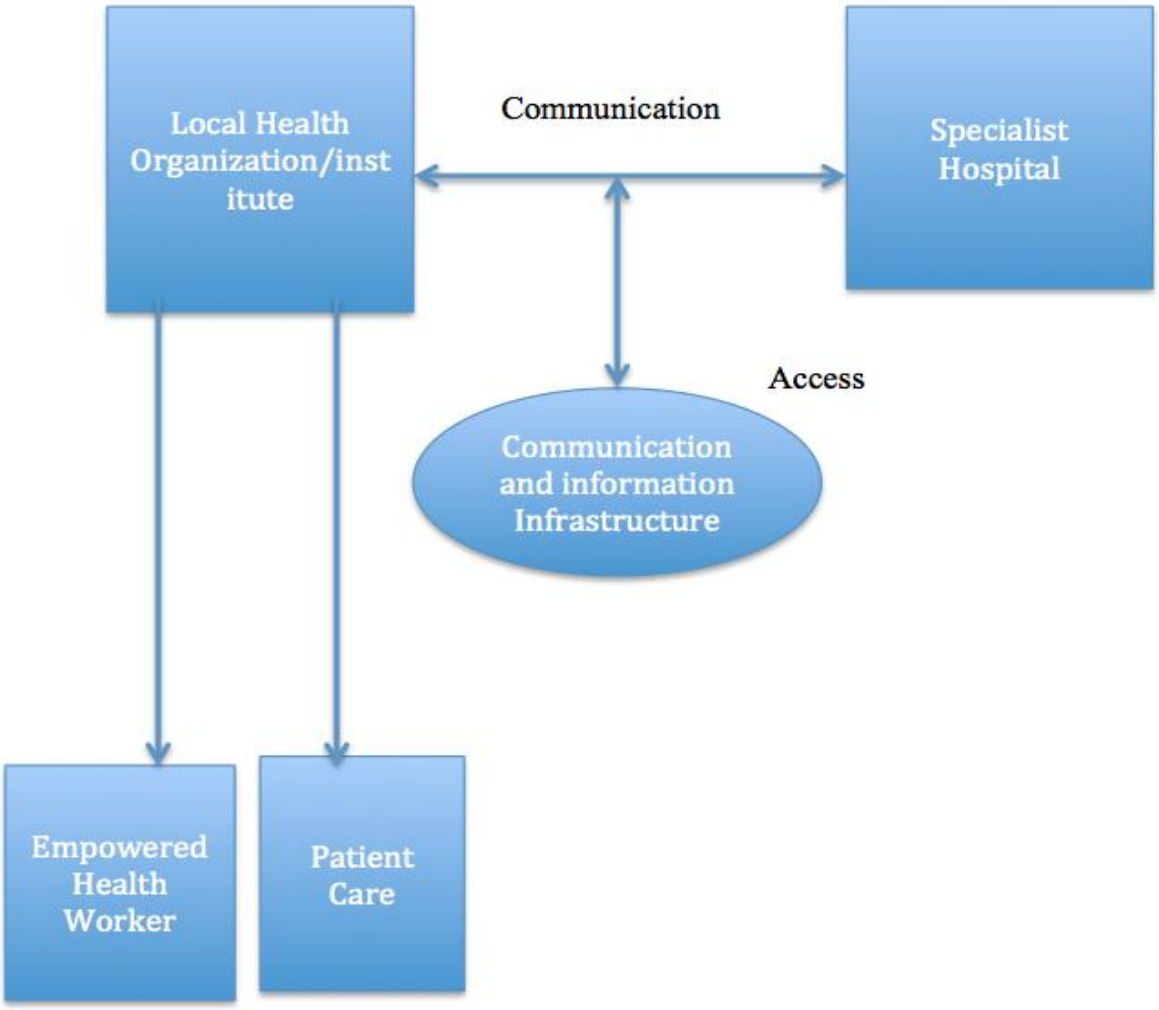

Figure 20: Telemedicine Model

This complete telemedicine model can be taken as an information infrastructure. The information infrastructure deals with both technology and non-technology factors of the organization and is transformed as organization transforms or vise versa.. The status and relationship between the infrastructures determine a system or an organization. Hence it will be relevant to study information infrastructures, their characteristics and challenges in order to understand the telemedicine system.

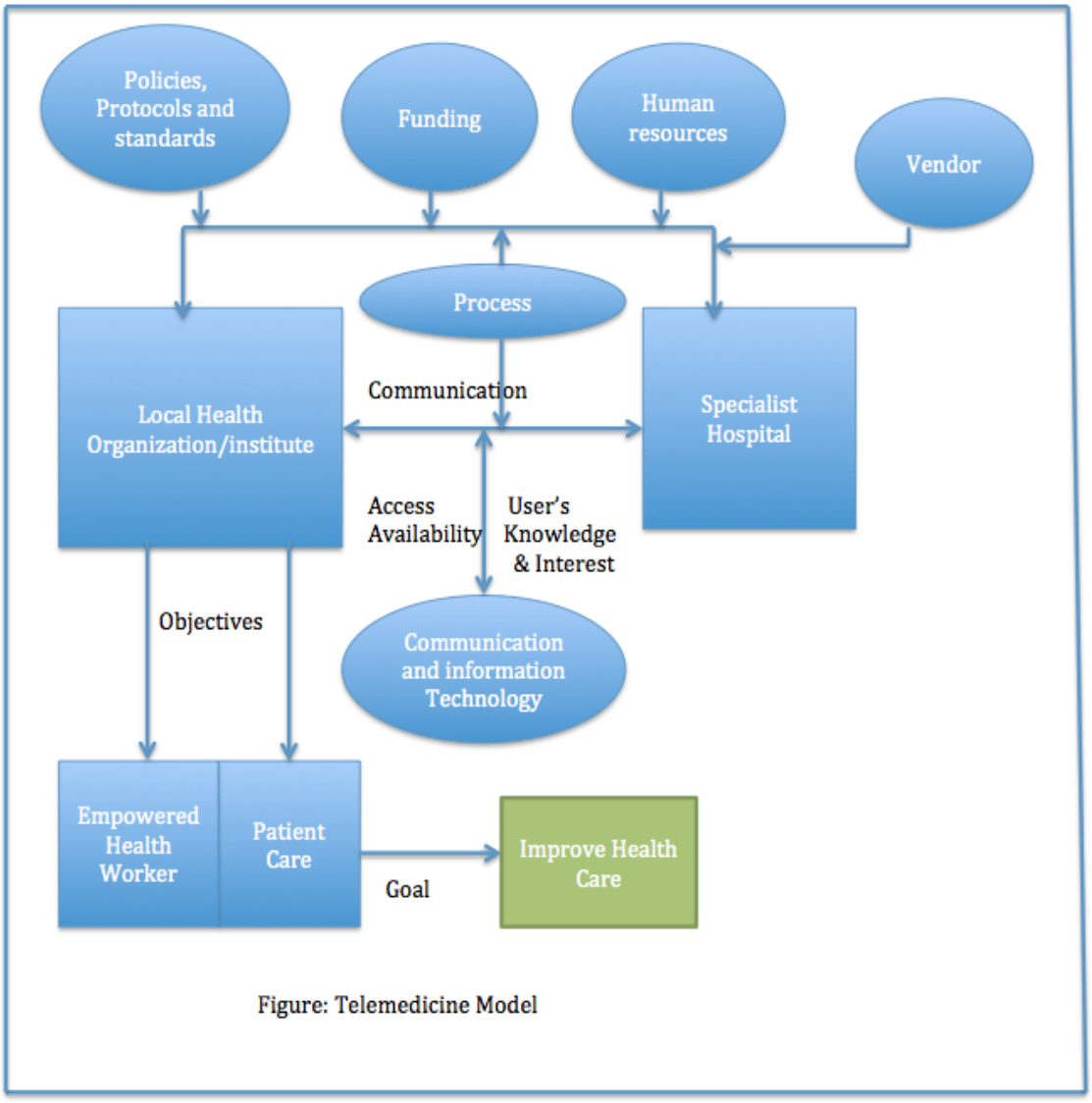

Figure 21: Telemedicine as an Information Infrastructure

Telemedicine as an information infrastructure is the set of organizational practices, technical infrastructure, and social norms that collectively provide for the smooth operation of clinical work at a distance[39]. The organization or a project will have tendencies to fail if any one of these entities is ignored.

5.2 Identifying Information Infrastructure

Star and Ruhleders[38] says that infrastructure typically exists in the background making it invisible, and it is frequently taken for granted. They also found that "despite good user prototype feedback and participation in the system development, there were unforeseen, complex challenges to usage involving infrastructural and organizational relationships". This implies that even though there is users' participation from the early days of developments, issues with informational infrastructure still arises. So it is important to identify infrastructure, their networks and relationships with the organization.

In my research in Kathmandu Model Hospital, I tried to identify the infrastructures, technological and non-technological entities, processes in order to identify their relationship among each other and role in the organization. The issues related to it were also looked into. I chose to visit its' outreach center, one nearby and the other at further distance. The information infrastructure identified in this study is shown in the diagram above, where multiple aspects of the telemedicine system are seen as information infrastructure.

5.3 Understanding information infrastructure

The characteristics studied by Hanseth and Monterio[35] for information infrastructure have been compared with the telemedicine information infrastructure in this research in order to get a better understanding of its purpose.

5.3.1 Enabling shared and open

The primary objective of telemedicine infrastructure was to assist remotely located heath workers in providing health care to local people. The enabling function of II at the hospital relates to its ability to assist remotely located health workers to provide health care to the local people. However, the same infrastructures were used to provide training to the health workers in remote places. It was also used for patient and specialist interaction. Similarly in KMH, the infrastructures were used to connect to international and national organizations making a network for knowledge and experience sharing among them. The organizations are also open for more collaboration with other institutes.

5.3.2 Heterogeneity

As stated earlier there are all categories of entities that constitute an information infrastructure from technology to people. This interaction of telemedicine technology, human resources and organization leading to sociotechnical networks that form a complete information infrastructure. The people of technical and clinical background came together using common telemedicine technologies to achieve common goal of improving health care delivery of people in Nepal by creating a network by linking each independent infrastructure with each other. This makes them interdependent. However the disadvantage is the breakdown in one infrastructure affects the rest. For example a technical problem in Kathmandu Model Hospital, will lead to breakdown in other out reach centers, which is very common in the Telemedicine service provided, by the hospital.

5.3.3 Installed Base

The newly developed or employed technologies in the organization are based on the install based (existing technologies). In Kathmandu Model hospital, many technologies have been replaced by new technologies that are more robust and advanced than the previous but the purposes of usage have been the same. For example they used 5 mbps bandwidth for normal videoconference but when they needed for high quality images transmissions they used digital video transport system that offers 30mbps. Similarly in Nangi, they used self-assembled computers (from donated parts) in the beginning to be familiarize with computers but were later replaced by new proper computers. Similarly they use solar power for the electricity unlike KMC. So it also depends on the availability and need. Hence the infrastructures are upgraded rather than replaced completely.

Figure 22: Assembled computer in wooden box (http://www.globality-gmu.net/page/2?s) and new computer on right at present.

5.4 Identifying and Addressing Information Infrastructure Issues

The issues and challenges faced by the Telemedicine Program at KMC can be categorized into three different orders based on order of issues provided by Star and Ruhleders[38] for information infrastructure.

The organization faced problems like technology selection and manpower and space shortage at the initial phase of the project. These are basically first order issues. However, the biggest issue that the project faced so far is financial issues. There is no or very little support from the Government and the Program is not business oriented. Since telemedicine is still new in Nepal, there is little information on its feasibility,

implementation and effectiveness. There are no basic trainings available on such innovative program in the country. They had to rely on the international and national volunteers for implementing and running the Telemedicine Program. At early days, Dr Mahabir Pun wrote to the British Board Casting Corporation (BBC) asking for ideas to bring the internet to remote villages. And that is when volunteers poured in to help him out with internet connections[91].

The first order issues give rise to second order issues. Whenever there is a breakdown in one infrastructure; it takes much time to fixed it. As stated by an IT Officer says:

" *The problem in the relay station breakdowns the whole internet networks around the villages. We have to wait for days and month to restart it again because the volunteers are not always available*".

It shows that there is a lack of trained manpower. This problem was found in all the three research sites. In KMC IT officer was responsible for hospital information system and telemedicine technology operations. Similarly there is lack of medical professionals to pick up the call from outreach centers immediately. The informants in NCWC and MMCH said that sometimes it is difficult to contact doctors when they need because they will be busy in their hospital work, some in OPD and some in surgery.

The third order issues that may arise from a clash of ideas were not visible in the project. The telemedicine technologies that were available in MMCH were not in use. It seemed more because of lack of training and awareness of the end users about the use of technology. The administrative people in MMCH were worried since the service was underused.

It is highly possible that most of these issues could be addressed by training and communication. The human resources need to be trained, made aware of telemedicine applications and their benefits. Protocols must also be established to guide the use of technologies. And as discussed earlier, the project needs to have a strong funding which would help them to have dedicated technical and clinical personnel for the telemedicine service. Funding is necessary for sustainability of the project in future.

5.5 Future Perspectives

When asked, if they had fulfilled the objective of the telemedicine project, Dr Pun expressed:

" *No there is still long way to fulfill our objectives. There are still many villages that are in desperate need of such programs*".

Similarly both leaders of the Organizations shared that in the future they will be connecting more villages to help people get access to primary health care as well as connect to other major hospitals of Nepal that are running telemedicine programs. They aim to conduct research activities to provide better services because they believe there is still a need for a better understanding of the Telemedicine Program. They are also planning to conduct training for health worker and explore the field of tele-education. As they look to setting up a well-equipped Telemedicine Centre in Kathmandu.

In developing countries like Nepal, sustainance of such program is very difficult. In such non-Governmental Organization (NGO) funded programs such as KMH and NREN, equipment is donated, much of the expenses are covered by other NGOs and INGOs. They are able to run for few months, but when the organizations are left to run on their own, they fail. However this organization is working on sustainence of the program by turning it into a business model. They are planning to charge patient for their service that could generate income for the Program. They are also working on web-based application, mobile health and will soon test the applications. They have also been working on ways to collaborate with the Government (they had collaborated with Government-run public health posts in remote areas). Similarly the supporting organization NREN have plans to sell bandwidth to other hospitals and organizations for distance education and generate income out of it for the Telemedicine Project.

`Dr Pun, Chairman of NWNP believes they have come a long way from where they started. Initially they had problems in connecting villages. They went through a lot of technical problems. Nonetheless he says the technology is getting cheaper and better now. They have been able to replace old with new equipment in many places. At the same time he emphasizes that these days the need for the telemedicine program has

been identified. He added that there are lots of clinics and health posts in villages that want to get connected in order to start telemedicine services hence raising its' demands.

5.6 Recommendations

Many factors influence the successful implementation of the telemedicine program. As per this study the factors that builds a successful telemedicine model (figure 23) are explained below.

5.6.a Information Infrastructure Planning and Development

The leaders of the Telemedicine Program have plans to expand the service to other rural villages and collaborate with other major hospitals. It is therefore important to have proper information infrastructures. There are places in Nepal that lack basic infrastructures like electricity and internet which have not yet reach many villages, in fact even the capital city suffers from long hours of power cut-offs. So it is important to build such basic infrastructure before going further with the connection or collaboration. The other important infrastructures that should be present prior to implementation are human resources and proper Governmental policies regarding the telemedicine service in order to avoid other risk and issue in the later stage of the implementation.

5.6.b Collaboration with Government

The Telemedicine Program should collaborate with the Government for implementing such programs because the Government should be responsible for taking electricity and internet to the villages. It will be wise for the telemedicine projects to collaborate with the Nepal Electricity Authority and Nepal Telecommunication Authority for facilitating electricity and internet. The project has informally collaborated with Government-run public health posts. However, as per the information provded by Dr Pun, many of the health care providers in Government Organization neglected the telemedicine program since there are no obligations for it. Therefore there is a need to have an accredited collaboration between

public health posts and the telemedicine project in order to make telemedicine service as a priority in the Government-run health organizations.

Similarly the government could subsidize the cost of electricity and internet to run the Telemedicine Program. Successful telemedicine program in India have collaboration with the Government, for example Apollo Telemedicine collaborates with Government Organization, Indian Research Organization for bandwidth,and the tele-consulatation service is bought by regional Government in villages [92]. The support from the Government plays a vital role in the sustainance of the program.

The Government should also amend policies to cut down on the taxes and revenues for the technology that are used and are being imported from abroad. These policies could help the organizations running telemedicine programs in Nepal.

5.6.c Readiness of the information infrastructure

Jannet at al[93] mentioned in their paper that readiness of the information infrastructure plays major role in success of the telemedicine projects. The human manpower should be trained, there should be proper access to information technologies. The information sharing is a vital part in the implementation phase to raise awareness among the stakeholders and customers. Moreover my research clearly indicated that there is much need to make patients aware, so that they understand and trust the program. In case of Manmohan Community Hospital in Pharping that is 19 to 20 km from Kathmandu, some people rather travelled to city hospital than relied on videoconferencing to the same hospital (in some cases).

Awareness among users and customers is vital to prevent the risks of underuse or misuse of the available technologies. The other important part is policy and protocols for using such technology and about patient treatment and patient privacy. The issue of patient privacy is not a major issue in Nepal where health equity is an issue. However, these are issues that can occur through passage of time. So the protocols must be adjusted or must be developed in the organization.

5.6.d Business Model: Approach to Sustainability

The program is funded by many international organizations, national organizations as well as funds generated by village people and from volunteers around the world. In this case there is possibility of halt once the funds and volunteers stop. Hence the development of a comprehensive business model for telemedicine can play an important role in reducing risks and costs, while increasing their probability of success.

Providing training to the local people in the village can generate the manpower within the local community without having to hire from the city. They can use local resources like solar power to generate electricity (which they are doing in Nangi. A nurse A in Nangi said that since health service is free she tries to generate small amount of incentives out of selling the medicine to the villagers. In this case it would also be wise to collaborate with pharmaceutical companies to directly provide medicine for lower prices. Collaborating with pharmaceutical companies will also benefit people by having timely access to medication especially in villages where there might not be all kinds of medication available.

Meanwhile they are also thinking to charge for the consultations, which could generate some funds for the project itself. However, it is also wise to collaborate with private hospitals and target the customers (hospitals and patients) that could pay for the services such as consultations and CMEs.

Similarly, focus should also be made on developing electronic patient record, that could reduce cost (though could be expensive to develop),Electronic patient record could be used as a store and forward method which is less expensive than the real time method. The health workers could enter the information for specialist in hospital to see and recommend. This will save time by not having to explain over and over to other specialists. It will also increase the access to specialist care for patient through local health care provider easily, without disturbing the specialists while in his regular work. The electronic patience data (within the patience privacy criteria) could also act as a resource for further researches.

Hence by reducing unnecessary cost and by making optimum use of the resource and service, a cost effective Telemedicine business model should be developed that would make it sustainable in the long run.

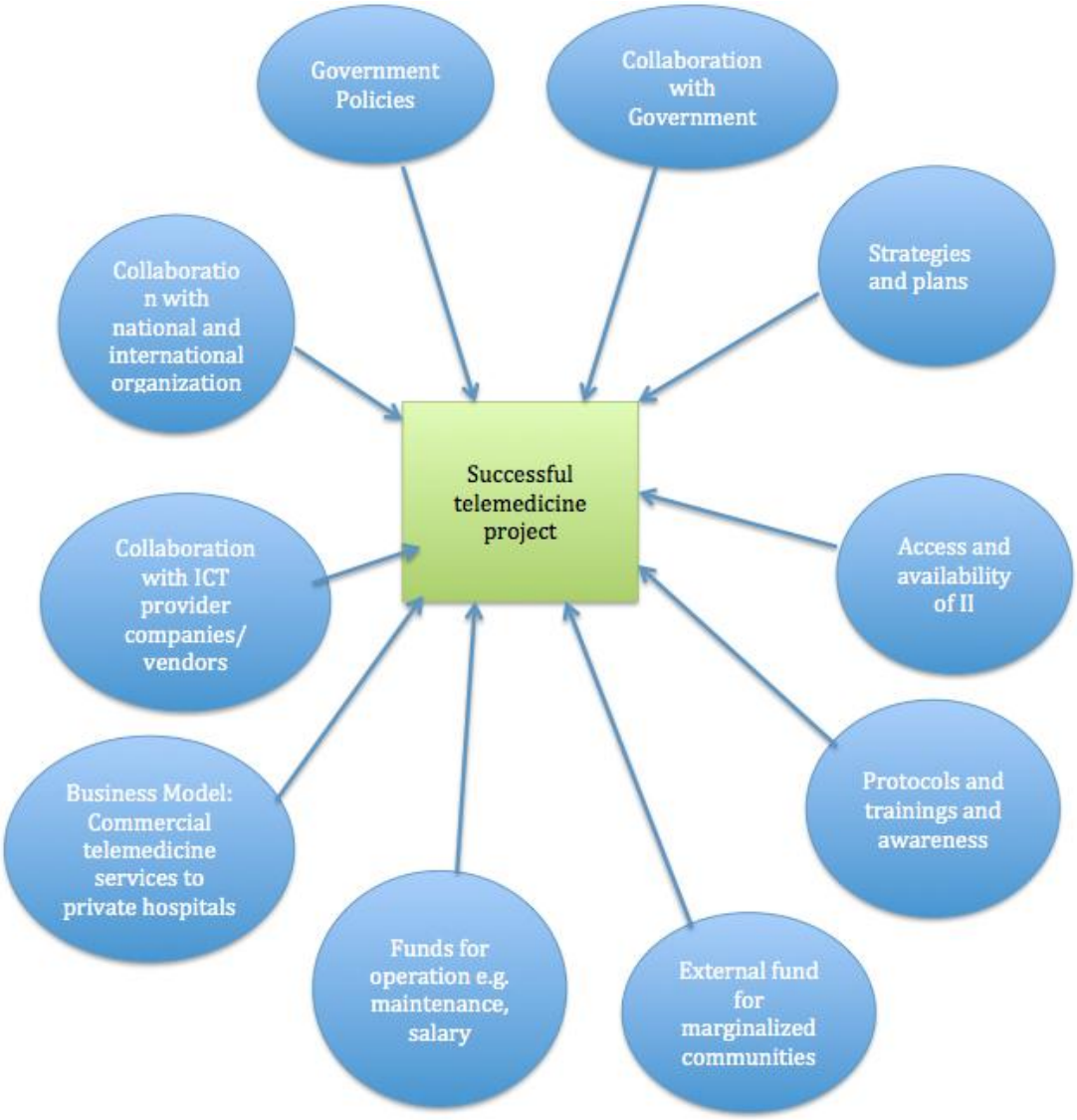

Fig 23: A Successful Telemedicine Model

5.7 Researcher's Perspective/Experience

Prior to my research I was aware of the fact that telemedicine could play an important role for providing basic health care to all the people of Nepal. However I was not familiar with practical implications. Since Nepal is a developing country with numerous geographically isolated villages which lack basic facilities like electricity, internet, healthcare, education etc. As a result, the stakeholders of the organizations involved in telemedicine program have encountered numerous challenges during the implementation.

Despite that it was still pleasant to see that Nepal has done quite an applaudable job of introducing telemedicine services in spite of lack of adequate infrastructure. In KMH, an excellent internet-based CME program has been running to empower health workers. The goal is to broaden the field from surgery to other field like dermatology, oncology, cardiology and other and increase the participation of CME attainders and make it more effective.

Likewise, the staff NCWC are doing decent job by providing health care as well as specialist care through telemedicine with the help of specialists and medical doctors in Kathmandu Model Hospital. It has set an example to the rest of the villages and given a hope of bringing health care in villages, as a result of which is now there is demand for such program. However, the chairman of Nepal Wireless Network admits to not having been able to meet the demand since it involves bringing electricity in the village to setting up a wireless network for connection with KMH.

Finally it was overwhelming to see how some people go beyond their limit to serve people in need. There were many individuals who were working and promoting the Telemedicine Program voluntarily, from all walks of lives, technicians, doctor, teachers, activists. They have also set an example for everyone, how despite, lack of basic infrastructure, telemedicine programs could be implemented in such remote places. The relevant articles regarding Nepal were inadequate but it was more than I expected. It was surprising to be reading papers about telemedicine in Nepal by many national and international authors. Similarly there are many organizations and hospital starting the telemedicine service from Kathmandu and other places. I found seven organizations (could be more) implementing in telemedicine.

Telemedicine programs have the potential to flourish in Nepal by providing health care and health education to remotely located patients and health workers respectively. Telemedicine can take health care to the next level (quality healthcare for all after reaching out to all the people of Nepal) with more sophisticated technology and processes in the future. Hence it is necessary to carry out further studies on locally available technologies usage for telemedicine and on cost and clinical effectiveness in context of Nepal. This would attract and make easier for hospitals and organizations implement more effective telemedicine programs in future.

5.8 Scope, Strength and Limitation of the Research

This research presents a case study on telemedicine service in Kathmandu Model Hospital. The case study research provided greater in depth understanding of the telemedicine application in KMH. The telemedicine service in KMH represents telemedicine in Nepal reaching out to remote villages. A study in KMH also provided scope and potential outcome on the health care service of Nepal. The study sheds light on the fact that telemedicine can improve health care in Nepal by empowering the local/rural health care giver and by improving the access and availability in rural areas.

Since the study was carried out in my home country it was easy for me to select the best organization delivering telemedicine service. Having already worked in a hospital in Nepal, I knew how the system worked. It was also easy for me to reach and communicate to my informants. I tried to get as much information I could by interviewing all the active members of the telemedicine program. I visited the out reach centers to understand remote telemedicine in the villages. Similarly, I tried to cover all the literatures, journals or articles available regarding Telemedicine in Nepal and tried to use that as a reference for my study. I tried to avoid biasness by being aware of those potential biases and by observing and interviewing several times on same subject matter.

Even though the research was carried out well prepared and smoothly, there were some limitations. Since telemedicine is new field in Nepal there were few active people working on telemedicine in KMH and the outreach centers. Since every detail could not be observed personally many times I had to rely on the data

collected from the interview. Meanwhile integrating findings from my observations and interviews was challenging, as there were some contradictions between what they said and what they did in order to show it is perfect (in some cases). Since I made good rapport with the informants to gather information, it might have prevented me from being critical in finding out the flaws of the programs.

My study does not cover the clinical effectiveness though I have tried to show some cost effectiveness of the telemedicine project. My case study provides basic information about the telemedicine program, its applications, scope and challenges of implementation and operation for interested parties. Further study on proper clinical outcomes and cost effectiveness s of the telemedicine project could encourage other institutes and organizations to implement telemedicine programs in Nepal and in other developing countries.

Chapter six: Conclusion

6. Conclusion

There has been a great increase in the use of information and communication technologies in health sector termed as "telemedicine" to improve quality of care in developed countries for many decades. Many authors have also stated the potential benefits of addressing health care issues in developing countries. However, very little is known about implementation of telemedicine in Nepal.

This research carried out in Kathmandu Model Hospital presents the role of telemedicine in Kathmandu hospital and its' outreach centers. The study found that tele-education and teleconsultation has been supporting health care delivery in KMH and its' outreach center. Telemedicine in KMH has reached out to people in remote areas improving access to essential health care and specialist consultation without having to travel for many hours and days, in lower cost (compared to hospital in city). Tele-education is used for information sharing and assistance from other renowned medical organizations in order to empower the health professionals. However there are many loopholes and challenges of this project from lack of sufficient infrastructures like electricity, internet, funding, training, policies and awareness among health workers and public, that questions the effectiveness and sustainability of the program.

In conclusion, telemedicine can be used as a tool to improve health care all over Nepal. Telemedicine has potential to address the issue of health care accessibility and availability. However, telemedicine programs need strong support form the Government for information infrastructure building and sustainability. There is also need for more researches on clinical and cost effectiveness in context of Nepal to encourage more organizations for telemedicine implementation. Despite the fact that most organizations have identified the needs and benefits for telemedicine implementation, they are in dilemma because of lack of information and adequate infrastructures for telemedicine.

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Appendices

4th November 2012

To whom it may concern

Ms. Sabitri Rai is a student at the Master of Science in Telemedicine and E-health programme at the University of Tromsø, Norway.

As part of the requirement for the Master programme, Ms. Sabitri Rai has to write and submit an original thesis.

Ms. Sabriti is from Nepal and wishes to write her thesis about telemedicine in Nepal. She wishes to interview administrators, doctors and other health workers dealing with telemedicine in Nepal.

I would be grateful if you could give Ms. Sabitri time to present her plans and consider approving the participation of your organization in her study (i.e. giving her institutional approval).

Sincerely,

Rolf Wynn

Professor, University of Tromsø, Norway

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phect NEPAL
Kathmandu Model Hospital
काठमाण्डू मोडेल अस्पताल

Date: December 17, 2012

To Whom It May Concern:

This is to certify that **Miss Sabitri Rai,** a Master's student at the University of Tromso had been granted permission to carry out her fieldwork in this organization for her Master's thesis.

She was allowed to participate in the ongoing telemedicine activities inside the hospital as well as at the outreach centers.

We support her effort and have tried to provide assistance necessary for the study. If you have any question, please do not hesitate to contact me.

Sincerely yours,

Dr. Saroj P. Dhital

Chief of Telemedicine Program

Sr. Consultant
Department of General Surgery
E-mail: drsdhital@gmail.com

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Questions
To the focal person.

1. When was the telemedicine program established?
2. What are the objectives of program?
3. How many villages have been connected so far?
4. Has the telemedicine service in any of these villages stopped? How many programs have been stopped so far? What were the reasons for its non-functionalities?
5. How many staffs are actively involved in telemedicine program?
6. How many volunteers do you have for telemedicine service?
7. Who is funding the program?
8. Is funding sufficient?
9. Who are the main stakeholders/ partner institutes?
10. Is there any collaboration with Government of Nepal? If so in what ways?
11. What were the challenges of implementing telemedicine service?
12. What are current challenges being faced?
13. Do you have plans to address them? Can you please describe them in brief?
14. Which do you think is bigger challenge, the human resource or the technology?
15. Do you remember any major challenge that you faced but later solved it? What was it and how did you successfully overcome?
16. Are there legal issues related to telemedicine services in Nepal?
17. What are possible challenges that you think could occur in future?
18. Has the program fulfilled its objectives?
19. What are futures plans for the program?
20. What are the organization's strategies for the sustenance of this program?
    Do you think that there is something important that I have missed out in my questionnaire that I need to know? Also please feel free to comment or make suggestion. Thank you for you co-operation and your valuable opinions.

Name (optional)……..Designation……..

Date:……..Place:……..

To the doctors/health care giver at outreach center

1. What is telemedicine in your opinion?
2. What other telemedical application do you think can be relevant or useful in context of Nepal besides teleconsultation?
3. How often do you use teleconsultations for patients care?
4. How many patients have been treated so far via teleconsultation since the service?

5. How many patients have been referred to central hospital since the introduction of telemedicine program?
6. Has there been a decrease in number of referrals to the central hospital after the introduction of telemedicine program? If so can you give the number in figure?
7. Have you felt the difference or changes between the traditional/ normal treatment and the treatment using telemedicine service? What are they?
8. What are the outcomes of treatment through telemedicine application e.g. diagnosis, mortality rate, frequency of hospital visit of patients etc.?
9. Are there any cases of negative outcome of treatment such as misdiagnosis in patients? If there are can you describe in brief?
10. What is your perception towards the program? Are you confortable in using the system and give service to the patients?
11. Do you think its user friendly?
12. Are you satisfied with the communication technology used?
13. What are the challenges of running this program?
14. What improvements should be done to make it more effective?
15. Have you had any training regarding the telemedicine activities?
16. What kind of training do you think it's important?
17. Have you faced any challenges with this program that has ben successfully overcome now? If yes, can you describe it in brief?
    Do you think that there is something important that I have missed out in my questionnaire that I need to know? Also please feel free to comment or make suggestion. Thank you for you co-operation and your valuable opinions.

Name(optional):……Designation:……..

Date:…….. Place:……..

For medical personal attaining Continuous Medical Education via tele-videoconferencing:

1. What is telemedicine in your opinion?
2. What other telemedical application do you think will be relevant or useful in context of Nepal besides tele videoconferencing?
3. Has CME via tele videoconference been useful to you? And in what ways?
4. Do you feel confident in applying the knowledge gained from the internet based CME into your practice or for patient care?
5. Has there been a change in your practice for patient care since the internet based CME? Can you please describe some?
6. What was the outcome? Can you please mention? (related to question number 5)

7. Are there cases of negative outcome as well? Can you please mention if possible? (related to question number 5)
8. Are you satisfied with the quality of education provided via video conferencing?
9. What differences have you found in the quality of education provided via video conferencing and face to face?
10. What are the difficulties that you have faced during the CME provided via video conferencing?
11. Do you think these kind of classes and trainings could be useful for all the medical professionals?
12. There weren't enough participants (not more than 8 during my observation), what do you think could be the reason?
13. How can participation be increased among medical personals?
14. In what ways do you think these internet based CME programs could be made more effective?
15. Would you personally prefer to attain all these CME trainings provided by the hospitals? How do you feel about these internet based CME?
16. In your experience, what field of medicine do you think will benefit from video conferencing (the ongoing process) the most?
17. Do you think that there is something important that I have missed out in my questionnaire that I need to know? Also please feel free to comment or make suggestion. Thank you for you co-operation and your valuable opinions.

Name (optional):……

Designation:……

Date:……Place:……

To the consultant at the central hospital:

1. What other field of telemedical application do you think will be relevant in context of Nepal besides teleconsultation?
2. How does the teleconferencing process occur between Kathmandu Model hospital and outreach center occur?
3. Are there any difficulties or challenges during the process? If so what are they?
4. What do you thing about the communication technology being used?
5. Are you satisfied with it?
6. What is your perception towards the program?
7. What are the challenges that you have faced during the teleconsultation process?

8. What improvements should be done to make it more effective?
9. Have you faced any challenges with this program that has ben solved now? If yes, can you describe it in brief?
10. Have you had any training regarding the telemedicine activities?
11. What kind of training do you think it's important?
12. Do you think that there is something important that I have missed out in my questionnaire that I need to know? Also please feel free to comment or make suggestion. Thank you for you co-operation and your valuable opinions.

Name (optional):……

Designation:……

Date:…… Place:……

Interview guide at outreach center

When did the collaboration start?
Who funds the program?
Does patient pays for the service?
How much do they pay?
Does the doctor willingly consult at the central hospital?
Are patient made aware of telemedicine service during their treatment?
Do you keep records of the patient using telemedicine service?
Can you tell me about the technologies used?

For IT professional

Can you tell me about the technologies used?
What are the common disturbances during the video conferencing and teleconsultancy?
What are other technical challenges of implementation and operation of this program?
Have you received any training regarding the telemedical activities?
What effort do you think is necessary to have seamless communication?
Could you explain to me the relation between Model hospital, NREN and TR