A Framework for Evaluating Telemedicine-Based Healthcare Inequality Reduction in Ethiopia: A Grounded Theory Approach

by

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submitted in accordance with the requirements for
the degree of

DOCTOR OF PHILOSOPHY

in the subject

INFORMATION SYSTEMS

at the

UNIVERSITY OF SOUTH AFRICA

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OCTOBER, 2019

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I declare that the above thesis is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the thesis to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

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Acknowledgement

The author would like thank the following people and institutes:

First and foremost, I would like to thank the God almighty for making my dream come true.

My first gratitude goes to my supervisor, Prof HH Lotriet, for his guidance and support throughout the study. Thank you very much for your prompt constructive comments and feedbacks.

I wish to express my appreciation to my mentor, Prof Isabella Venter, for her support and comments. Thank you very much for supporting me and shaping the thesis.

I wish to present my gratitude to the language editor of the thesis, Mrs Ann Bytheway.

I wish to thank my family for their support and patience throughout the course of the study. I would like to appreciate particularly my elder brother, Getachew Wagaw, for his advice and support.

My last gratitude goes to the University of South Africa and Bahir Dar University for giving me the opportunity to conduct this study.

Dedication

I would like to dedicate the thesis to my family and my beloved wife, Tirukelem Haile, my son Kaleb Mekonnen and my daughter Maryamawit Mekonnen. Without their support, it would not have been possible to complete the study.

Summary

Telehealth makes healthcare services accessible by underserved and resource-constrained rural communities of developing countries such as Ethiopia. However, the limitation of frameworks on telemedicine-based healthcare inequality reduction is a challenge for developing countries. In Ethiopia there are four telemedicine projects; however, there is no evidence that any of these projects have been evaluated by considering contextual issues. This academic research explored telehealth practices in Ethiopia with the aim of developing a comprehensive telehealth evaluation framework for developing countries. Such a conceptual framework could be used to inform health institutes and governmental policy makers and in so doing create a vehicle for the implementation of improved health practices in Ethiopia. A grounded theory approach is used to qualitatively explore the usefulness of telemedicine practices in Ethiopia, in mitigating healthcare inequality. Grounded theory makes use of emerging insights in order to contribute to new knowledge. From the inductive analysis of the study, themes such as barrier removal, service quality, synergetic effect, localization, technical setup, resource utilization and managerial readiness emerged to formulate a framework for evaluating telemedicine-based healthcare inequality reduction in the context of developing countries like Ethiopia. This study contributes to the understanding of the question of how telemedicine practices can be evaluated, to support the healthcare service and reduce the healthcare inequalities in resource constrained communities in Ethiopia. Moreover, the framework could be used during evaluation of telemedicine-based healthcare inequality reduction in the context of developing countries like Ethiopia.

KEY TERMS:

Telemedicine; Telemedicine evaluation; Telemedicine framework; Telehealth; Healthcare inequality reduction; ICT in health; Grounded Theory; Telemedicine in Ethiopia; Telehealth evaluation model; Telemedicine in developing countries; Telemedicine and healthcare inequality reduction; Inductive analysis

Table of Contents

List of Figures

List of Tables

List of Acronyms

APA	American Psychological Association
ART	Anti-Retroviral Therapy
ATA	American Telemedicine Association
CAR	Central African Republic
CDCP	Centres for Disease Control and Prevention
CSA	Central Statistical Agency
CSDH	Commission on Social Determinants of Health (World Health Organization)
DHS	Demographic and Health Survey
DRC	Democratic Republic of Congo
EDHS	Ethiopia Demographic and Health Survey
EMR	Electronic Medical Record
ETA	Ethiopian Telecommunication Authority
FLR	Female Literacy Rates
FMoH	Federal Ministry of Health
GBD	Global Burden of Disease
GTZ	German Technical Cooperation
HEW	Health Extension Workers
HIV/AIDS	Human Immune Virus/ Acquired Immune Deficiency Syndrome
IMR	Infant Mortality Rate
ICT	Information and Communication Technology
I-TECH	International Training and Education Centre for Health

ITU	International Telecom Union
ITU	International Telecommunication Union
JHU	Johns Hopkins University
LGBT	Lesbian, Gay, Bisexual, and Transgender
NASA	National Aeronautics and Space Administration
NTCC	National Telemedicine Coordinating Committee
OHIH	Office of Health and Information Highway
QDA	Qualitative Data Analyzer
QRCA	Qualitative Research Consultants' Association
SMS	Short Message Service
SSA	Sub-Sahara African
SAMSS	Sub-Saharan African Medical Schools Study
STI	Sexually Transmitted Infection
TB	Tuberculosis
TSEHAI	Technical Support for the Ethiopian HIV/AIDS Initiative
UN	United Nations
UNICEF	United Nations Children's Fund
UNDP	United Nations Development Program
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNISA	University of South Africa
WHO	World Health Organization

Chapter 1 INTRODUCTION

1.1 Background

Healthcare inequality refers to the existence of systematic and potentially solvable healthcare service differences among socially, economically and geographically defined population groups; it is a relative health status difference between two groups; for instance, mortality and morbidity rate disparities between higher economic class and lower economic class (Venkatapuram et al., 2010). Healthcare inequality is a persistent global challenge but it is worse in developing countries, such as Ethiopia, where millions of people die every year due to a shortage of healthcare professionals, poor healthcare infrastructure, lack of healthcare awareness, shortage of money and shortage of transportation (Memirie et al., 2016; Skaftun et al., 2014; Tranvåg et al., 2013). According to Marschang (2014), the main causes of healthcare inequality are the multifaceted interaction between personal, social, economic and environmental factors.

Telemedicine has been suggested as a solution for reducing healthcare disparities both in the developing world and in developed countries; however, the limitations of the available telemedicine evaluation frameworks, particularly lack of understanding the context of developing countries and the effect of telemedicine on mitigation of healthcare inequalities, are a well-known challenge (Chang, 2015). Although implementation of advanced communication and information systems in the healthcare sector was comparatively slow (Oyegoke, 2013), currently, in 2010 — using health information technologies like telemedicine—public health decisions are being guided by real-time data. Telemedicine entails, according to Alexandru (2010),

> *"the application of contemporary information and communication technologies, mainly bidirectional audio-video communications, telemetry, and computers to deliver health*

services to isolated patients and to improve communication between specialists and primary care providers far away from each other" (Alexandru, 2010, p.2).

In order to increase healthcare accessibility and at the same time reduce healthcare imbalances between communities, telemedicine has been implemented in different countries such as Botswana, Haiti, Peru, the Philippines, Kosovo, Siri Lanka (Nouhi at al. 2012; Desai et al., 2010; Kumar et al., 2011; Canchihuaman et al., 2011; Van Olmen et al., 2013; Vatsalan, D. et al., 2010). In developing countries, due to the presence of very high healthcare service inequality between urban and rural communities, the implementation of telemedicine in underprivileged communities enables the delivery of healthcare services to under-served people. For instance,

- In Botswana, tele-radiology and tele-dermatology have been used (Desai et al., 2010);
- In Liberia, universal tele-radiology has been used for paediatric and obstetrics care as well as for the treatment of tuberculosis (Archer, N. and Phil D. (2016);
- In Haiti, use has been made of disaster response and crisis maps via Twitter to manage a cholera outbreak (Kumar et al., 2011);
- In Peru, training and education has been delivered by means of the Internet (Canchihuaman et al., 2011);
- In the Philippines, Cambodia, and the Democratic Republic of Congo (DRC), health self-management has been implemented[1] (Van Olmen et al., 2013);
- In Afghanistan, tele-consultation has been utilized so that medical doctors could treat stroke patients (Mayar W, 2013);

[1] Health self-management is a mechanism that enables patients to keep records of their own case using technologies such as smart phones and online services.

- In Kosovo, video-conference-based education for clinicians, medical students, and nurses has been implemented (Hoxha et al., 2013);
- In Sri Lanka, remote tele-consultation with health specialists has been used (Vatsalan, D. et al., 2010);
- In Kenya, India and South Africa, short message service (SMS) has been used to educate people on how to prevent HIV/AIDS infection (Velthoven et al., 2013);
- In Uganda and India, SMS has been used for the surveillance and tracking of malnutrition and malaria (Källander et al., 2013); and
- In Tanzania, SMS has been used for disease information management and patient monitoring (Källander et al., 2013).

Telemedicine has been utilized in the developed world as well—a study conducted at a high security prison in UK recommended that healthcare inequalities could be tackled by telemedicine (Hitchcock, 2017). Studies carried out in America revealed that telemedicine helped reduce the racial and social inequalities that exist in healthcare and the healthcare disparities that still plague rural parts of America (Lewis, 2016).

1.2 Problem context

The World Bank (2016) defines Ethiopia as a low income and poor health status country. The scattered settlements of the Ethiopian people and the inaccessibility of some of these settlements has made healthcare challenging and healthcare inequality is thus common place.

Although the Ethiopian government tries to maintain the *"health for all"* principle of the World Health Organization (WHO), research and country reports show that a very high proportion of the population are underserved and are victims of healthcare inequality (Memirie et al., 2016; Skaftun

et al., 2014; Tranvåg et al., 2013). Furthermore, according to the Federal Ministry of Health (FMoH) (2010), the shortage of healthcare workers and health facilities in the country has increased healthcare inequality. According to the WHO (2010), there are 3 physicians for every 100,000 members of the population in Ethiopia (see Table 1). According to WHO (2014): "the physician to population density of Ethiopia is 0.025/1000 which makes the country one of the countries with the lowest physician to population ratio in the world" (Johansson, 2014, p. 5). Most medical doctors are attached to hospitals in the larger cities (Deressa and Azazh, 2012), thus in rural areas, people do not have the same access to healthcare as city dwellers.

More than 80% of the Ethiopian population live in communities in rural areas. Apart from the healthcare challenges they face, they also have low socio-economic status, very low literacy rates, conduct harmful traditional practices, are highly dispersed and road and transportation infrastructure in these areas are poor (Deressa and Azazh, 2012).

Table 1: Total Numbers and Density for Key Human Resource for Health Categories (FMoH, 2010, P.6)

Category	**Number**	**Ratio per 1,000 people**
Health extension workers	34,382	0.43
All nurses	20,109	0.26
Lab technologist and technicians	2,823	0.04
Physicians (general practitioners and specialists	2,152	0.03
Pharmacy technicians	2,029	0.03
Health officers	1,606	0.02
Radiographers	1,486	0.02
Midwives	1,379	0.02
Environmental health specialists	1,246	0.02
Pharmacists	632	0.01

The government of Ethiopia has implemented several programs to support the healthcare system in these communities. For instance, with the intention of building the capacity of healthcare workers and strengthening the national health systems in resource constrained localities,

telemedicine projects have been implemented in several parts of the country (Weldegebrial and Berhie, 2016; Shiferaw, and Zolfo, 2012).

Telemedicine was originally launched in Ethiopia by the National Telemedicine Coordinating Committee (NTCC) formed as a joint initiative of the Federal Ministry of Health (FMoH), Medical Faculty of Addis Ababa University, and the Ethiopian Telecommunication Authority (ETA) (Kifle at al., 2004). Following this initiative, three more projects were established by different organizations to support the healthcare system. The organizations are: - the International Telecom Union (ITU), the Pan-African Initiative (Ethio-Indian Telemedicine Project), Johns Hopkins University (Tsehay Project), and I-Tech Ethiopia (Swinfen Charitable Trust project). The goal of these programs was to reach the underserved communities by efficiently utilizing the medical and public health professionals that are concentrated in the larger cities (Kifle et al., 2008).

1.2.1 International Telecom Union (ITU)

The first telemedicine project in Ethiopia was established by the International Telecom Union (ITU) in 2003. The project was aimed at ensuring access to affordable and clinically acceptable primary healthcare for underserved rural communities (UN, 2009, p.976). It had a host at Black Lion Referral Hospital to provide tele-radiology, tele-dermatology, and tele-consultation services for healthcare workers, basically medical doctors, public health workers and medical students.

1.2.2 Pan-African e-Network (Ethio-Indian Telemedicine)

The second telemedicine project in Ethiopia was initiated by the Pan-African e-Network. This project interconnects selected telemedicine sites in Africa with the main telemedicine service provider in India. With the help of the African Union, telemedicine was established in some of its member states. Since Ethiopia has been the seat of the African Union and satisfied the selection

criteria, ten public hospitals were selected to connect to the main telemedicine service provider in India (NTCC, 2009).

In Ethiopia, most experienced medical specialists are found in the Tikur Anbessa (Black Lion) hospital in Addis Ababa, the capital city of Ethiopia. As a result of this, the telemedicine centre in this hospital is connected to other telemedicine centres outside Addis Ababa and delivers tele-radiology and tele-dermatology services to, for instance, Gondar, Jimma and Nekemte hospitals. This telemedicine centre also interconnects other hospitals in Addis Ababa such as Alert, St. Paul, and Zewditu hospitals.

Physicians at Jimma hospital use the Internet to communicate and consult with specialists in Wolisso and Metu Hospitals (Pan-African e-Network, 2009) these hospitals are in the Oromia region.

1.2.3 Johns Hopkins University (Tsehay Project)

In 2006, Johns Hopkins University started a telemedicine project that focused on HIV/AIDS prevention, its treatment and the rehabilitation of these patients. Its centre is in the United States of America (USA) and it serves two locations in Ethiopia namely, Black Lion Referral Hospital located in Addis Ababa (capital city of Ethiopia) and Hawassa Hospital located in Southern Ethiopia (Hawassa town). This telemedicine service uses real-time telemedicine through video-conferencing. It provides medical and consultation services for medical professionals, medical students, and patients. The program is known as Technical Support for the Ethiopian HIV/AIDS ART Initiatives (TSEHAI).

1.2.4 I-TECH Ethiopia (Swinfen Charitable Trust)

Currently, the Swinfen Charitable Trust—established in 1998 to support developing countries by giving them access to medical specialists via telemedicine—has telemedicine links with the

following Ethiopian hospitals: Adventist Mission Hospital; All Africa Leprosy; TB and Rehabilitation Training Centre; ALERT; The Black Lion Hospital; and Mekele Hospital (Molefi, 2010).

I-TECH is an international network that has enabled Kenya, India, Ukraine and Namibia to collaborate with Ethiopia to build capacity in healthcare and to strengthen the national health systems in resource constrained localities (I-TECH, 2015). Currently, Mekele University is utilizing this technology as well and I-TECH has continued its additional telemedicine site construction at the medical school of Bahir Dar University.

Although these four telemedicine projects were established in Ethiopia by various institutes, there is no evidence that any of these projects have been evaluated. Moreover, there is no published research work on these projects except a single conference paper published by Kifle et al. (2005). Kifle studied only one of the telemedicine projects in Ethiopia thirteen years ago.

1.3 Problem Statement

This academic research explores telehealth projects in Ethiopia with the aim of developing a comprehensive telehealth evaluation framework for developing countries. Such a conceptual framework could be used to inform health institutes and governmental policy makers and in so doing create a vehicle for the implementation of improved health practices in Ethiopia.

A grounded theory approach has been used to qualitatively explore the usefulness of telemedicine practices in Ethiopia in mitigating healthcare inequality. Grounded theory makes use of emerging insights in order to contribute to new knowledge.

1.4 Research Aim

The aim of this research is to explore telemedicine practices and healthcare inequality in order to develop a framework that will inform health service delivery for underserved communities in Ethiopia; making a knowledge contribution to existing telemedicine knowledge and discourse about telemedicine in academic literature.

1.5 Objectives

The objectives of this study are to:

1. Describe the current status quo of telehealth at the four Ethiopian telemedicine sites;
2. Understand the strengths and weaknesses of current practice on the basis of theoretical (literature) and empirical (interviews with participants) information;
3. Develop a conceptual framework that will inform improved practice of telehealth in Ethiopia; and
4. Make a knowledge contribution to existing telehealth knowledge discourse in academic literature.

1.6 Research Questions

The central question of this study is:

How should a telemedicine evaluation framework be developed in order to reduce healthcare inequality at community level?

To answer this central question, the researcher raised the following sub-questions as foundations:

1. How should telemedicine practices on the reduction of healthcare inequality be evaluated in Ethiopia?

2. What insights does an evaluation of telemedicine in Ethiopia provide in terms of the reduction of healthcare inequality in the country? and
3. How do these insights inform a framework for improving the telemedicine practices in reducing healthcare inequality in Ethiopia?

The above research questions guided the research design, literature review, and data gathering techniques.

1.7 Scope of the Study

This study explores telemedicine implementations in Ethiopia. Four telemedicine sites within the Ethiopian health information systems were investigated, namely: - the International Telecom Union (ITU), Pan-African Initiative (Ethio-Indian Telemedicine Project), Johns Hopkins (Tsehay Project), and I-Tech Ethiopia (Swinfen Charitable Trust) project.

1.8 Summary

Although healthcare inequality has been a persistent problem globally, the case is worse in developing countries where people suffer from communicable diseases. In order to support the healthcare systems, different mechanisms such as telemedicine, have been used. However, how should telemedicine practices be evaluated? This study investigates the telemedicine practices of Ethiopia in order to design an evaluation framework for improving the telemedicine practices in rural communities of developing countries.

This study is organized as five chapters. The first is an introductory chapter that includes introduction statements, context of the problem, research questions, and objectives and scope of the study.

Chapter 2 reviews relevant and related literature on healthcare inequality. It is set out in three sections, namely: The first reviews the different definitions and causes of healthcare inequality. It also reviews healthcare inequality in the developing world, focusing on Ethiopia. The second section reviews related work on telemedicine in general but in particular in developing countries. It discusses the historical background, forms, benefits, challenges, and infrastructure of telemedicine. The third section reviews related work on telemedicine evaluation. It discusses the meaning of telemedicine evaluation, types of evaluation, and telemedicine evaluation in Ethiopia.

Chapter 3 presents the research approach and the research design of the study. It includes discussion of the methods of data gathering and data analysis as well as the ethics that govern it.

In Chapter 4, the results of the study are presented. The emergent themes that arose through inductive analysis are presented with supporting citations from the narratives of participants.

In Chapter 5, the findings of the study are discussed and concluding statements are presented. In this chapter the limitations of the study, its implications for policy, practice and research and recommendations for future research are mentioned.

Chapter 2 RELATED LITERATURE

2.1 Introduction

In Chapter 1, the research problem was stated, the research justified and the study objective and scope of the study defined. In Chapter 2, the related literature will be discussed. It will be done as three sections. In the first section literature on healthcare inequality will be reviewed. This will include the causes and effects of healthcare inequality globally, in the context of developing countries and with specific reference to Ethiopia. In the second section, the key concepts of telemedicine, its historical background, benefits and challenges, its affordability and roles will be discussed. In the last section, the evaluation of frameworks and evaluation in general will be reviewed: this will include types of evaluation and their importance within telemedicine.

2.2 Healthcare inequality

Terms for "*inequality"* are different in different parts of the world. For instance, in the United States of America (USA), the term "*disparity"* is used while "*variation"* is applied in Great Britain. Europe mostly uses "*inequality"*.

Researchers also have different opinions about the two terms "*inequality"* and "*inequity"* and how these should be used when referring to healthcare services (Fleurbaey and Schokkaert, 2011). According to the dictionary "*inequity"* is "*the state or quality of being unfair and unjust"*; while "*inequality"* means "*the state of being unequal particularly in rights, status, or opportunities*" (Oxford Word of the Year Dictionary, 2018). According to the Centres for Disease Control and Prevention "*healthcare inequality*" is "*the presence of disparities in controllable or remediable aspects of health*" (Centres for Disease Control and Prevention (CDCP), 2011) but "*health equity"* is "*the study of the differences in the quality of health and healthcare across different populations*".

The simple definition of "*inequality"* is "*impartiality*" or "*disparity*"—two quantities that are not equal. Based on the definition of Cook *et al*. (2016), "*disparity"* is "*any healthcare service differences after adjusting healthcare demands and preferences*". Similarly, the USA National Institutes of Health in 2005 defined "*health disparities"* as "*any differences in the prevalence, incidence, mortality and disease burden and other adverse health conditions that occur among communities in the United States*". On the other hand, "*healthcare inequality"* is "*the existence of systematic and potentially solvable differences among socially, economically and geographically defined population groups*"; it is the relative health status difference between two groups; for instance, mortality and morbidity rate disparities between higher economic classes and lower economic classes (Venkatapuram et al., 2010).

"Inequality and "*inequity"* are commonly used terms in the literature; and some researchers use the two terms interchangeably while others say there is difference between them. "*Inequality"* can be vertical or horizontal. If people with higher needs are not getting higher services, this is *vertical* inequality. If people with the same needs are not getting the same services, this is known as *horizontal* inequality (Stewart et al., 2015).

The term "*healthcare inequality"*, although interchangeably used with "*healthcare disparity*", is often the preferred term used in scientific literature (CDCP, 2011). Hence, to match the common understanding of healthcare inequality in a healthcare context, different definitions from literature have been considered in order to provide an operational definition. For this study, the term "*healthcare inequality"* is defined as *"any observed healthcare service difference between two or more groups, communities or nations".*

2.2.1 Healthcare inequality and its causes in the developing world

Uneven distribution of healthcare services is still a global challenge (Eshetu and Woldesenbet, 2011). However, in almost all developing countries—specifically Sub-Saharan Africa (SSA), the Middle East, and South Asia—it is a critical problem (WHO, 2011; Soors at al., 2013). It is in these countries that 99% of the world's maternal deaths occur and millions of people suffer from preventable health problems such as infectious diseases, malnutrition, and birth complications (Alicke et al., 2017). A lack of human resources, weak infrastructure, and poor supply chain management systems, compound the challenges the health systems of SSA countries face (Bilal et al., 2011). The existence of high morbidity and mortality in different parts of the world is in many cases attributable to the inequalities in healthcare access and delivery (Lawrence and Kisely, 2010).

The main causes of this inequality can be associated with differences in socio-economic status; differences in education; the existence of minority groups; spatial differences; gender differences; and environmental influences (King et al. 2013; Steinbach, 2009; WHO, 2008). These causes will be discussed in more detail in the following sections.

2.2.1.1 Socio-economic status

Socio-economic status is the measure of the social and economic position of an individual or a family on the basis of their income, education and occupation and according to the American Psychological Association (APA) is a major factor of healthcare inequality (APA, 2015). According to Marmot et al. (2010), the wealthy live up to seven years longer than the poor. The poor often have unhealthy lifestyles which can include: smoking; obesity because of their eating habits; high teenage birth-rates; and drug abuse.

The foremost contributor to socio-economic inequality —and thus access to essential healthcare services—is financial means (Skaftun et al., 2014). Income-related inequalities directly affect healthcare utilization both horizontally and vertically. It is worth noting that the socio-economic gap within developed countries is increasing which in turn results in healthcare inequality among different socio-economic classes (Vallejo-Torres, 2013).

According to a report of the United Nations Development Program (UNDP) (2013), income inequality increased in two successive decades (1990-2010) in developing countries by 11%:

> *"On average - and considering population size - income inequality increased by 11% in developing countries between 1990 and 2010. A significant majority of households in developing countries - more than 75% of the population - are living today in societies where income is more unequally distributed than it was in the 1990s" (UNDP, 2013, p.3).*

and this was also included by Braggion et al.

> *"…the differences between richer and poorer people (both economically and culturally), as well as the inequalities among population groups, have increased in the last decade" (Braggion et al., 2013, p. 706).*

Larrimore (2011) noted that individuals, groups, communities, and countries earning higher incomes, have better healthcare coverage, are able to visit physicians more often and their health facilities are better than their poorer counter-parts. People who earn a high-income can afford the cost of healthcare services such as expensive private hospitals and overseas medical treatments in developed countries (Johnston et al. 2010; Pavel et al., 2016). In contrast, the majority of poor people in developing countries cannot afford the cost of healthcare services outside public healthcare facilities (Alam et al., 2015).

Lower-income countries often are unable to deal with treatable and preventable diseases (Bollyky et al., 2017). Most of these diseases are communicable disease such as malaria, tuberculosis (TB),

human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS), and diarrhoea. According to a World Bank (2015) report, almost all (99%) people who die from AIDS, malaria, or TB live in the developing world. Furthermore, child mortality is high in low-income countries. For example, in 2013, there were 76 deaths per 1,000 live births in low-income countries which is more than twelve times the average under-five mortality rate in high-income countries (United Nations Children's Fund (UNICEF), 2014).

Wagstaff et al. (2014) in their research mentions that there is large country-to-country healthcare disparity:

> *"…health-status inequalities have increased in 42% of countries, and the health status among the poorest 40% of the population declined in about a quarter of these countries" (Wagstaff et al., 2014, p. 1).*

The situation is worse in developing countries, such as in Africa, which has to deal with 25% of the global disease burden, but only has access to 3% of global healthcare professionals and where less than 1% of world's health expenditure is spent (Mash et al., 2018).

The socio-economic difference between social groups is also the cause of healthcare inequality in Ethiopia. According to Gashaw (2012), the cause of almost 80% of morbidity in Ethiopia can be associated with preventable nutritional and communicable diseases. Most of the experienced medical specialists in Ethiopia are found in private health facilities which the poor cannot afford (Soucat and Scheffler, 2013). For example, of the 1806 qualified physicians in Ethiopia in 2006, 56% of the specialists and 38% of the general practitioners, worked in private healthcare facilities (WHO, 2010).

Low-income communities often have to travel long distances to access public health facilities and these are commonly crowded with patients (Yallew et al., 2012; Tadesse et al., 2013).

2.2.1.2 Education

Education is another factor influencing the fair distribution of healthcare provision among people. Research findings on the relationship between education and health, for instance by (Vogl, 2014), support this. Communities with more educated people are healthier than their less-educated counter-parts (Li and Powdthavee, 2015). Research conducted by Ross et al. (2012) found that

> *"...Americans with less than a high school education were almost twice as likely to die in the next 5 years compared to those with a professional degree" (Ross et al., 2012, p. 10).*

In developing countries people often suffer from communicable diseases because of a lack of education and awareness. For example, globally in 2013, 17 000 children under the age of five died per day mostly because many mothers do not know how to feed and take care of their children, (UNICEF, 2014). Badji's research findings also show that family health differences exist between educated and uneducated parents—the educational level of a mother and the health of her children are directly related (Badji, 2016). This is confirmed by Bado and Susuman (2016), who found that the infant mortality rate of uneducated mothers is higher than the infant mortality rate of educated mothers. Tariku found that the healthcare inequality between educated and uneducated mothers in Ethiopia is very high (Tariku, 2017). This inequality is compounded by the low literacy rate in the developing countries —according to The United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics (2015)—the literacy rate in developed nations was 99.2% in 2013; whereas in 2015 the literacy rate in Oceania was 71.3%; in South and West Asia it was 70.2% but in Sub-Saharan Africa it was only 64.0%. Figure 1 depicts infant mortality in terms of female literacy in some SSA countries (Susuman et al., 2016).

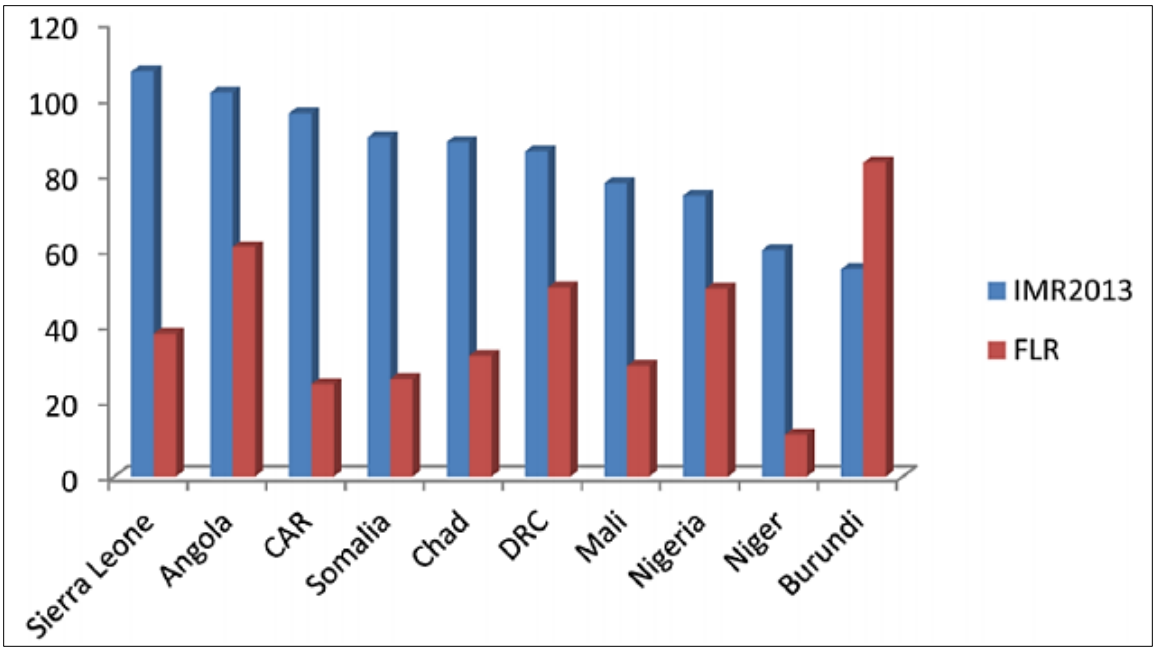

Figure 1: Infant mortality rate (IMR) and female literacy rates (FLR) in selected African countries – 2013 (Susuman et at., 2016, p.2). CAR: Central African Republic; DRC: Democratic Republic of Congo;

Sub-Saharan Africa has a high percentage of uneducated people especially in its rural areas. This in turn shows that education plays a role in the reduction of healthcare inequalities

> *"…Individuals who completed higher education are more likely to live in good health than those with lower education" (Mackenbach, 2012, p. 765).*

Early marriage and adolescent births are a challenge in developing countries. According to the United Nation (UN), about 11% of all births worldwide (that is 16 million births), are adolescent births and the mothers are aged between 15 and 19. The vast majority of these births are in developing countries (WHO, 2016).

Furthermore, the educational background of people has a significant influence on the health status of a family. A family that has an educated mother, "*can be considered as nurse of a family*", is found to be healthier than its counter-part with an uneducated mother.

> *"…children are at a greater risk of dying before age five if they are born in rural areas, among the poor, or to a mother deprived of basic education" (UNICEF, 2012, p.39).*

According to a 2015 report of UNESCO, the literacy rate of all in Ethiopia is 49.1%, the male literacy level is 57.2% and female literacy level is 41.1%—thus a difference of 16.1%.

2.2.1.3 Minority groups

Healthcare inequalities also exist among ethnically diverse communities (López and Gadsden, 2016). It is an issue in countries where the populations are ethnically diverse.

In the USA, infants born to black women are 1.5 to 3 times more likely to die, than infants born to women of other races/ethnicities. Similarly, inequality in preventable hospitalizations is also large (CDCP, 2011). According to the American College of Physicians (2010) racial and ethnic minorities have less access to health care than whites, for example, the level of un-insurance of Hispanics is 34% compared to 13% among whites.

In the United Kingdom (UK), the census data taken between 1991 and 2011 showed ethnicity associated with poor health (Becares, 2013). According to this report, there is continuous healthcare inequality of Pakistani and Bangladeshi women living in UK as compared to white women. Their morbidity rate exceeds the morbidity of white women by 10%.

In Australia healthcare inequality is also reported:

> *"overall life expectancy for native Australians is 69.1 years for men and 73·7 years for women, these figures are about 10 years less than for non-native Australians" (Australian Institute of Health and Welfare, 2014, p. 6).*

In South Africa, healthcare inequality exists between whites and blacks and this is associated with the former apartheid laws and policies. According to Li (2014), the healthcare service provision between blacks and whites has not shown significant improvement since 1994.

Ethnic inequalities are particularly emphasized in the older population. For example, 56% of all women older than or equal to 65, suffer from a limiting long-term illness, however for Bangladeshi, Pakistani and White Gypsy women at similar ages this is 70%. (Becares, 2013).

The Lesbian, Gay, Bisexual, and Transgender (LGBT) minority groups, according to Hafeez et al. (2017), also suffer from healthcare inequalities due to their sexual orientation. In countries like Ethiopia the LGBT issue is not discussed and is religiously and culturally prohibited.

2.2.1.4 Spatial differences

Spatial disparities are also common causes for healthcare service inequalities throughout the world. Due to geographical location differences—where communities are dwelling— healthcare services and healthcare resources may be inaccessible. Rural and coastal areas[2] are often marginalized in terms of healthcare services because members of these communities have to travel long distances to get medical services (Banerjee et al., 2011).

The rural-urban healthcare service inequality has resulted in a noticeable effect on the life expectancy of rural communities in the USA (Singh and Siahpush, 2014).

Unfair distribution of healthcare workers in Romania is a cause for healthcare inequalities particularly between communities in rural and urban areas. According to Dumitrache et al. (2016), 66% of health professionals work in six big cities whereas 5% of rural communities have no medical doctors at all.

The North-South healthcare inequality in Ghana is also the result of spatial difference (Akrofi et al., 2018).

[2] Coastal areas are the boundary or interface areas between land and sea.

Due to spatial differences in Ethiopia, the healthcare service inequality is a common problem for rural and remote areas where medical service provision is very limited. This uneven medical service coverage and health resources distribution between regions is still a persistent problem for the nation where more than 80% of the population lives in rural areas which have underdeveloped road and transportation systems. Consequently, only 28% of births take place in health facilities (Weis, 2017).

Healthcare inequality in the developing world is high due to the fact that the majority of their population live in rural areas that: are distant from basic healthcare service delivery stations; far from schools; have no access to electricity or clean water (Bilal et al., 2011). Moreover, the rural people of most developing countries are vulnerable to drought and poverty (De Silva and Kawasaki, (2018). According to a report of WHO/UNICEF (2010), only 5% of rural communities in SSA get water piped to their premises whereas 35% of urban communities use water piped to their households.

The majority of the Sub-Saharan Africa (SSA) population live in rural areas where access to basic health facilities and specialists are not available or too far away to access. To illustrate this, in Ethiopia, 43% of doctors are found in the capital city (Morgan et al., 2018). This is the case for many developing countries for example rural communities in India have access to only 25% of doctors compared to urban dwellers (Anand and Fan, 2016). The healthcare disparity between rural and urban communities of developing countries is a common challenge that nations are striving to reduce, but research reports show insignificant changes. Furthermore, the shortage of healthcare professionals is a common challenge which aggravates the healthcare inequality of most developing countries (WHO, 2010; Strasser et al., 2016). Figure 2 shows the global workforce and burden of disease.

Sub-Saharan Africa is the region with the lowest density of doctors and nurses and has the highest disease burden. The main cause of the shortage of physician is migration to the US and other countries because it is possible to earn high salaries in the developed world. For instance, *"as of 2006, there were almost as many Ethiopian physicians in the United States (542) as were practicing in the public sector in Ethiopia (638)*" (Berhan, 2008)[3].

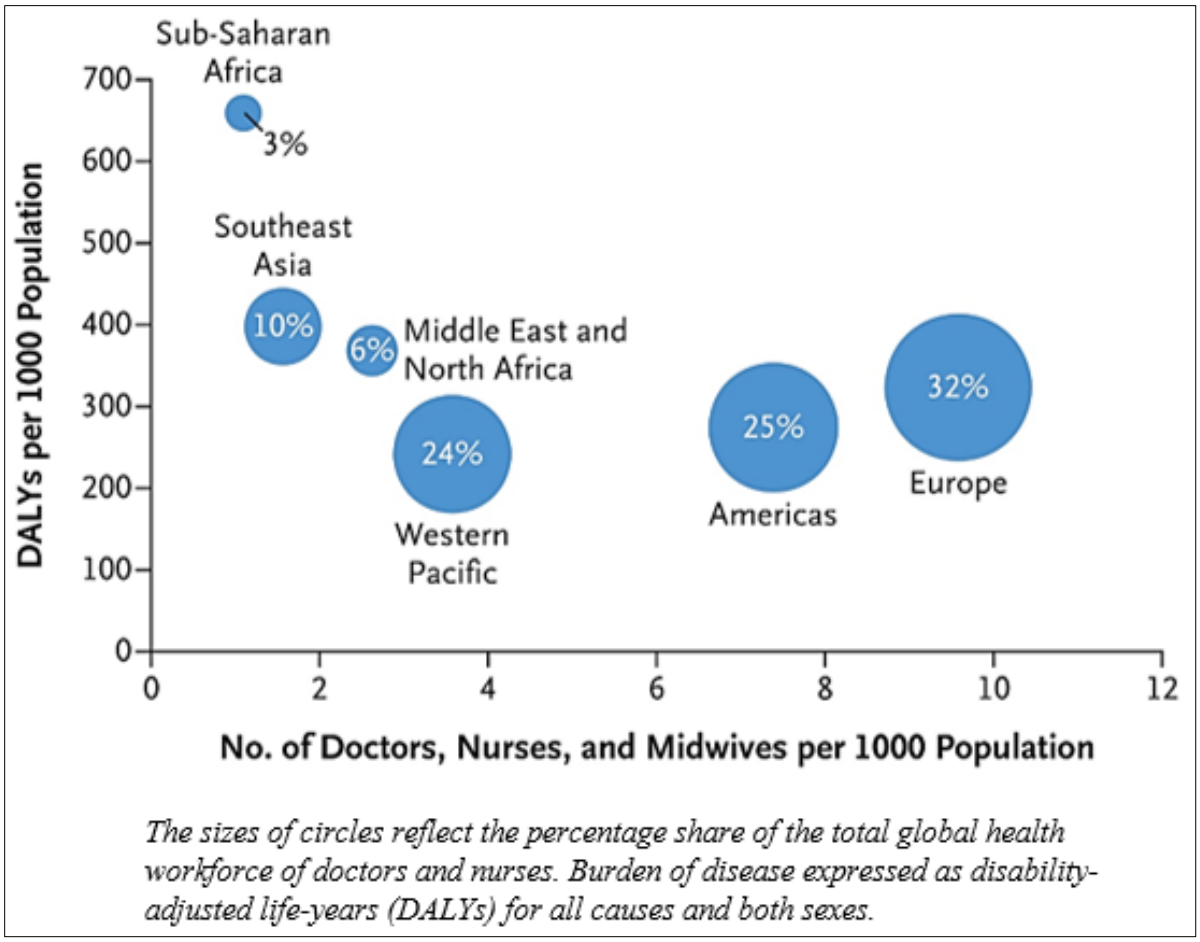

Figure 2: Global Health Workforce and Burden of Disease According to WHO Region (Crisp and Lincoln, 2014, p.953)

[3] There is no latest report.

According to Azikiwe (2009), there are more Sierra Leonean doctors working in the Chicago area than in Sierra Leon. The main migratory flows are from Egypt, South Africa, Nigeria, Kenya, Ghana and Ethiopia.

Globally, 400 million people do not have access to basic healthcare services (WHO and World Bank, 2015) due to spatial healthcare inequality. It is a cause for poor maternal, neonatal and antenatal healthcare in rural locations where mothers give birth in their homes without medical assistance, and are four times less likely to use contraceptives (Weis, 2017; Gebreyohannes et al. 2017).

2.2.1.5 Gender

Researches have shown that there is healthcare inequality between men and women. In the USA for instance, coronary heart attack is more common amongst men than women, (CDCP, 2011). In developed countries, women live longer than men (Fedotenkov and Derkachev, 2017), but women have higher morbidity and disability at older ages, poorer mental health, anxiety and depression, than men (Excellence, 2011).

According to Matthews (2015) the existence of gender differences in health and its inequalities are the outcomes of biological and social factors. These social factors are the cause of the higher mortality rate of men, as revealed in a study by Kivimäk et al. (2018) and include: their type of employment, risk taking behaviour; smoking and alcohol.

2.2.1.6 Environmental factors

Environmental factors such as natural disasters — floods, landslides, earth quakes, and storms— are becoming more common due to the effect of global warming. Apart from natural disasters, millions of people die every year from environmental factors such as air pollution, which is often the problem in urban areas. Other damaging environmental factors are carbon dioxide, lead,

asbestos, and industrial waste, which all create health disparities (Olanipekun and Babatunde, 2016); McKinney et al., 2015; CDCP, 2011).

Many parts of Ethiopia are affected by environmental factors such as desertification, deforestation, global warming, greenhouse effects, soil pollution and degradation, and industrial pollution (Gebru, 2016). As a result of this, communities in these areas are exposed to different types of diseases. For instance, according to Delil et al. (2016) 75% of the country and about 68% of the total population live in areas at risk of Malaria. Malnutrition caused by environmental conditions is also a major health problem in rural Ethiopia (Matariya et al., 2016). Hence, those communities need a mechanism for accessing healthcare services, for instance, by using a telehealth service.

2.2.1.7 Culture

In Ethiopia, according to Gebreyohannes et al. (2017), because of some cultural practices that may negatively impact healthcare access, antenatal services show poor performance. For example, there are food taboos during pregnancy; it is customary to give birth at home; and pregnant mothers from rural areas do not want to expose their private parts to male midwifes during antenatal care and delivery (Zepro and Ahmed, 2016; Yousuf et al., 2011). This has resulted in low use of antenatal care and delivery at health centres.

According to Mangham-Jefferies et al. (2014), the Health Extension Workers (HEW[4]) strive to create awareness on the removal of harmful traditional practices such as female circumcision (genital-mutilation) and under-age marriage. Three in four women, aged between 15-49, are

[4] "A new government program aims to improve the situation by employing 'health extension workers' to operate in rural communities. Already, over 30,000 women have been trained to work in 15,000 health posts throughout the country. Women are being chosen for health post jobs, because they are more likely to remain in rural communities with family ties and the care of children. Female health extension workers are given a year's medical training. Employed in rural areas, their focus is on prevention techniques, administering tests for HIV/AIDS and tuberculosis, and treating common diseases such as malaria. Antenatal care is also an important part of their training; the United Nations Children's Agency (UNICEF) estimates 60 women die every day in Ethiopia from complications related to childbirth" (FMoH, 2009).

circumcised (Gebremariam et al., 2016); and in rural parts of Ethiopia, under-age marriage is common (Erulkar, 2013). Although the healthcare awareness of rural communities, has improved, HEWs reported the resistance of communities to change, as they are keen to maintain traditional practices.

2.2.2 Healthcare inequality in Ethiopia

The federal government of Ethiopia has been working hard on healthcare service provision. However, like other developing countries, the healthcare service inequality in Ethiopia is a serious challenge that governmental and non-governmental organizations have been striving to address (Tranvåg et al., 2013; Tesfaye et al., 2017). Compounding factors are: the shortage of health facilities; highly dispersed settlements of rural communities; and poor road and transportation infrastructure (Berhan and Berhan, 2014; Deressa and Azazh, 2012).

The brain-drain is another challenge faced by Ethiopia—its medical specialists leave the country for better salaries in other countries (Foreman, 2013). According to WHO (2018), in Ethiopia there is one physician per 48 million people and one nurse per 12,000 people.

Although the country has been producing new medical graduates every year in its different universities, they emigrate to the USA and some rich African countries, such as Botswana (Deressa and Azazh, 2012; Siegel and Kuschminder, 2012). According to WHO (2014):

> *"the physician to population density of Ethiopia is 0.025/1000 which makes the country one of the countries with the lowest physician to population ratio in the world" (Johansson, 2014, p. 5).*

The healthcare inequality in Ethiopia is especially pronounced between rural and urban communities and is a serious challenge to the government.

The economic life of these rural communities is based on agriculture and they are settled in a widely dispersed manner (Baye, 2017). These widely dispersed settlements make it difficult to deliver basic services such as: healthcare, education, clean water, electric power supply, roads and transportation (Peng et al., 2014).

According to Mangham-Jefferies et al. (2014), Health Extension Workers (HEW) are playing a significant role in rural communities providing face-to-face teaching on disease prevention, family health services, health education, and environmental sanitation (see Table 2).

Table 2: Sixteen health packages of the health extension program (Mangham-Jefferies et al., 2014, p.2)

Family health	**Disease prevention and control**	**Hygiene and environmental sanitation**
Family planning	HIV/AIDS and STIs	Construction and maintenance of sanitary latrines
Maternal, new-born, and child health	Tuberculosis	Solid and liquid waste disposal
Nutrition	Malaria	Water supply safety measures
Vaccination	First aid	Control of insects and rodents
		Food hygiene and safety
		Personal hygiene
		Healthy home environment
Health Education and Communication (cross-cutting)		

In Ethiopia, wealth, the educational level of mothers, and region of residence are all factors that determine the level of healthcare of the community (Sullivan et al., 2010; Mekonnen et al., 2013). This section considered healthcare inequality, its causes, healthcare inequality in the developing world and healthcare inequality in Ethiopia.

Section 2.3 dealt with healthcare inequality, its causes, how it is experienced in the developing world, more specifically in Ethiopia. The next section considers how telemedicine could address this problem.

2.3 Overview of Telemedicine

Although three decades have elapsed since the Alma Ata's declaration of "*health for all by the year 2000*", the world has still not reached the target of worldwide healthcare coverage in terms of access, equity and quality of care (Shiferaw and Zolfo, 2012). The rapid world population growth, new disease incidences, and drug-adapting diseases have been bottlenecks for quality healthcare service delivery throughout the world.

Quality healthcare service delivery for all communities is a challenge and researchers and institutions have been struggling to determine how to achieve it.

Following the drastic growth of information and communication technologies (ICTs) during the last two decades, various information systems have been used to assist the healthcare system in the management of data, communication and decision-making processes. Since ICT is supporting the healthcare system to create better healthcare coverage and to access specialists who are concentrated in the big cities, even developing countries (like Ethiopia) have been using this technology to save lives and improve the health outcomes of patients in rural areas.

In this technology-dependent age ICT has the potential to support healthcare systems and improve its delivery. According to Ebenezer Afarikumah (2014), accurate health information and effective communication are vital components for disease monitoring and prevention. As coined by this researcher, ICT is a powerful tool in controlling disease outbreaks, and can improve individual health and healthcare services. This is achieved by using ICT to exchange information about diseases, drugs, and finance, as well as the training of healthcare workers, anytime, anywhere, easily and quickly. These electronic systems have been deployed in several nations to strengthen healthcare services irrespective of their distances from those service providers who need support (American Telemedicine Association, 2012).

Since the first use of ICT in the healthcare industry, new terms have been introduced to express these integrated services: Tele-Medicine, Tele-Health, and e-Health. The term "*telemedicine*" derives from the Greek word "*telos*" meaning "*at a distance*" and the Latin word "*medicus*" meaning "*medical treatment"*. Literally, it means medical service delivery at a distance (Doshi et al., 2008).

Most definitions stem from this literal meaning:

- Hein (2009) defines telemedicine as the use of information technologies to exchange health information and provide health care services across geographical, time, social, and cultural barriers.
- El-Mahalli et al. define telemedicine as healthcare services that can be provided from distance including diagnosis, treatment, prevention, education, and research (El-Mahalli et al., 2012)
- The World Health Organization further expands the definition as

"the delivery of health care services … using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, and for the continuing education of health care providers" (WHO, 2010, p. 9).

- According to the American Telemedicine Association (ATA, 2012), telemedicine is the application of electronic means to improve a patient's health status from a distance particularly in remote areas.
- Similarly, Combi et al. (2016) strengthen the definition of telemedicine as health ICT that enables remote specialists to interconnect with on-site healthcare workers to provide diagnosis and treatment support.

Telemedicine is the clinical application of telecommunication technologies to provide medical services from distance (Wicklund, 2016) while telehealth which is a broader term that covers more of non-clinical services such as healthcare training, medical education, administrative services and telemedicine itself (AAFP, 2019). Tele-monitoring is a term used for technologies that enables remotely managing patients specially for used for patients suffering from chronic illnesses such as

cardiopulmonary disease, asthma, and heart failure at the home (Meystre, 2005). Tele-care is a term used for providing remote care for physically disabled and elder people so as to allow access the care and reassurance they needed at home (Perez et al., 2018).

For the sake of this study, tele-medicine is defined as *the application of ICTs to provide healthcare services to distant localities in order to reach underserved localities and mitigate healthcare inequalities.*

2.3.1 Historical background of telemedicine

Although it is difficult to trace the exact date when telecommunications were first applied in healthcare systems (Morilla et al., 2017), the concept may have originated centuries ago. For instance, bubonic plague information was communicated throughout Europe by heliograph or bonfire in the same manner as it was applied for famine and war (Shore and Yellowlees, 2018). Similarly, the early African villagers used smoke signals to indicate incidence of serious disease. This smoke signal also warns communities to get out of the village (Verulkar and Limkar, 2012).

Physicians were among the principal users of the telephone, by the year 1900. It has served as the backbone of medical information communication. During World War I, radio was used to transfer medical information from isolated localities. Moreover, during the Vietnam and Korean wars, radio was utilized to communicate with the medical staff (Fazal, 2014). According to these authors, one of the first endeavours to solve the time and distance barriers was telemetry research and this development was carried out by the National Aeronautics and Space Administration (NASA) during its space-flight program. The telemetry set-up on earth could monitor astronauts' health conditions in space.

The innovation of television, by the late 1950s, brought significant advancement in the history of telemedicine. Healthcare professional were able to use interactive video links using televisions. This demonstrated to researchers the possibility of distant diagnosis via interactive television. The first major set of telemedicine programs were initiated in the 1970s in the USA (Kruse et al., 2016)

Typical telemedicine communication involves a bidirectional (two-way) communication between two or more stations with medical professionals exchanging information, using both store-and-forward and interactive methods to share health information. Medical consultation uses multimedia formats i.e. video, image, audio, text, and animation/simulation. The introduction of the Internet brought radical change in the history of healthcare services because of its improved accessibility, but more importantly quality of service (Kauer et al., 2014; Unützer et al., 2012).

With the introduction of contemporary ICTs, for example computers, the Internet, and cell phones the way people are exchanging information is being transformed (WHO, 2010). The incredible popularization of the Internet has been the basis for supporting healthcare systems using such technologies. This has allowed telehealth practices to propagate, in various ways, throughout the world (WHO, 2010).

2.3.2 Forms of telemedicine

With the primary purpose of saving the lives of people, telemedicine can be delivered using two forms of transmission (see Figure 3).

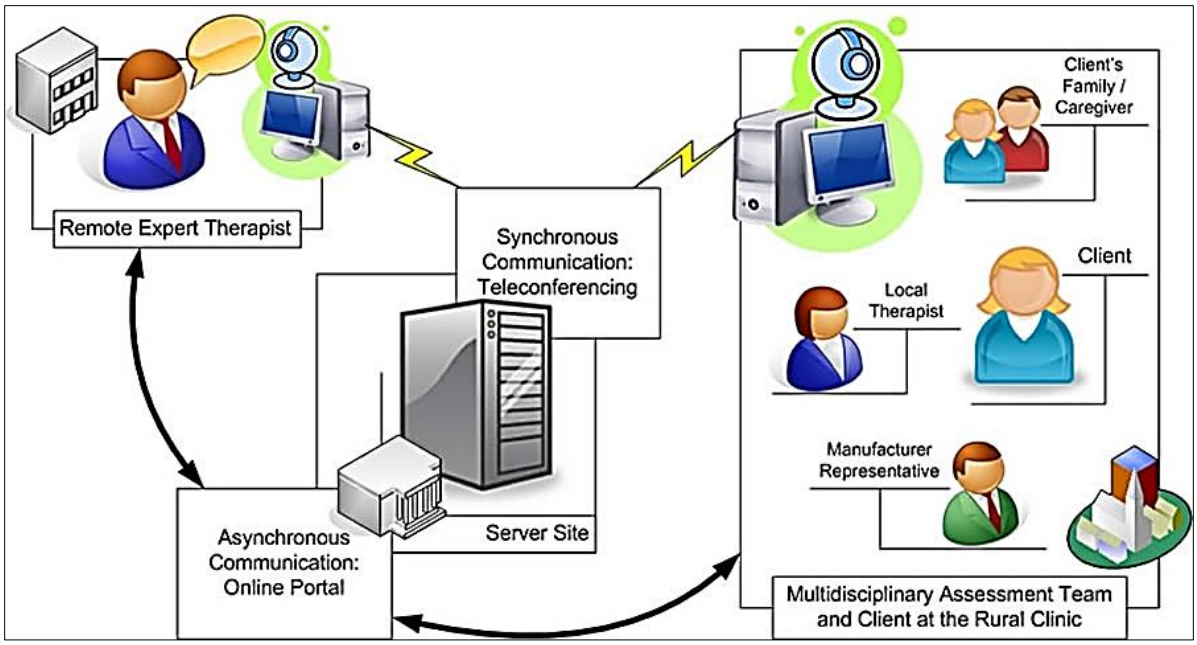

Figure 3: Synchronous and Asynchronous Telemedicine Transmissions (Saptono et al., 2007 p.3)

The first one is store-and-forward or asynchronous transmission, by which images are communicated electronically to a consulting specialist through email or web-based interfaces (Maarop et al., 2011). It is a mode of transmitting the recorded health history of patients to healthcare service providers such as physicians or nurses, to treat the patient, using the recorded information outside of real-time. This type of transmission is often practiced between a primary care provider in a rural area and a consultant in some other location. There are five steps that asynchronous transmission follows. They are (see Figure 4):

1. A patient is examined,
2. Data is sent electronically,
3. Specialist analyses the examination by retrieving data from the telemedicine server,
4. Findings become available and the requesting physician continues treating the patient.

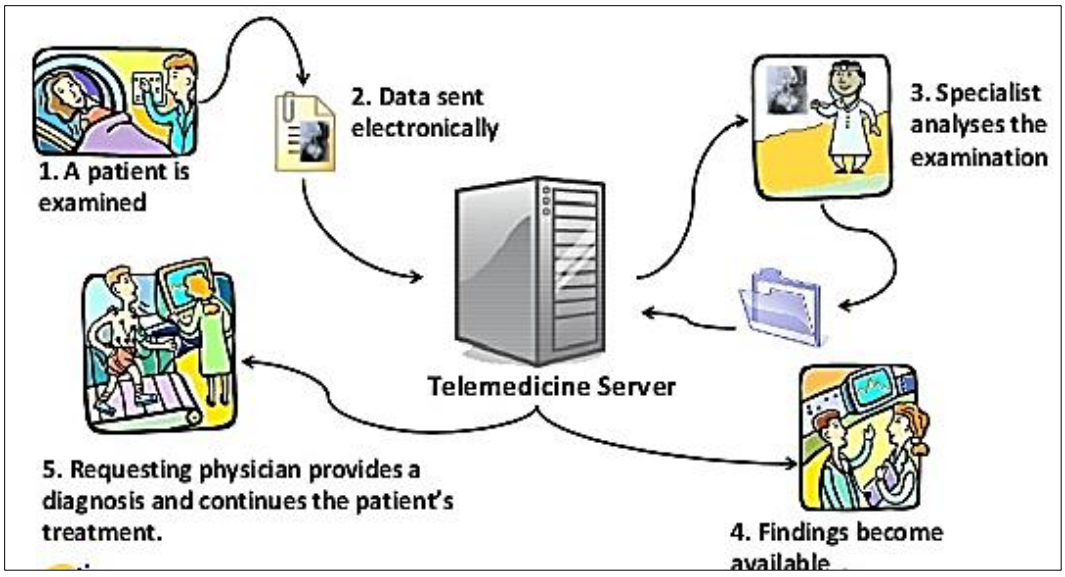

Figure 4: Asynchronous (Store-and-Forward) Telemedicine (Buglione, 2017 P.9)

The second form is "real-time" or video-conferencing or synchronous transmission, by which the medical healthcare worker and the patient meet concurrently but in different locations throughout the world (Kiah et al., 2014). This type of live video-conferencing is a two-way interaction between a healthcare provider and a patient by using audio-visual technologies.

In addition, according to Desai et al. (2010), there is a hybrid form of transmission that integrates the above two forms, which is designed to increase diagnostic reliability.

Which of these different forms of telemedicine is applied depends on the available infrastructure and the need of institutions which have differing healthcare levels? For example, inter-institutional i.e. the exchange of patient and clinical records and databases between health facilities. Tele-education services are often used providing in professional education for medical staff members as well as public education. Moreover, tele-monitoring and tele-care are being used for remote home care and emergency cases (Challa, 2013).

The form of connection between two or more telemedicine users who are not in a common physical location can be (a) professional-professional, (b) professional-professional-patient, and (c) professional-patient (Castro et al., 2014).

2.3.3 Benefits of telemedicine

Governments are aware of the potential of telemedicine in supporting the healthcare system. Especially in the developing world, telemedicine is supposed to play a significant role in the support of communities suffering from a shortage of healthcare workers and health facilities (Kamsu-Foguem and Foguem, 2014). According to the Sub-Saharan African Medical Schools Study (SAMSS) (2010), in the Sub-Saharan Region, there are fewer than 13 physicians for every 100,000 people; in Ethiopia there is just 1 physician for every 48 million people (WHO, 2018). In addition, in Ethiopia, majority of the health specialists and all the better health facilities are only found in the big cities. Consequently, rural people, and that means most of the SSA population (Gajewski et al., 2017) as well as the population in rural areas of Ethiopia, do not have access to specialized medical personnel and better health facilities. In African countries, the problem is aggravated by road and transportation challenges.

However, by understanding the capacity of ICT, researchers and organizations have been working to integrate ICT with the healthcare system so as to improve healthcare coverage (Shiferaw and Zolfo, 2012) As a result, and to evaluate their effect, various telemedicine pilot projects have been established throughout the world. For instance, in Africa, telemedicine projects have been set up in Mozambique, Uganda, Senegal, Kenya, and Ethiopia (Hailemariam et al., 2013).

The benefit of telemedicine especially for isolated communities, localities with poor road and transportation, and a scarcity of medical workers and facilities, is multifaceted. According to Jones at al. (2013), telemedicine enables improved access to primary and secondary healthcare services.

As stated by Hwang et al., (2018), telemedicine can be utilized to offer clinical services, distance education (e-learning), tele-monitoring and peer-support for health workers. Moreover, better health quality, time and cost effectiveness, improved accessibility to healthcare workers can be obtained from the use of telemedicine (Mars, 2013; Fichman et al., 2011).

Most literature emphasizes that the primary benefit that telemedicine can create is access to variety of healthcare services, particularly for distant communities (Shiferaw and Zolfo, 2012). This in turn enables distant medical personnel to diagnose, evaluate and track health condition of patients (Serper and Volk, 2018). This potential of telemedicine, as stated by Ly et al. (2017), has resulted in the recruitment and retention of physicians.

The other most important benefit of telemedicine is its ability in reducing the number of referrals to off-site services (Russo et al., 2016) which consequently mitigates the distance travelled by patients and healthcare providers; reduces cost and leaves time to extra work (Ebad, 2013).

In addition, the introduction of such technology is removing geographical barriers (Kruse et al., (2018) and has created collaborative work between countries so as to improve the lives of people. As a result, distance learning and continuous training are being provided to remote localities and healthcare workers (Bagayoko et al., 2014). This inspires rural healthcare providers to stay there in their rural areas because they have access to professional development and assistance (Bonney et al., 2015).

Telemedicine enables better utilization of medical resources like equipment, labs, and pharmacies. This enhances the services of hospitals and reduces outsourcing (Ebad, 2013). As pointed out by Saleh et al. (2015), this in turn helps in the effective mobilization of healthcare provision particularly in cases of disease outbreaks.

Furthermore, telemedicine is improving the quality of life of and services to people. For instance, patients suffering from chronic diseases have found telemedicine a suitable service (Salisbury et al., 2015) because they usually do not want to travel from one location to another to check their health condition periodically. Currently, these kinds of patients need systems that remotely monitor their health status. One obvious help of telemedicine has been to deliver tertiary care and to allow patients to look at their earlier treatments (Di Cerbo et al., 2015).

Sharing the experiences of specialists is found to be critical for remote localities that suffer from a shortage of experienced healthcare worker (Ly et al., 2017).

2.3.4 Challenges of telemedicine

Although telemedicine has been implemented in various countries to save and improve the lives of people, there are several challenges that health institutions are facing. The effect of these challenges in developing countries has resulted in underdeveloped telemedicine service provision. These challenges are broadly associated with a country's socio-economic, technological, and organizational issues.

It is obvious that the advancement of technology in the developing world is too slow as compared to the rest of the world. However, due to the wide application of ICTs for the past three decades, dramatic changes have been observed. Technological barriers that have been hindering telemedicine, according to Shiferaw and Zolfo (2012) include low band width, lack of reliable Internet, accessibility problems, poor tele infrastructure, expensive telecommunication cost and unreliable electrical power supplies (Karunaratne, 2018). These are the common challenges observed in many African countries.

Furthermore, telemedicine has been facing human and organizational challenges (Mars, 2012) such as shortage of staff in remote areas, overburdened health workers, a lack of awareness, a

shortage of specialists, poor user acceptance by health workers (Mars, 2013), a shortage of health facilities, poor road and transportation, a lack of e-readiness and scarce financial resources (Machira and Palamuleni, 2018).

The biggest technological challenge is the "digital divide" which is the difference between people who have and use ICTs and those who do not. It is a constant problem for developing countries where the penetration of the Internet is extremely low. Consequently, the potential of telemedicine to reach a large number of rural communities is limited (Afarikumah, 2014). Since ICT is the backbone of contemporary telemedicine, access to services that can improve as many people's lives as possible is unlikely unless there is ICT readiness. However, many countries have been challenged by poor ICT infrastructure (Karunaratne, 2018).

In line with this, uneven and unreliable Internet service distribution is a common challenge in developing countries. Even the available Internet connection in many African countries has limitations in bandwidth (Nyirenda-Jere and Biru, 2015) which restricts the exchange of large telemedicine data quickly especially in a store-and-forward mode of telemedicine. Besides, low image quality, for instance in the case of X-rays, constrains physicians who need to make the right decision, unless there is sufficient bandwidth (Afarikumah, 2014).

Moreover, health and technology literacy limitations in some telemedicine sites aggravated the problem (Afarikumah, 2014). Consequently, countries have been unable to fully utilize the potential of this technology. Besides, physicians who lack motivation and a slow acceptance of the technology, have limited the benefits of telemedicine services (Ly et al., 2017). According to Desai et al. (2010), the lack of motivation is mostly the result of an absence of reimbursement for physicians. Likewise, unqualified healthcare workers in rural areas and an inability to train them earlier, has intensified the problem (Ebad, 2013).

Furthermore, an absence of suitable regulation policies, and cultural obstacles are threatening the implementation of telemedicine (Mansouri-Rad et al., 2013). Even the information security, privacy and licensure issues are problems in the developing world (Garg and Brewer, 2011).

Research findings show that the main challenges of telemedicine service provision are related to the socio-economic aspects of countries (Hooshmand and Yao 2017). For example, an inability to afford telemedicine infrastructure, a shortage of trained manpower, a lack of acceptance of the technology by medical workers, and a lack of awareness are frequently mentioned problems.

2.3.5 Telemedicine infrastructure

In order to attain the multifaceted benefits of telemedicine, the availability of an appropriate ICT infrastructure is one of the main requirements. The common telemedicine infrastructure encompasses technical, economic and social aspects.

Even though technical infrastructure requirements vary based on the type of telemedicine services they offer, according to HealthIT (2014), most telemedicine programs require the following:

1. *Access to Broadband Internet Connection:* access to sufficient bandwidth to transmit audio-visual data is required though this is a challenge when it comes to connecting with rural health service providers. Telemedicine service providers often face the difficulty of getting reliable and affordable broadband connection
2. *Imaging technologies or Peripheral devices:* service providers use various devices to record, process, transmit and store data between the sender and he receiver. These devices need to have good quality. Telemedicine service providers use, for instance, digital stethoscope to transmit lung and heart sounds to remote providers.
3. *Access to technical support staff:* appropriate technical support staff is required to run and maintain telemedicine systems.

4. *Staff training:* the provision of training for all staff members involved in the telemedicine program is required. In order to enhance efficiency and reduce errors in telemedicine service provision, well-trained staff is required.

Most developing countries complain about the affordability of telemedicine as they are fighting against economic problems. As stated by Kruklitis at al. (2014) the initial cost of establishing telemedicine is high because the modern mode of telemedicine, for instance video-conferencing, needs the latest high specification equipment. However, as compared to the potential of this technology has in saving the lives of people, countries should be motivated to invest in it. After all, "how much does a life cost?" Countries which invest generously in the health sector to improve the health of their citizens, have a healthier work force and this in turn allows them to effectively achieve the economic growth that they want.

The telecommunication infrastructure is the circulatory system of a country. The transmission of still-images or videos requires broad band transmission to exchange a lot of data within a short period of time between a health worker and a specialist who interprets images and videos so as to prescribe drugs or to make further decisions.

The reliability of the Internet is another precondition of the current telemedicine systems. Within the healthcare system Patient-to-professional, patient-to-patient, professional-to-professional communications are increasing exponentially. Many hospitals are currently using the Internet to get interconnected with their patients or other hospitals; because of the Internet, the use of social media and some application software that support video-conferencing and store and forward forms of telemedicine, does not require large investments in expensive equipment. Besides, mobile phones are a valuable part of the healthcare system. However, a reliable and strong Internet connection and a reliable electric power supply are mandatory.

Both patients and healthcare workers spend much of their free time on mobile phone services for healthcare purposes (Ventola, 2014). Nowadays, especially in the developed countries, it is common to see pregnant women, sports persons (Peart et al., 2019), healthcare professionals, and patients install application programs on their mobile phones that check their physical condition and allow them consult their physician (Goetz et al., 2017).

2.3.6 Telemedicine in the developing world

Since developing countries are characterized by many socio-economic problems, they bear the majority of the world's disease burden such as malaria, HIV/AIDS, respiratory and diarrheal diseases. For example, according to Scott and Mars (2015, p) "Africa is home to 14% of the World's population, and still struggles with 24% of the global burden of disease (GBD), and yet is served by just 3% of the world's health workers with access to merely 1% of world health expenditure".

Poor infrastructure, shortage of skilled manpower and lack of health facilities aggravate the problem and result in the highest maternal and child mortality rates in these countries.

To reduce health problems, different types of programs have been implemented in different countries. Telemedicine was one of these programs established to deliver healthcare services from a distance, especially for communities that are very far from health facilities (Ciancio, 2014).

Telemedicine is an innovative solution that interconnects communities to shared health facilities and healthcare providers, to improve healthcare service provision, especially in resource-constrained localities. According to Ajiboye et al. (2014):

> *"…telemedicine may in fact have a more profound impact on developing countries than on developed ones. Satellite stations in Uzbekistan, wireless connections in Cambodia, and microwave transmission in Kosova have shown that the low bandwidth internet can reach*

into remote areas, some of them with troubled political situations and uncertain economic environments" (Ajiboye et al., 2014, p. 557).

Telemedicine has been practiced in different developing countries to support their healthcare systems, especially for underprivileged communities (Eccles, 2012). For instance, in Botswana, tele-radiology and tele-dermatology (Desai et al., 2010); in Liberia, universal tele-radiology for paediatric services, the treatment of tuberculosis, and obstetrics care (Archer and Phil, 2016); in Haiti, disaster response and crisis maps via Twitter were utilized to manage the cholera outbreak (Kumar et al., 2011); in Peru, training and education through the Internet (Canchihuaman, et al., 2011); in the Philippines, Cambodia, and DR Congo, health self-management5 (Van Olmen, et al., 2013) ; in Afghanistan, tele-consultation between medical doctors for stroke patients (Mayar, 2013); in Kosova, video-conference based education for clinicians, medical students, and nurses (Latifi, et al., 2009); in Sri Lanka, remote tele-consultation with health specialist (Vatsalan, et al., 2010); in Kenya, India and South Africa, short message service (SMS) was used to provide education on how to prevent HIV/AIDS infection (Mbuagbaw et al., 2015); in Uganda and India, SMS was used for surveillance and tracking of malnutrition and malaria (Källander, et al., 2013); and in Tanzania, SMS was used for disease information management and patient monitoring (Källander, et al., 2013).

Moreover, according to Eccles (2012, p. 1), "in a world where income level, ethnic origin, and geographical location serve as primary determinants of people's access to health care, telemedicine constitutes a possible approach to overcoming many of the existing barriers to care".

[5] Health self-management is a mechanism that enables patients to keep records of their own case using technologies such as smart phones and online services.

The implementation of portable ultrasound facilities and tele-radiology have created better opportunities to access ultrasound services for resource constrained localities (Stanton and Mwanri, 2013). In Sub-Saharan Africa (SSA), there is huge healthcare access inequality between urban and rural areas. According to Stanton and Mwanri (2013), 30% of women in SSA urban areas get obstetric ultrasound services, however, it is only 6% in rural settings.

Even though developing countries are utilizing telemedicine for different purposes to increase healthcare access and coverage, researchers have reported common barriers that are hindering them. For instance, poor infrastructure, high cost, lack of technical expertise (WHO, 2010), unstable electric power supply, poor communication networks, poor Internet access in rural areas (Ciancio, 2014), and poor financing of telemedicine (Lewis et al., 2012).

2.3.7 Telemedicine in Ethiopia

Ethiopia is the second-most populous country in Sub-Saharan Africa with a population of 94.1 million in 2014 (World Bank, 2015). More than 84% of its population lives in rural areas which are difficult to provide with healthcare services.

In Ethiopia, four projects have been implementing telemedicine. The first one was initiated by International Telecommunication Union (ITU) project in 2003 (Mengesha et al., 2013). In 2005, Ethio-Indian Telemedicine Program (Pan-African E-Network) linked 10 hospitals; providing tele-dermatology, tele-radiology, and tele-consultation. The 2006 Johns Hopkins University telemedicine basically focused on HIV/AIDS prevention, treatment and rehabilitation. I-Tech Ethiopia (Swinfen Charitable Trust) is the latest and worldwide telemedicine application that focused on Ethiopia too.

There is an old but good tradition that has been practiced for centuries in Ethiopia that the majority of its people celebrate every year on November 12, according to the Ethiopian Calendar, locally

called “Hidar Sitaten” meaning “Fumigate November”. On this day, every community both in urban and rural parts of the country, destroy any dirty materials around their villages. The societies believe that if the dirty materials are left after this day, they cause communicable diseases. In the early morning of this day, villages are covered by smoke. Likewise, in some other African villages, smoke signals are used to indicate incidence of serious diseases. These communities have been using smoke as a traditional means of communication among communities.

The use of modern communication systems in Ethiopia began 100 years back during the regime of Emperor Minilik II (1889 – 1913) who introduced electricity, telephone, telegraph, cinema, public schools, the printing press, and hospitals for the first time in Ethiopian history (Ejigu, 2014). Although the emperor was passionate about the use of such technologies, people around him resisted the acceptance of such technologies; and called the Telephone “Creature of Satan”. Similarly, it has been 6 decades since Ethiopia began Radio which was in 1941 and Television 1942. Gradually, these communication systems have been used in the healthcare system too.

In Ethiopia, the introduction of telemedicine as a stand-alone program was established by International Telecommunication Union (ITU) TM project in 2003 (Mengesha et al., 2013).

The other telemedicine project in Ethiopia was initiated by the Ethio-Indian Telemedicine Program (Pan-African E-Network) in 2005. This project interconnected selected telemedicine sites in Africa with the main telemedicine service provider in India. With the help of the African Union in the selection of sites from its member states, telemedicine was established in selected states. Since Ethiopia has been the seat of African Union and satisfied the selection criteria, ten public hospitals were interconnected to Tikur Anbessa Hospital, as shown in Figure 5 below, providing tele-dermatology, tele-radiology, and tele-consultation (NTCC, 2009).

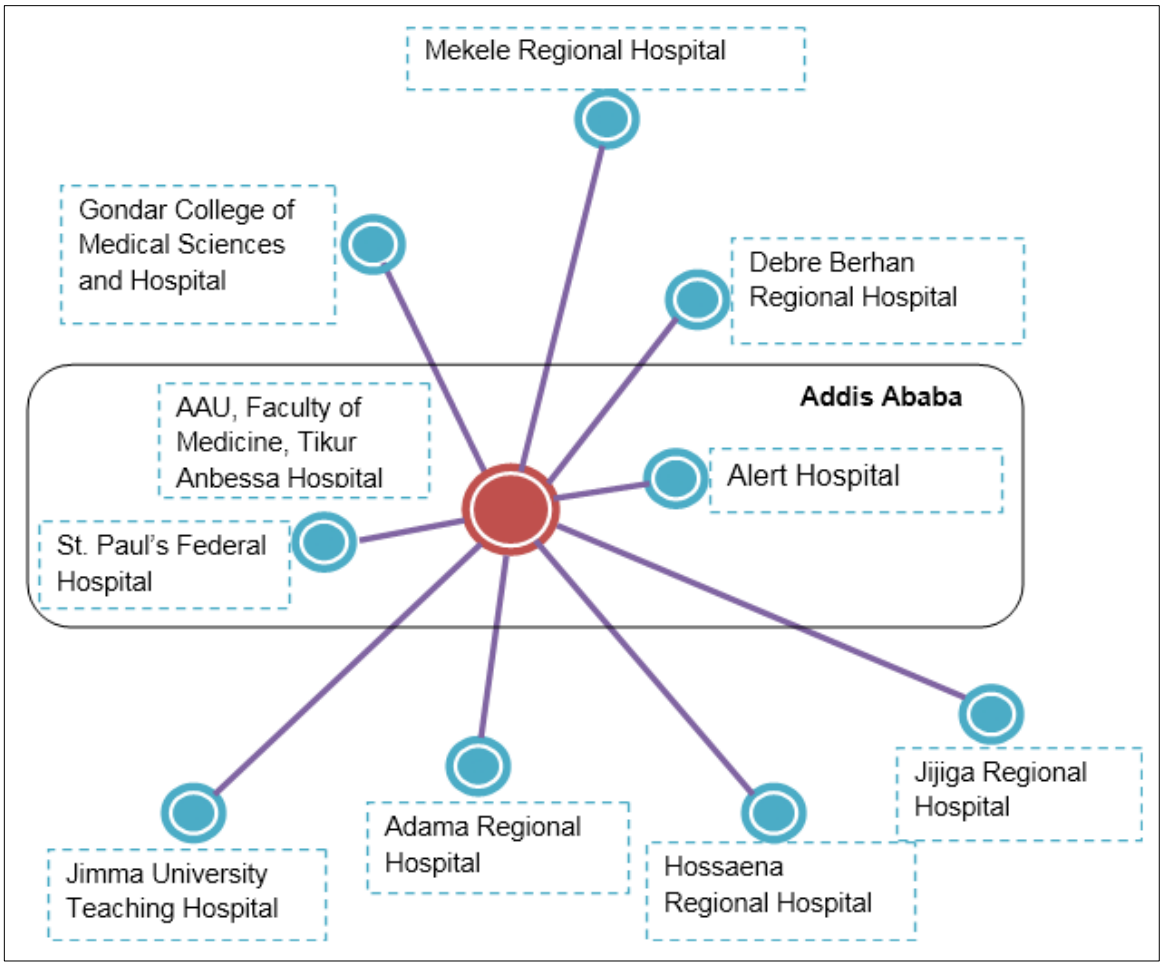

Figure 5: Hospitals included in the first Ethiopian Telemedicine project (Pan-African eNetwork, 2009, P.7)

Since medical specialists are mainly found in Addis Ababa, the capital city of Ethiopia, tele-radiology and tele-dermatology have been practiced at Tikur Anbessa (Black Lion), Alert, Zewditu Gonder, Jimma, Nekemte and St. Paul hospitals. A physician in Jimma hospital can use the Internet to communicate and access consultation services with specialists in Wolisso and Metu Hospitals (Pan-African e-Network, 2009) (see Figure 6).

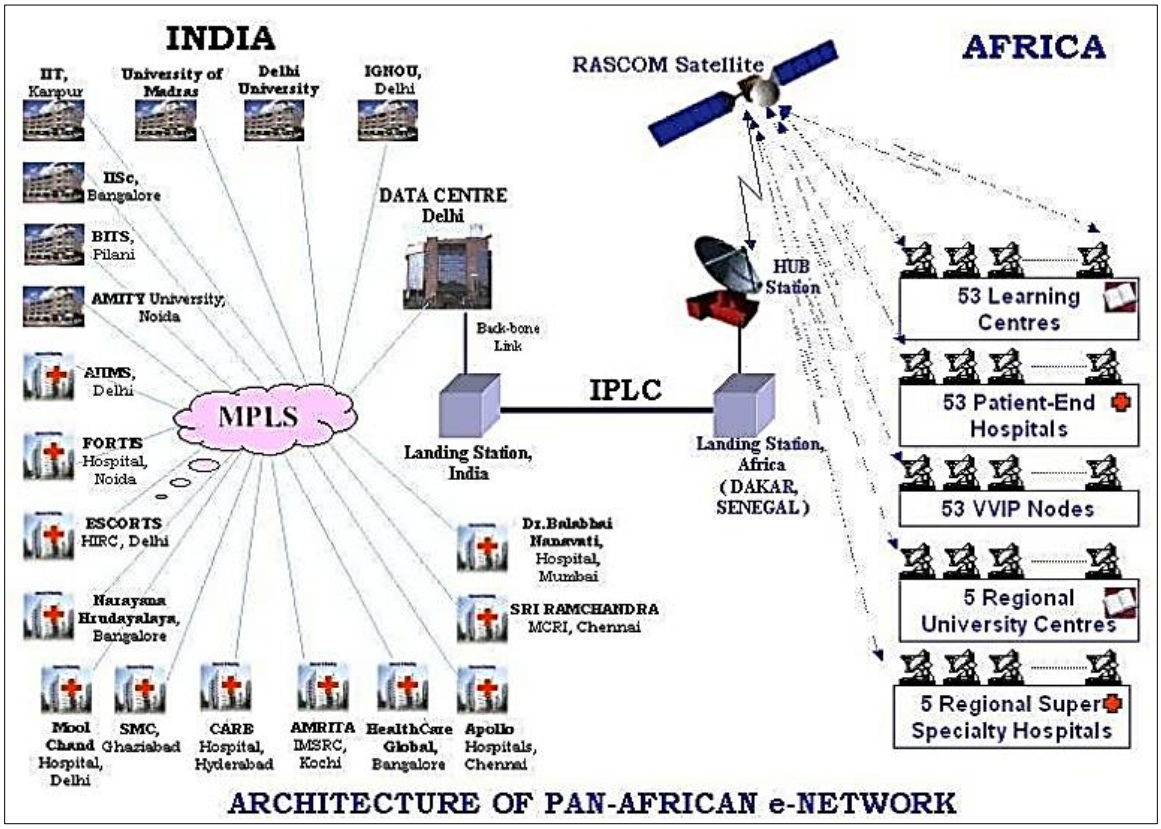

Figure 6: Architecture of Pan-African e-Network (Pan-African e-Network, 2009, P.9)

The basis of the 2006 Johns Hopkins University telemedicine project was to focus on HIV/AIDS prevention, treatment and rehabilitation. Having its centre in the USA, it has been working at two locations in Ethiopia namely, Black Lion Referral Hospital located in Addis Ababa and Hawassa Hospital located in Southern Ethiopian (Hawassa town). This telemedicine service uses the real-time type of telemedicine through video-conferencing. It provides medical and consultation services for medical professionals, medical students, and patients. The program is known as

Technical Support for the Ethiopian HIV/AIDS ART Initiatives (TSEHAI). Every week, physicians from Hopkins, Eastern Carolina University, and the Mayo Clinic meet in a virtual space to discuss real cases with health service providers working in clinics across Ethiopia (Howard, 2011). The TSEHAI program works in four regions of Ethiopia—Addis Ababa; Benishangul Gumuz; Gambella; and the Southern Nations, Nationalities, and People's Region (see Figure 7).

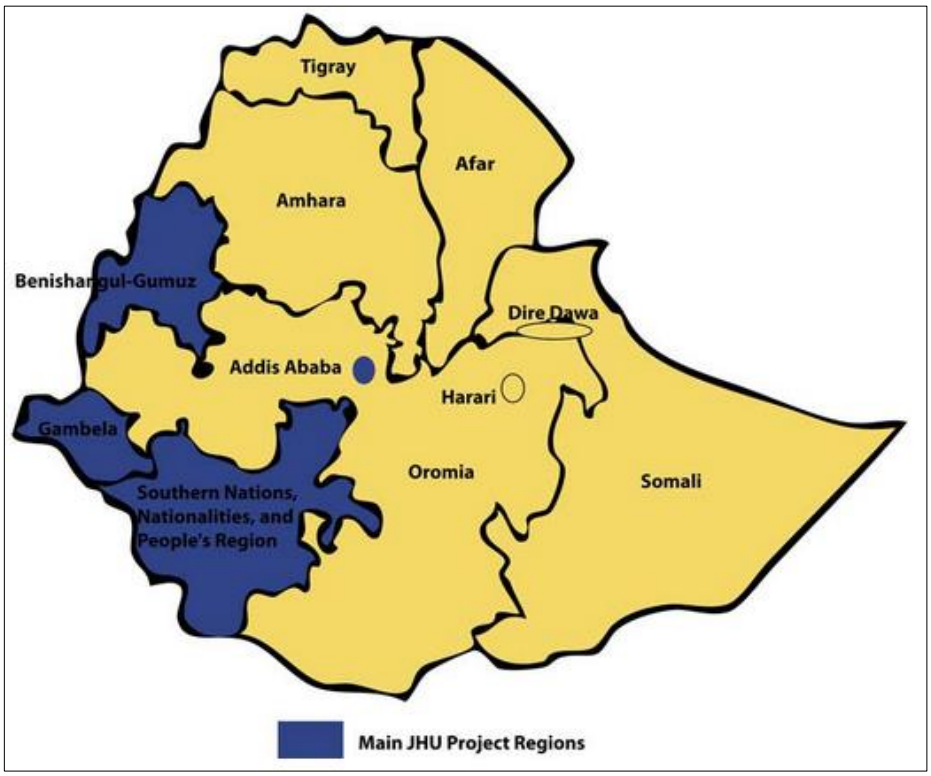

Figure 7: TSEHAI Program (Howard, 2011, P.14)

After the Pan-African eNetwork initiative, healthcare providers have recognized the benefits of telemedicine and additional telemedicine service providers have been connected with hospitals.

Currently, the Swinfen Charitable Trust, established in 1998 to provide support in the developing countries that are using medical specialists via telemedicine, has telemedicine links with Ethiopian hospitals: Adventist Mission Hospital, All Africa Leprosy, TB and Rehabilitation Training Centre (ALERT), Black Lion Hospital, and Mekele Hospital (Wootton et al., 2013).

The other tele-education and telemedicine service provider in Ethiopia is I-TECH Ethiopia. I-TECH is an international network working with Ethiopian collaborators to build the capacity of healthcare workers and strengthen the national health systems in resource constrained localities (I-TECH, 2015). Currently, Mekele University is utilizing this technology well. I-TECH has continued to construct its additional telemedicine site at the medical school of Bahir Dar University.

These telemedicine implementations have created awareness and motivated healthcare workers, policy makers and technology experts. Hence, basically telemedicine benefits in developing countries, like Ethiopia; because 80%, which is more than 75 million, of the Ethiopian population lives in rural areas, where basic healthcare is inaccessible.

2.4 Telemedicine evaluation

Although telemedicine has been playing a significant role in medical health services, there is a lack of clear evidence concerning its effectiveness in reducing healthcare inequalities (Dinesen et al., 2016). Also, a lack of well-evaluated approaches for telemedicine, that considers contextual aspects, has been a challenge for decision-makers and policy formulators. According to Khoja et al. (2013), although various telemedicine projects have been remarkable in their demonstrations of fundamental feasibility and safety issues, most of them have not been guided by systematic evaluation frameworks. They limitation of an evaluation framework to assess the effects of this technology on healthcare service provision to communities in such a way as to reduce healthcare inequalities. Besides, the primary objective that a telemedicine investigation has, is to ensure that the most appropriate technology is being utilized in the most effective way (Mehrotra et al., 2016).

The dictionary definition of evaluation is “an act of measuring quality characteristics”. Based on this basic definition, the term has been customized for various purposes. As it was stated by Barker

(2014), evaluation is “systematic investigation to determine the success of a specific program”.

Evaluation does not only focus on outcomes but should also seek to reveal insights from the program implementations and the context in which they operate (Peersman, 2014). When the term is used in the healthcare setting like telehealth, it is defined as

> *"The act of measuring or exploring properties of a health information system (in planning, development, implementation, or operation), the result of which informs a decision to be made concerning that system in a specific context" (Hovenga and Kidd, 2010, p. 242).*

Thus, telemedicine evaluation is a systematic technique of gathering, analysing, and using data to answer questions about the effectiveness and efficiency of telemedicine programs. Telemedicine evaluations are most often carried out to confirm that objectives are met; to identify strong and weak sides; to deliver data to help future development; to provide evidence of the benefits and impacts of the telemedicine program; and to position the telehealth program within current services and research settings. Moreover, according to (Agboola et al., 2014), the evaluation of telehealth programs plays a significant role for several policy objectives such as (1) assessing the success or failure of the telehealth programs objectives; (2) determining the availability of a better alternative mechanism to achieve the same objective; (3) ascertaining the existence of unwanted effects; and (4) making informed policy decisions (Agboola et al., 2014).

2.4.1 Telemedicine evaluation types

Since evaluation results that come out of qualitative studies are important in showing new insights, (Sutton and Austin (2015), it is highly recommended to apply different types of telemedicine evaluation to telemedicine programs. Evaluating the telemedicine practices enables project developers and healthcare workers to measure the extent to which targets are being achieved,

identifying the causes that hamper or facilitate their realization, and to formulate a framework for its future use.

According to Agboola et al. (2014), the type of telemedicine evaluation used depends on the project phase, that includes planning, implementation and impact assessment (see Figure 8).

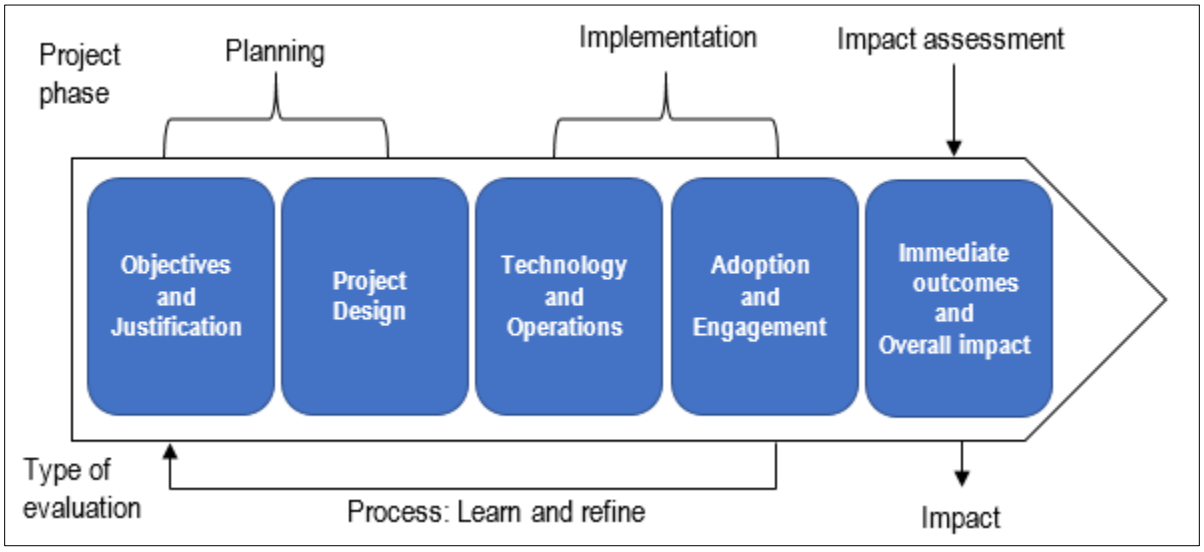

Figure 8: Telehealth Program Pathway (Agboola et al., 2014, p. 6)

The focus of this research is on the evaluation of telemedicine programs which help to evaluate immediate outcomes and the overall contribution of those programs on the healthcare system in Ethiopia.

Hence, based on the development stage and measurement feasibility of telehealth programs, there are four mainly used types of evaluations: (1) evaluability assessment, (2) documentation evaluation, (3) process or formative evaluation, and (4) summative or outcome evaluation (Agboola et al., 2014) (see Table 3).

1. **Evaluability assessment:** is a type of assessment conducted prior to or at the commencement of a telehealth program. It should clearly state the objectives and expected outcomes of the

project. Determination of research design, measurement tools and data collection instruments, and analysis strategies are done in this type of evaluation (Agboola et al., 2014).

Table 3: Types of Telehealth Evaluation (Agboola et al., 2014, p. 3)

Type	**Definition**	**Key features and uses**
Evaluability	Assessment conducted prior to or at the beginning of a program to make explicit the goals and objectives of the program and intended effects or outcomes	Frame research question
		Determine research design
		Identify measurement tools and data collection methods
		Determine analytic methods
Documentation	A narrative description of the implementation of the program	Description of procedures and protocol used
		Description of difficulties encountered
		Description of steps taken to address barriers to implementation
		Identify successful strategies to dealing with barriers
		Enable others to reproduce the program in other settings
Formative or process	Evaluation focusing on the effects of the program on the process of care	Behavioural and attitudinal changes related to program adoption and use
		Identify barriers to adoption and use
		Resolve workflow integration issues
		Identify technical problems
Summative or outcome	Provides evidence of the intended effects of the program.	Robust evidence of program effects
		Identify benefits of a program
		Provide evidence to decision makers and policy makers of a program's benefits

2. **Documentation evaluation:** This type of evaluation is a narrative description of the implementation of the program. Most often it includes description of procedures and protocol used, difficulties encountered, steps taken to address barriers to implementation, successful strategies to dealing with barriers, and how to enable others to reproduce the telehealth program in other settings (Agboola et al., 2014).

3. **Formative evaluation:** When applied to a telemedicine assessment, the goal of formative evaluation is to monitor telemedicine practices in order to provide feedback that can be used by health organizations to improve their services. It is an ongoing process evaluation that focuses on the effects of the program on the process of care. According to (Agboola et al., 2014), a formative evaluation includes behavioural and attitudinal changes related to the program adoption and use, identifying barriers to adoption and use, resolving workflow integration issues, and identifying technical problems.
4. **Summative evaluation:** On the other hand, many researches use summative evaluation at the end of a program or project in order to assess general trends and specific descriptions. Summative evaluation has the goal of assessing, for the purpose of this study, a telemedicine facility at the end of a project in order to understand its outcome in line with the target. Summative evaluation is further divided into impact evaluation, outcome evaluation, cost-effectiveness or cost-benefit analysis, secondary analysis, and meta-analysis.

According to (Agboola et al., 2014), summative evaluation is carried out to provide evidences on the intended effects of a telehealth program for decision and policy makers.

2.4.2 Telemedicine evaluation frameworks

A number of telehealth evaluation frameworks have been proposed by researchers on the basis of different factors. For example, the absence of a universally recognized standard, differing weaknesses of current methodological appropriateness, and restricted coverage of evaluation focuses (Chang, 2015). Consequently, each of these evaluation frameworks has its own shortcomings. For a comprehensive summary of existing telehealth evaluation frameworks (see Table 4).

Table 4: Summary of Telemedicine Evaluation Frameworks

Constructs	**Author**
Human (Service provider and patient/client) System (Organization and technology) Environment (Society and rules and policies)	*Chang (2015)*
A framework for delivery design, implementation, and evaluation of telehealth services	*Nepal et al. (2014)*
Telemedicine Maturity Model	*Van Dyk (2013)*
Preceding assessment (purpose of telemedicine application, relevant alternatives, international, national, regional or local level assessment) Multidisciplinary assessment (health problem and characteristics of the application, safety, clinical effectiveness, patient perspectives, economic aspects, organizational aspects, socio-cultural, ethical and legal aspects) Transferability assessment (cross-border, scalability, and transferability)	*Dyrvig et al. (2014)*
Patient control, Clinician quality of care, Organization sustainability, and Technology capability	*Dattakumar (2013)*
Health service outcomes, Technology outcomes, Affordability and cost effectiveness, Social and behavioural impact and Ethics	*Khoja et al. (2013)*
Functionality (Consultation, diagnosis, monitoring, mentoring) Technology (Modes, network design, connectivity) Applications (Treatment modalities, medical specialty, disease types, sites)	*Bashshur et al. (2011)*
Telemedicine capabilities, Social outcomes, Social values, ICT policy, e-health policy, Data security and ICT infrastructure	*Kifle et al. (2008)*
Clinical outcomes (clinical effectiveness, patient satisfaction, diagnostic accuracy, and cost) Non-clinical outcomes (technical evaluation and management evaluation)	*Aoki et al. (2003)*
Performance measures (Time, quality, cost) Outcome measures (Safety, efficacy, effectiveness) Summary measures (Cost comparisons) Operational considerations (Access, acceptability) Other issues (Confidentiality, legal)	*Ohinmaa and Reponen (1997)*

The recent telemedicine evaluation framework proposed by Chang (2015) used a three-dimensional framework constituting six constructs for evaluation of telemedicine programs. The constructs are human (service provider and patient/client) system (organization and technology) and environment (society and rules and policies). However, Chang has recommended a more comprehensive framework that involves contextual matters and participant observation in order to identify new insights.

Dyrvig et al. (2014) have developed a model for the assessment of telemedicine. This model has three subcategories: preceding assessment, multidisciplinary assessment, and transferability assessment. However, this model puts less emphasis on the human aspects of telemedicine evaluation than the previous model. Bashshur et al. (2011) have also designed a three-dimensional model that includes functionality (consultation, diagnosis, monitoring, mentoring), technology (modes, network design, connectivity), and applications (treatment modalities, medical specialty, disease types, sites). In a similar manner, this model also puts little emphasis on the human aspects of telemedicine evaluations.

Meanwhile, Khoja et al. (2013) have identified themes that could be used for the evaluation of ICT use in healthcare namely health service outcomes, technology outcomes, affordability and cost effectiveness, social and behavioural impact and ethics.

These telemedicine evaluation frameworks were developed on the basis of previous works and in consideration of particular contextual issues. Most of them were developed in the context of developed countries using pre-supposed theories and quantitative approaches. However, this current study is carried out to develop a telemedicine evaluation framework that will be used for evaluating the effect of telemedicine practices on the reduction of healthcare inequalities, particularly in the case of developing countries. Moreover, previous studies were quantitative using already developed theories. However, unlike them, this study is conducted without presumed theories, and rather it is focussed on the real-life experiences of healthcare workers who have worked in telemedicine projects. This study is a qualitative investigation where the gathered data are inductively analysed to identify emerging themes. Besides, in the case of developing countries, not enough studies have been carried out on the telemedicine evaluation frameworks in general and on reduction of healthcare inequalities in particular. Furthermore, this study focusses on

contextual issues in Ethiopia where more than 80% of the population lives in rural areas facing the huge healthcare service inequalities as compared to the big cities of the country. As a result of this, new insights have emerged, after inductive analysis of the data gathered from telemedicine experts in Ethiopia.

The inclusion of these new insights has a significant role, these insights contribute to the telemedicine evaluation literature. Besides, the new framework will have strong significance in the context of developing countries where socio-economic factors affect the implementation of telemedicine projects.

2.5 Summary

Healthcare inequality, which is referred to as any observed healthcare service difference between two or more groups, communities, nations which are socially, economically and geographically defined, is a global problem, but it is at a very critical stage in the case of developing countries. The common causes of these differences are socio-economic, educational, spatial, ethnic and racial, minority group, gender, environmental and cultural disparities. Healthcare inequalities have been measured using health outcomes like mortality rates, morbidity, disability, infant deaths, and life expectancy. Although healthcare inequality is the problem of the world, it is very severe in the Sub-Saharan African countries which suffer from weak infrastructure, lack of human resources and poor supply management. The main sources of this problem are shortage of health facilities and physicians, low socio-economic status, low literacy rate, harmful traditional practices, highly dispersed settlements of rural communities, and problems of road and transportation. The healthcare inequality between rural and urban communities is very high in developing countries such as Ethiopia.

The origin of telemedicine, that is healthcare delivery from distance, goes back to simple communication of health information, but it was started in a modern way in the 1970s in the US. Since telemedicine has drastically provided access to healthcare, reduced costs, solve time and geographical barriers, it has been playing a substantial role in saving the lives of people. Of course, the technology is facing challenges like unreliable electric power supply, lack of awareness, socio-economic challenges, regulatory and policy issues, and cultural barriers. Moreover, although telemedicine has magnificent benefits, its establishment cost is the biggest challenge for most developing countries. However, even with these constraints, developing countries are using telemedicine to save the lives of people.

These days, almost all people understand the potentials and benefits of ICTs in supporting the healthcare system. On this basis the investment of countries in e-Health, including telemedicine is increasing. Researchers have been studying instances of outstanding and failed telemedicine practices. However, it is not possible to find evaluations of telemedicine endeavours from a healthcare inequality perspective within the developing countries. For instance, in Ethiopia, there is only a study whose findings were utilized by policy formulators in order to better access and serve the more than 80% of the population who live in rural areas. Therefore, to know the current status of telemedicine within the Ethiopian context and investigate its contribution to reducing healthcare inequality among underserved communities, a summative evaluation of telemedicine sites was carried out.

In the next chapter, the research approach, the research methodology, the study participants, the data collection techniques and the data analysis approach of this study will be discussed.

Chapter 3 Research Approach

3.1 Introduction

In Chapter 2, related literature on healthcare inequalities, telemedicine and its evaluation frameworks were reviewed. In Chapter 3, the research methodology and design will be discussed. More specifically, the research epistemology, theoretical perspective, methodology and methods will be discussed as well as data sources, data analysis, ethical considerations, validation and reliability issues.

3.2 Research philosophy

A research philosophy deals with how a researcher considers the world and how the assumptions of a researcher underpins the research strategy and the methods chosen as part of that strategy.

"philosophy is to research as grammar is to language" Graham (2005, p. 4).

Moreover, having a philosophical stance helps to show the position of the researcher to the reader. It highlights the knowledge, reality and fact-finding strategies used in a particular research. Crotty identified four elements that define a research process (see Figure 9).

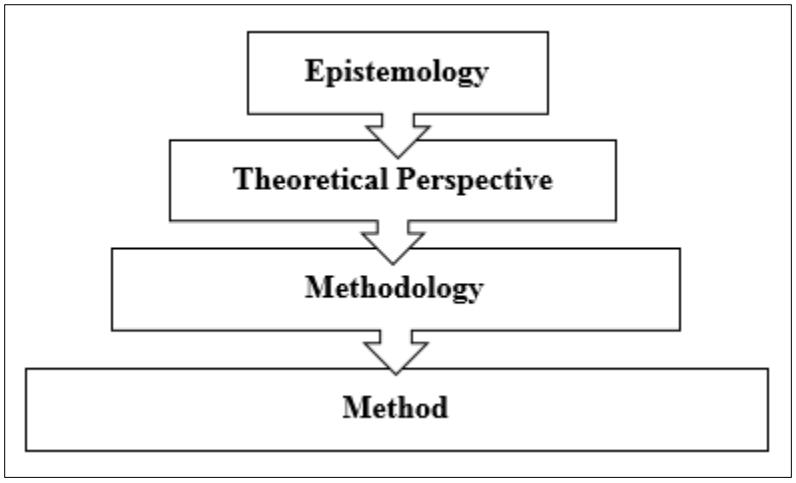

Figure 9: Four elements of research process (Crotty, 1998, p. 4)

3.2.1 Epistemology

Epistemology is a branch of philosophy that deals with the nature of knowledge (Crotty, 1998). Crotty is of the opinion that three epistemological assumptions determine a researcher's approach towards knowledge – objectivism, constructionism and subjectivism (Crotty, 1998) (see Table 5).

Table 5: The four elements of research philosophy

Epistemology	**Theoretical perspective**	**Methodology**	**Methods**
Objectivism Constructionism Subjectivism (and their variants)	Positivism (and post-positivism) Interpretivism • Symbolic interactionism • Phenomenology • Hermeneutics Critical inquiry Feminism Postmodernism etc.	Experimental research Survey research Ethnography Phenomenological research Grounded theory Heuristic inquiry Action research Discourse analysis Feminist standpoint research etc.	Sampling Measurement and scaling Questionnaire Observation • Participant • Non-participant Interview Focus group Case study Life history Narrative Visual ethnographic methods Statistical analysis Data reduction Theme identification Comparative analysis Cognitive mapping Interpretive methods Document analysis Content analysis Convention analysis etc.

The objectivist epistemology holds that meaning and meaningful reality exists apart from the operation of any consciousness whilst subjectivist epistemology holds that meaning is imposed on the object by the subject. This research used the constructionist epistemology which holds that different people may construct meanings in different ways depending on, for example, different eras or culture. In the constructionist approach subject and object emerge as patterns in the generation of meanings (Crotty, 1998).

3.2.2 Theoretical perspective

A theoretical perspective is a set of assumptions about reality that inform the questions researchers ask and the answers they arrive at as a result. This study uses the interpretive theoretical perspective as it enables the researcher to capture the views of participants (Jebreen, 2012); investigating personal lived experiences in detail, and scrutinizing how people understand their personal and social world. In this study, the personal lived experiences of telemedicine users and experts are analysed. What constitutes reality are the practical experiences of societies and healthcare workers who have been utilizing the telemedicine services within the Ethiopian context. Moreover, the lived experiences of these communities are expected to reveal how telemedicine could be exercised in order mitigate healthcare inequalities.

3.2.3 Methodology

A methodology refers to the steps taken and the strategy used to execute the research. It presents the rationale behind the choice of methods adopted (Crotty, 1998). Grounded theory was developed by Glaser and Strauss in the 1960s, when they were working together on a study how staff handles dying patients in hospitals (Glaser and Strauss, 1967). Glaser and Strauss observed the importance of having a well thought out and clearly formulated systematic methodology for collecting, coding and analysing data. This methodology is known as grounded theory.

Grounded theory is a systematic methodology in qualitative research that enables a researcher to inductively develop a theory. It is aimed at generating theories and hypotheses rather than testing them (Birks and Mills, 2011; Gibson and Hartman, 2014; Glaser and Strauss, 1967; Urquhart, 2013). The inductively analysed results of grounded theory provide conceptual theories that explain the studied empirical phenomena. According to Lewis-Beck et al. (2013):

"…Grounded theory (a) provides explicit, sequential guidelines for conducting qualitative research; (b) offers specific strategies for handling the analytic phases of inquiry; (c) streamlines and integrates data collection and analysis; (d) advances conceptual analysis of qualitative data; and (e) legitimizes qualitative research as scientific inquiry" (Lewis-Beck et al., 2003, p. 440).

Goulding (1999) is of the opinion that grounded theory is suitable if a subject area has received scant attention in previous studies or has been overlooked in the literature. Grounded theory requires systematic data collection, coding, and analysis in order to generate a new data-based theory. The steps of the grounded theory methodology are (see Figure 10):

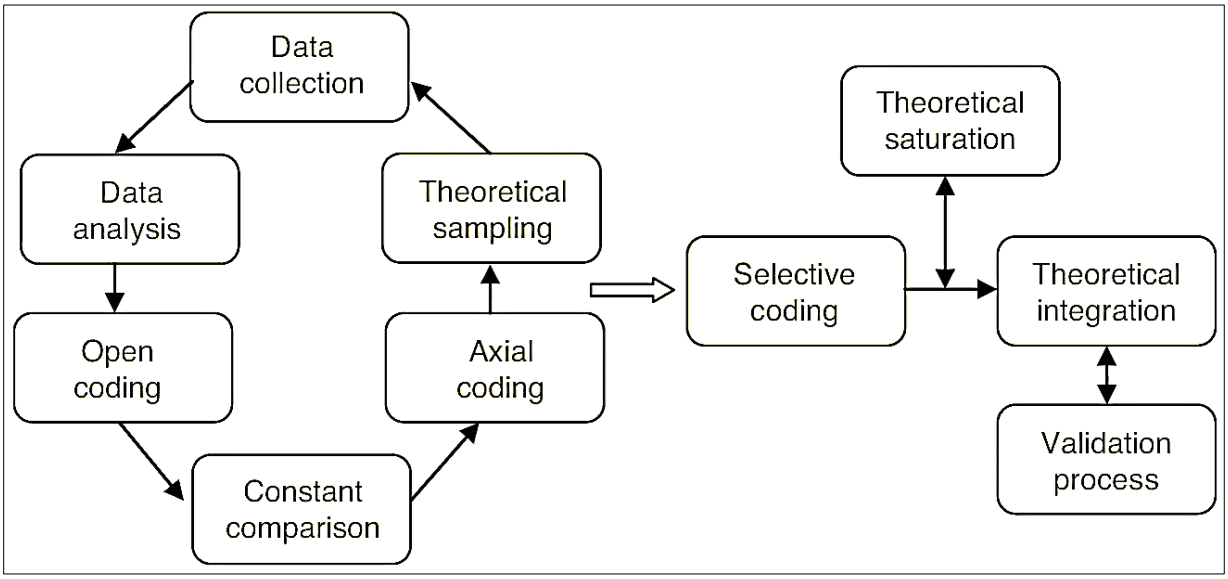

Figure 10: Grounded theory (Roman et al., 2017, p. 994)

3.2.4 Methods

Research methods are procedures or techniques used to collect and analyse data. (Crotty M., 1998). Although several methods can be used, the methods adopted should be appropriate for the underlying theoretical perspective and methodology chosen.

The methods which will be used for this research are:

3.2.4.1 Case studies

According to Yin, multiple-case studies are useful as it is then possible to observe the disparities within and between cases (Yin, 2003). Carrying out a multi-case study increases the reliability of the research. Moreover, Yin stresses the importance of studying fewer cases but each in more detail.

3.2.4.2 Interviews

The interview is a data collection technique that enables the collection of detailed data from study participants. Interview questions can be structured in three ways namely structured, unstructured and semi-structured. In a structured interview, the interviewer raises a set of questions which are predetermined and prepared in advance for all study participants in the same order. This type of study is easy for data gathering and analysis but it does not motivate the interviewer to raise additional questions. In contrast, in an unstructured interview – the interviewer asks questions which are not prepared in advance or not planned. The interviewer raises questions spontaneously. As a result, different study participants can be asked different questions. Although an unstructured interview enables the gathering of details and unexpected results, it takes a long time and is very difficult to analyse. In a semi-structured interview, some predetermined questions are raised for all study participants while the rest of the questions are not planned in advance and spontaneously arise in a free-flowing conversation between the interviewer and the participant.

In this research the semi-structured interview is employed. The semi-structured interview is an open-ended interview conducted with certain probes (or questions) which allow for "*reflection-in-action*" and which determine in what direction the conversation goes (Schön, 1987). According to Turner (2010), using open-ended questions creates opportunities for both interviewer and interviewee to raise and cover topics in more detail. In order to be sure to address all aspects,

Turner suggests that interviewees from different fields of expertise be targeted (Turner, 2010). Telemedicine experts, public health workers and health informatics workers were asked semi-structured questions. All interviews were transcribed.

3.2.4.3 Field notes

Field notes are the writing down of observations which can provide new insights and can allow the researcher to comprehend the context of an interaction or action (Bogdan and Biklen, 2007).

In qualitative research, researchers record what they observe during their field visits. It supports and explains what the observed event might mean and provides answers to the research questions during the data analysis phase (Bogdan & Biklen, 2007; Pitney & Parker, 2009).

This researcher's field notes on the telehealth practices in Ethiopia enriched the data and helped the researcher to critically understand the telehealth context, and observe how activities are running around telehealth sites. This researcher took field notes primarily during real-time tele-dermatology cases and tele-consultation. Moreover, the field notes helped the researcher to verify what the professionals said and to get additional information.

3.2.4.4 Coding

Several types of coding were employed to analyse the transcribed interviews as well as the field notes.

Open-coding—the researcher familiarizes himself or herself with the gathered data by listening to the audio recordings and reading transcripts again and again. Then, the transcribed data is read line by line and coded so as to identify concepts and phrases. This process is carried out for all transcriptions, beginning with the first interview. The raw data is analysed without any presupposed theories or hypotheses and data from each study participant is constantly compared for similarities.

Axial coding—in this phase, relationships between the identified subcategories that have been found during the open coding phase, are identified. The researcher looks for themes, using latent and semantic approaches, from generated codes considering data reduction.

Selective coding—in this phase, identified categories during axial coding are further refined and the core categories of the study are identified. Finally, the researcher reviews all discovered categories and reduces the data based on internal coherence in themes that have strong distinctions between them.

Finally, the researcher presents the identified themes and sub-categories to the study participants in order to get feedbacks and to modify the data accordingly.

3.3 Research design of this research effort

The research design refers to the overall approach that a particular research follows in order to integrate the data collection, measurement, and analysis processes in an appropriate manner (De Vaus, 2001).

As mentioned before, this research used grounded theory as a methodology. This started with the collection of qualitative data to address the research question, namely, *"How should telemedicine be practiced in order to reduce healthcare inequality at community level?"*.

The grounded theory methodology requires of the researcher to review the collected data and when repeated ideas, concepts or elements become apparent, these are tagged as *codes*. As more data is collected, and re-reviewed, codes can be grouped into concepts, and then into categories. These categories may become the basis for a new theory.

3.3.1 Data Collection

Different methods of data collection were employed (see Figure 11).

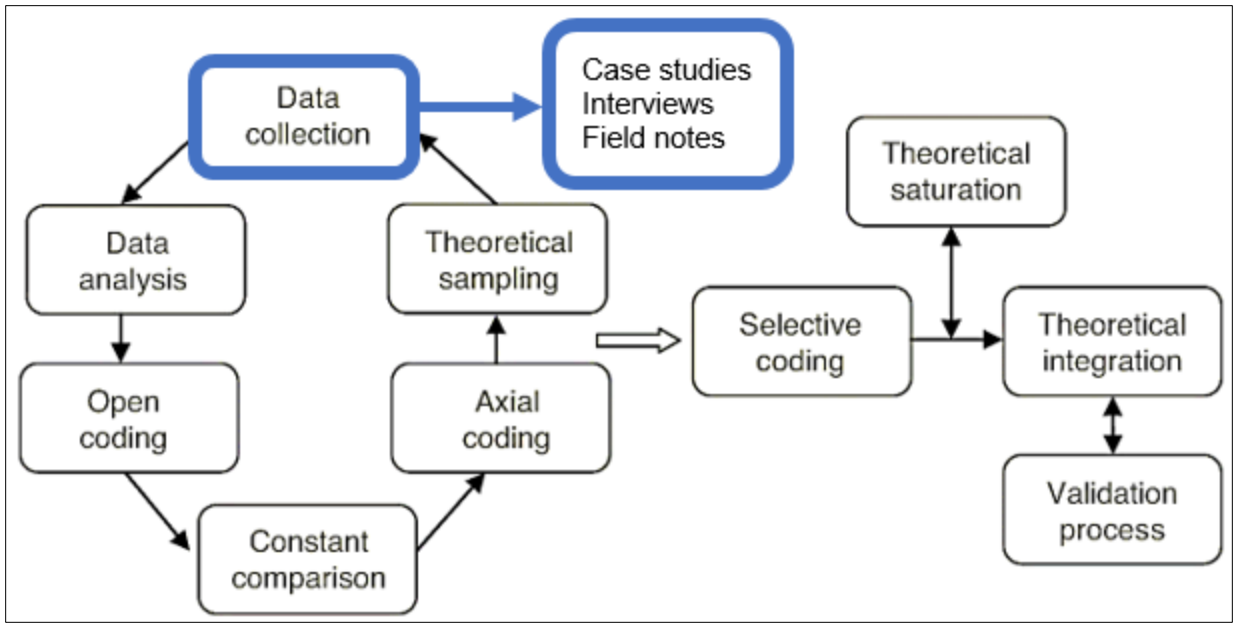

Figure 11: Methods of data collection

3.3.1.1 Case studies

To investigate the contribution of telemedicine in healthcare mitigation in the Ethiopian context, four telemedicine programs were qualitatively studied. Each of the following cases has been implemented at different times by different organizations having different objectives. As a result of this, it is necessary to study them case by case. Figure 12 shows the telemedicine programs/cases in Ethiopia. Detailed description of the case studies is presented in Section 1.2 and Section 2.3.7.

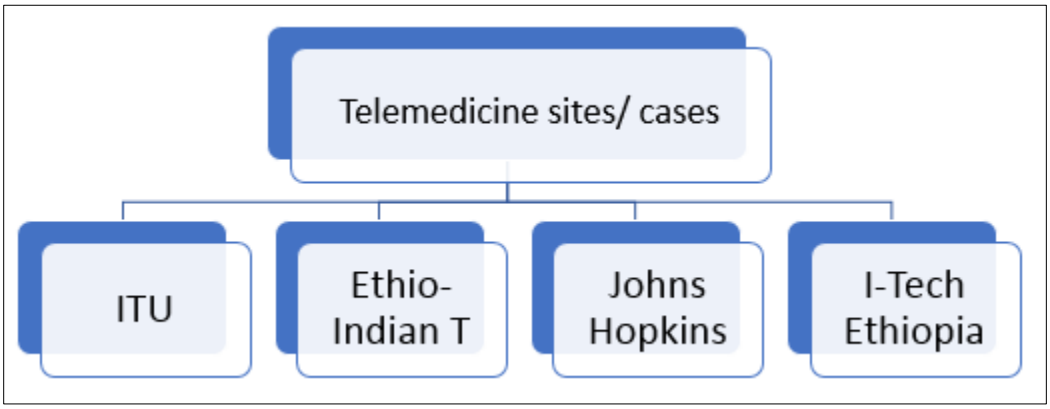

Figure 12: Telemedicine Programs/Cases in Ethiopia

3.3.1.2 Interviews

The researcher identified potential research participants in order to get sufficient data for the study.

BIOGRAPHIES OF PARTICIPANTS

To ensure confidentiality concerning the personal information of research participants, subjects were given reference codes, these were users in place of names during citation of interview quotes (see Table 6).

Interviews were conducted with health professionals and telemedicine experts who have experience in operating and utilizing telemedicine services. The three telemedicine experts were interviewed on the four telemedicine programs. The first participant (TP1) was given two interviews because he was assigned as a telemedicine expert in two projects (Sites 1 and 2).

TP1: Research participant one is a senior physician of the Black Lion Referral Hospital. The expert has been working for several years as a telemedicine expert in addition to his duties as radiologist. Being a telemedicine expert for two telemedicine projects hosted at this hospital was a good opportunity for this expert to share experiences on the contextual issues and the strengths and weaknesses of those projects. Continued training, conferences and courses attended both locally and abroad contributed to the expert's knowledge and skills. As a result, this participant played a significant role in providing vital information during his interview about telemedicine project 1 (Site 1) and Telemedicine project 2 (Site 2). Furthermore, this expert has himself carried out research and published on the Ethiopian telemedicine projects.

Table 6: Reference codes of research participants

Reference Code	Types of Respondents	Site Number	Type of Interview	Number of Interviews
TP1[6]	Telemedicine Experts	1,2	Face-to-face Face-to-face Face-to-face	3
TP2 TP3 TP4 TP5	Medical Director Medical Director Physician Physician	4 3 1 2	Electronic mail Face-to-face Electronic mail	2
TP6 TP7	Senior Health Information Consultants	1 2 3	Face-to-face Face-to-face	2
TP8 TP9	ICT Expert ICT Expert	4	Face-to-face Face-to-face	2
TP10 TP11	Public Health Workers	2 3	Face-to-face Face-to-face	2

NB: Throughout this document TP refers to those telemedicine research participants.

TP2: Research participant two is a medical director and senior health system manager working in Ethiopia. The headquarters of the office is found in the USA and its branches are hosted at Black Lion Hospital and Hawassa University's Medical School. The expert has been supervising the video-conference type of telemedicine services since the commencement of the project in Ethiopia.

TP3: Research participant three has served as a coordinator of telemedicine services and a medical director at Alert Hospital. This participant has much experience on the store-and-forward type of telemedicine services. Moreover, he has attended tele-health training and conferences several times.

TP4: Research participant four is a physician who specialized in paediatrics and has been using tele-based health services for the past five years. The physician's closeness to and day-to-day utilization of the technology, and enabled this participant to use it for various healthcare services.

[6] TP1: was interviewed as Telemedicine Expert since he served as an expert in two Telemedicine Programs; and interviewed as a telemedicine user.

TP5: Research participant five is also a physician who has exposure to tele-education and tele-consultation at hospital and university level. His experience in the utilization of ICT for health enabled him to support his duties with such technologies.

TP6: Research participant six has specialized in information technology and health informatics. He has been working on electronic medical information systems. He has been working as a data manager, and a health informatics expert in governmental and non-governmental organizations.

TP7: Research participant seven is a statistician, a health informatics consultant and health a data manager who has worked for more than ten years in governmental and non-governmental organizations. Moreover, he has been working on electronic medical record (EMR) systems for six years. His experience with tele-health services has played a significant role in informing this study.

TP8: Research participant eight is a software engineer who has run more than 10 successful software projects for different organizations including health institutes. Moreover, he is a director of an e-learning centre. He is well-experienced in designing, implementing and using online services.

TP9: Research participant nine is a director of Information and Communication Technologies of Bahir Dar University. He has been managing information and communication technologies for education and health purposes for some time. This expert has attended several information and communication training courses and conferences and is working in several active projects.

TP10: Research participant ten is a public health professional who has worked for sixteen years in non-government organizations. He has two MSc degrees in public health and health informatics.

He has a strong passion for the integration of ICT with public health services. This worker has attended training on telemedicine projects.

TP11: Research participant eleven is a public health officer who has worked for thirteen years in governmental and non-governmental health organizations. His office uses multimedia and ICT facilities to deliver health training and awareness to communities. His experiences in implementing such technologies in urban and sub-urban areas were the main reasons for including him in this study.

PROBES

All of the participants were given a copy of the interview questions and a letter of informed consent (see Appendix A). Immediately after acknowledging their willingness to participate voluntarily, the researcher contacted them again to agree on a convenient location, date and time for the interview.

A series of open-ended probes on telemedicine practices and healthcare inequality in Ethiopia were discussed with the study participants (see Appendix B). The semi-structured interview was the primary data collection instrument. The researcher interviewed professionals from different disciplines who all had telehealth experience. All these participants have been described in detail and fall into four categories: telemedicine experts (TM), medical doctors (MD), public health (PH) workers, and IT specialists.

The semi-structured interview that was conducted with each participant took approximately one hour. With their permission, the interviews were audio-recorded. During these contacts, the researcher asked if they had any questions concerning the study.

The number of research questions raised for each research participants varied depending on the participant's expertise. The first thirteen questions were common across each group of participants, but for the telemedicine experts, an additional thirteen questions were asked (see Appendix C). Follow-up questions were raised until conceptual saturation was reached.

SAMPLING

Theoretical sampling is a sampling procedure in grounded theory. According to Glaser and Strauss (1967), theoretical sampling is

> *"…the process of data collection for generating theory whereby the analyst jointly collects, codes and analyses his data and decides what data to collect next and where to find them in order to develop his theory as it emerges (Glaser and Strauss, 1967, p.45)"*

As the first stage of theoretical sampling, the telemedicine experts were selected. However, the rest of the samples were selected based the collected data and the codes identified from the collected data. The samples were selected since the focus of a qualitative approach is understanding a phenomenon rather than looking for its generalizability (Morse, 2007; Creswell, 2007). The first stage of theoretical sampling, helps select samples that are thought to be more informative as described by Anderson (2010) and enables the creation of maximum variability among samples which in turn helps with the generation of new ideas.

Hence, the researcher collected data from the identified telemedicine practices in Ethiopia. Although all experts involved in Ethiopian telemedicine endeavours could potentially be asked to participate in this qualitative study, study participants were selected and data was collected from them, until theoretical saturation was reached.

A number of issues affect sample size determination in qualitative research, however, it mainly depends on theoretical saturation of the study. Moreover, Morse et al notes that sample size

depends on appropriateness and adequacy (Morse et al., 1995). Theoretical saturation, according to Morse (1994), is a continuous taking of samples and analysing data by the investigator until no new data appears and all themes are well-created.

Unlike quantitative studies, qualitative research investigations can use much smaller samples. This is due to, according to Ritchie et al. (2003), the diminishing returns to qualitative samples-more data does not necessarily lead to more information. The other reason is that qualitative research has the intension of identifying new insights rather than the generalization of hypothesized statements (Glaser, 2004; Crouch and McKenzie, 2006). Moreover, since qualitative research is labour-intensive, a large sample takes more time than a small sample and is therefore usually unfeasible (Atran, 2005).

3.3.1.3 Field notes

During each interview, field notes of observations were handwritten by the researcher to pin down and understand the context and meaning of the interview (Bogdan and Biklen, 2007). The researcher pointed out what to observe and keep record during the field visits. In this study, a semi-structured filed note was used. The researcher recorded what telemedicine experts were using the telemedicine technology, what they were trying to accomplish in order to provided healthcare service to remote clients, how they were exactly operating the technology, how do different healthcare workers work together, and generally, the researcher observed what was happening in each site that was relevant to the research questions.

3.3.2 Data analysis

As already mentioned, qualitative data was gathered from the telemedicine sites (each case study) through interviews with telemedicine experts, researchers, medical doctors, public health professionals, and ICT experts, as well as field notes.

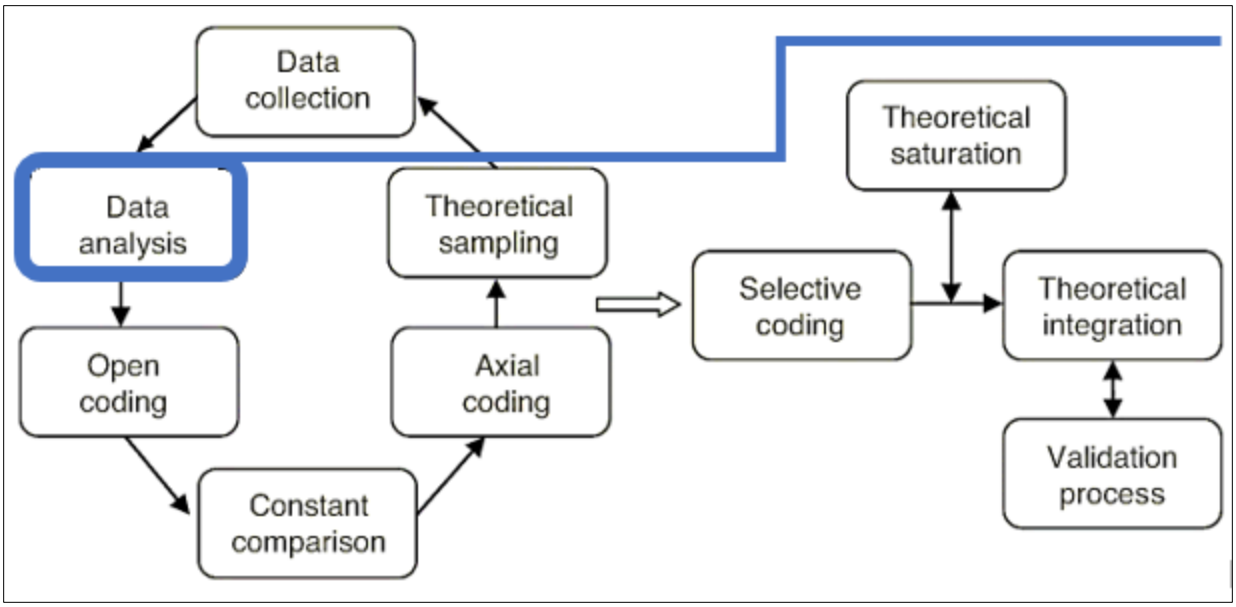

Figure 13: Grounded theory data analysis

These were transcribed and inductively analysed in order to allow emerging new concepts to emerge from the interview data (see Figure 13).

The analysis process was supported by qualitative data analyser (QDA) software - Atlas ti version 7.0. Insertion of all transcribed data, coding and creating categories, and systematic identification of emerging themes were accomplished using this software.

In a qualitative method, the collected data is inductively analysed to generate core categories from detailed information (Bamberger et al., 2006). The primary output of conducting an inductive data analysis is to formulate a model or framework that emerges from summaries of large quantities of raw data in a systematic way. The analysis in this study was carried out without any predefined hypotheses, rather categories and relationships were created from the data. The analysis has an emic focus-which represents the setting in terms of the participants and their view points, rather than an etic focus-in which the setting and its participants are represented in terms that the researcher brings to the study. Emic analysis enables the researcher to identify culturally specific

thoughts and real-life experiences of the study participants with respect to the telemedicine practices in Ethiopia. Then by using etic analysis, which is the researcher's perspective of the study, the researcher organizes the results of emic analysis (Woodside, 2010).

The data analysis process was done as per the Noble and Mitchell (2016) suggestions (see Figure 14).

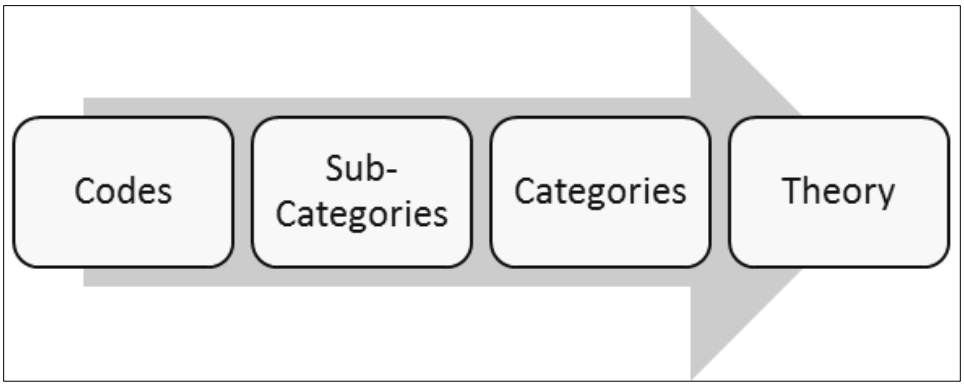

Figure 14: Data Analysis Process (Noble and Mitchell 2016, p. 35)

First the transcribed interview results were read and coded. Then, subcategories were formed from inter-related codes. The subcategories were further organized through axial coding so as to create higher level categories. Finally, the emerged core categories formed a framework for evaluating telemedicine-based healthcare inequality reduction in Ethiopia.

Then the findings were reported in the conventional way – meaning the top-level categories were used as main headings and specific categories as subheadings. Detailed descriptions of categories and appropriate quotations were included to illustrate the meanings of the categories.

3.3.2.1 Coding process

The analysis was carried out in three consecutive phases (see Figure 15). According to Strauss and Corbin (1990), grounded theory uses open coding, axial coding and selective coding to generate a theory grounded on data. The coding was carried out as follows:

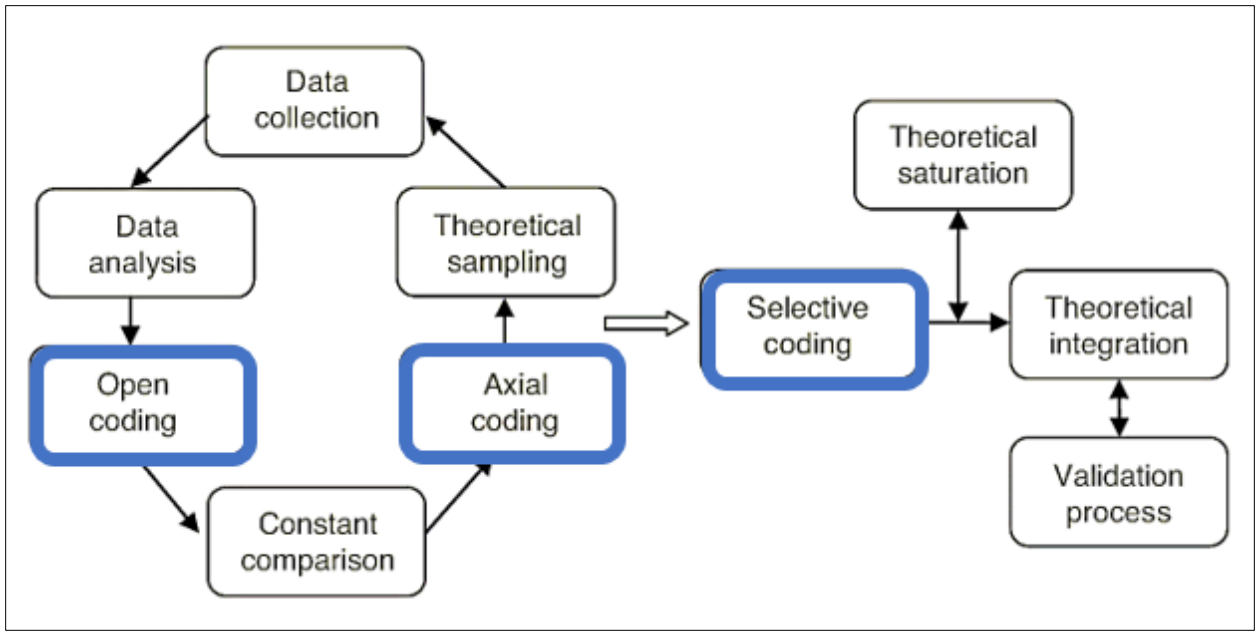

Figure 15: Coding process in grounded theory

OPEN CODING

Thirty-two data-driven codes were generated from this phase. This phase reduced the data down into 32 conceptual components or subcategories on the evaluation of telemedicine-based healthcare inequality mitigation in underserved communities.

AXIAL CODING

In this phase, relationships between the subcategories from the open coding phase were identified. The researcher looked for themes, using latent and semantic approaches, and identified twenty-five sub-categories.

SELECTIVE CODING

In this phase, the categories identified axial coding were further refined and the core categories of the study were identified. Finally, the researcher reviewed all discovered categories and reduced data, based on internal coherence in themes and strong distinction between them. Accordingly, seven major themes emerged on the evaluation of telemedicine practices in healthcare inequality

reduction. Finally, the researcher defined and named these themes in order to recognize essence of the themes.

SATURATION

Glaser and Strauss (1967) suggest the concept of saturation for an appropriate sample size determination in qualitative studies. In this study factors such as quality of interviews, sampling technique, number of interviews per participant, and experience of the researcher enabled the researcher to achieve conceptual saturation of the study using a small sample size (Marshall et al., 2013; Sandelowski, 1995; Morse, 2000). Data saturation is commonly defined as when no new data emerges from additional sources and can be further described at two levels – code saturation (no additional issues are identified) but also meaning saturation (no further dimensions, nuances or insights of issues are identified) (Hennink, Kaiser and Marconi, 2017). The analysis of interview data showed that meaning saturation (i.e. the point at which no further dimensions, nuances, or insights of issues are identified) was achieved after eleven interviews. The gathered and analysed interview data eventually became redundant and reached conceptual saturation by the time the eleventh study participant was interviewed.

BIAS

Cross-checking of data reduces the potential systematic bias that can occur due to using only one data source, method, or procedure (Shwandt, 2007; Maxwell and Miller, 2008). Thus, in this research, data was collected from most of the telemedicine projects using interviews. In a qualitative method, the conclusions are based on verifying the data from different sources because this increases the credibility and trustworthiness of the study (Yin, 2011).

In addition to that the procedure of double sampling was applied. This is because, according to Yogesh (2006), double sampling procedure (a) maintains reliability of the sample, (b) reduces errors, and (c) determines precision based on a number of observations. Hence, various groups of experts need to be involved. In this study these are:

1. The first group of research participants are telemedicine experts who have been participating in telemedicine projects. This group of experts contributed the most important data concerning the current status of telemedicine practices in those selected localities. These research participants have seen the ups and downs of these practices.
2. The second group includes medical doctors and physicians who have experienced exposure to the provision of services from telemedicine projects, or have gained from them. Medical doctors usually are some of the major users of such systems both as service provider and receiver. These include health consultations, training and education.
3. The third group of research participants are public health professionals who use such services to train or consult communities on a variety of health matters.
4. The fourth group of research participants includes senior health informatics experts who have been working in various eHealth projects. The experience of this group helped in obtaining interesting results. These ICT professionals have been engaged in video conferencing systems that are used in a variety of fields, which include health, training, judgment, and education.

3.4 Research ethics

Ethics basically refers to the moral principles that govern a person's behaviour or the conducting of an activity. Using the correct ethical procedures can prevent or mitigate harms from study participants. Hence, the protection of study participants in any research is imperative (Orb et al., 2000).

This dissertation is being conducted as per UNISA's policies and ethical standards. To ensure this, the researcher fulfilled UNISA's ethical clearance and the data gathering instrument was presented to the research committee and was accepted (see Appendix D). Permission letters were received from the Addis Ababa City Regional Health Bureau and Bahir Dar University in order to collect data from participants (see Appendix E and Appendix F). To get these two permissions, the researcher adhered to all the necessary preconditions, particularly in terms of privacy, confidentiality and anonymity of the respondents.

3.4.1 Participants privacy protection

Privacy is one of the main principles that guides any research involving human participants. According to Whelan (2007), study participants assume that their responses remain confidential and secure. This is their assurance for their truthful responses not to be used in ways other than those intended.

Throughout this study, the safety and protection of participants were well-maintained. Before any interview stared, each participant's written/oral informed consent was obtained (see Annex A) and they were informed that if they were not willing to participate in the study, or wished to withdraw from it any time, then they were able to do so, and their treatment and respect was not adversely affected.

Before carrying out any interview, all participants read or listened to the purpose of the research that he/she was asked to participate in. Each participant needed to understand their contribution to knowledge, to feel free to make independent decisions, and to understand that the interview was a formalized interaction between him/her and the researcher. Moreover, they were asked about their willingness to have their interviews recorded using a tape-recorder; and at the end of the research

processes, the recorded files were destroyed, because of the ethical procedures put in the ethical clearance.

To maintain ethical standards and the integrity of the research process, according to Baez (2002), anonymity of the study participants and confidentiality of the data they provide must be and were protected at all phases of data transcription, organization and analysis.

3.5 Validity and reliability

Inspecting the data for its validity and reliability supports the credibility of the research findings. According to Claire Anderson (2010, p.2),

> *"the validity of research findings refers to the extent to which the findings are an accurate representation of the phenomena they are intended to represent" (Claire Anderson, 2010, p.2).*

In most qualitative researches, the term *"trustworthiness"* is used rather than validity. On the other hand, reliability refers to "the consistency of the research findings (Kvale, 1996; Golafshani, 2003). Ensuring reliability demands hard work and commitment to maintain consistency during interviewing, transcription and analysis of the findings.

To ensure validity of research findings, it is advisable to collect data from numerous independent sources on the same scenario. To explore the telemedicine practices on healthcare inequality within the Ethiopian context, data were collected from different experts until theoretical saturation was reached.

3.6 Summary

In Chapter 3, the research design and methodology of the study is discussed. The researcher applied constructivist epistemological assumptions and interpretive theoretical perspectives. Data was collected from telemedicine experts, medical doctors, public health professionals and ICT

experts via interview. The data were analysed inductively to generate a theoretical framework that could inform strategic plan developers, policy formulators, educators and researchers to work on the improvement of healthcare delivery using such technological products particularly for underserved communities. In Chapter 4, a detailed discussion of the study findings will be presented.

Chapter 4 FINDINGS

4.1 Introduction

The aim of this research was to explore telemedicine practices and healthcare inequality in order to develop a framework that will inform health service delivery for underserved communities in Ethiopia; thus, making a knowledge contribution to existing telemedicine knowledge and discourse about telemedicine in academic literature. A grounded theory methodology was used to gather and analyse data from telemedicine sites. The research was guided by three research questions: (1) How should the telemedicine practices on the reduction of healthcare inequality be evaluated in Ethiopia? (2) What insights does an evaluation of telemedicine in Ethiopia provide in terms of the reduction of healthcare inequality in the country? and (3) How do these insights inform a framework for improving the telemedicine practices in reducing healthcare inequality in Ethiopia? Because of their personal-lived experiences with telemedicine projects in Ethiopia, telemedicine experts, physicians, health informatics consultants, ICT experts and public health workers were selected to participate in the study. This chapter presents the study findings and their corresponding interpretations that emerge from the primary data gathered from study participants in relation to the three research questions.

4.2 Occurrences of themes and their contextual description

The researcher employed grounded theory – a qualitative data gathering and analysis methodology to identify emerging themes and categories from data. The three coding stages (open coding, axial coding and selective coding) of grounded theory were used to identify core categories from the raw data. Beginning from the first interview, the researcher familiarized himself with the gathered data by listening to the audio records and reading transcripts again and again. Then, the researcher generated data-driven initial codes across the entire data in a systematic manner by collating

transcripts, using ATLAS ti software for systematic organization and management of the qualitative data. Then, the researcher looked up relationships among the generated codes considering data reduction and identified twenty-five categories.

Next, the researcher constantly compared all discovered categories and reduced data based on internal coherence in themes that had strong distinction between them. Accordingly, seven core categories emerged. Finally, the researcher defined and named these themes so as to capture the essence of the themes. Hence, as Figure 16 shows, the themes, barrier removal, service quality, synergetic effect, localization, technical setup, resource utilization and managerial readiness emerged to formulate a framework for evaluating telemedicine-based healthcare inequality reduction in Ethiopia.

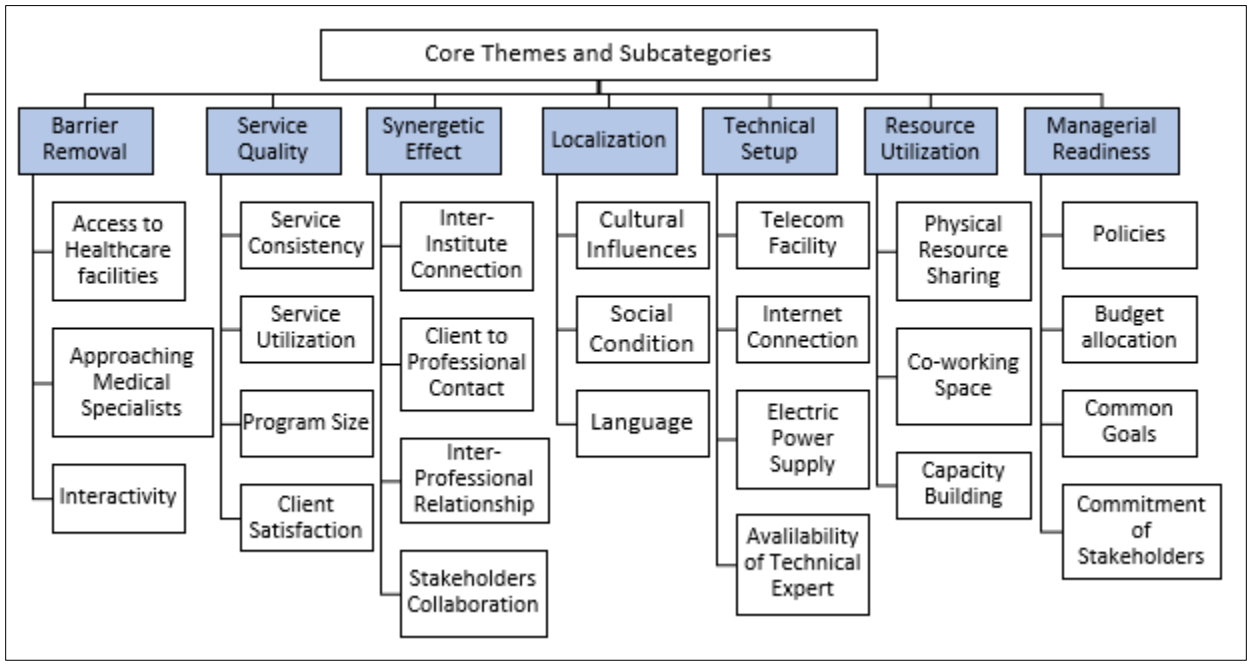

Figure 16: Emerged high-level research findings

Each of these themes came from patterns that were identified from the repeatedly raised responses of research participants. The occurrence of statements related to the twenty-five sub-categories were identified from the transcribed interviews (see Table 7).

Table 7: Themes, sub-categories and their occurrences

MAIN THEME	SUB-CATEGORIES	TP 1	TP 2	TP 3	TP 4	TP 5	TP 6	TP 7	TP 8	TP 9	TP 10	TP 11
Barrier Removal	Access to healthcare facilities	X		X			X	X		X		
	Approaching medical specialists	X			X		X		X			X
	Interactivity		X					X				
Synergetic Effect	Inter-institute connection	X		X		X					X	
	Client-to-professional contact			X	X				X	X		
	Inter-professional relationship		X			X		X			X	
	Stakeholders collaboration				X			X	X			
Service Quality	Service consistency						X	X				
	Service utilization	X		X		X			X			
	Program size	X	X				X			X		X
	Client satisfaction		X	X	X							
Localization	Cultural influences					X				X		
	Social condition	X						X				
	Language			X						X		
Technical Setup	Telecom facility	X			X		X				X	
	Internet connection	X				X	X		X			
	Electronic power supply	X		X			X				X	
	Availability of Technical experts		X									
Resource Utilization	Physical resource sharing	X			X							
	Co-working space	X		X				X			X	X
	Capacity building	X		X						X		
Managerial Readiness	Policies		X		X					X		X
	Budget allocation	X				X	X				X	
	Common goals		X			X				X		X
	Commitment of stakeholders			X		X			X			

NB: "X" indicates that the study has direct evidence for the corresponding category from study participants who are referenced using codes (TP1 to TP11).

Based on the analysed data, the study findings were given meanings that could be used for the evaluation of telemedicine practices on the reduction of healthcare inequality within a particular context. These meanings for these themes are derived from the meanings that research participants

used during the interview. Finally, the researcher presented the identified themes and their meanings to research participants in order to see their feedbacks (see Table 8). The author verified that the feedback of the study participants supported the study findings. Hence, the main themes, barrier removal, service quality, synergetic effect, localization, technical setup, resource utilization and managerial readiness that have been derived from the gathered data are now given contextual meanings.

Table 8 Contextual Descriptions of Themes

Theme	Contextual Description
Barrier removal	It refers to the act of removing healthcare services barriers and enhancing provision of telehealth care services as per the demands of communities through better accessibility of healthcare facilities and workers to reduce the healthcare service inequalities without the restriction of distance.
Quality of service	It denotes quality and performance of telemedicine service provisions consistently.
Synergetic effect	It refers to the inter-relationships and communication among the telemedicine main stakeholders such as health institutions, patients and healthcare professionals.
Localization	It refers to customizing telemedicine services to meet the context of a particular community, language or community's "look and feel".
Technical setup	It denotes establishing dependable telecommunication network, Internet connection, electric power supply and technical expert.
Resource utilization	It denotes the use of basic health-related resources basically physical resources, co-working space, time and knowledge of health institutes and healthcare professionals.
Managerial readiness	It refers to the overall arrangement of healthcare institutes' requirements for an effective telemedicine service delivery in terms of firm policy formation, budget allocation, setting common goals and commitment of stakeholders.

4.3 Thematic analysis of findings

Thematic analysis of the seven themes and their sub-categories are presented below. For greater clarity, selected interview transcriptions are also included under each subcategory. In the analysis process, the various dimensions of the themes, from the Ethiopian telemedicine practices viewpoint, are also considered.

4.3.1 Barrier Removal

The primary purpose of any telehealth service is to enhance accessibility of healthcare services and to increase the interaction of medical specialists and patients without the restriction of distance. In those four telemedicine projects, respondents confirmed that telemedicine enhanced healthcare services as per the demands of users through enhancing accessibility of healthcare facilities and workers, without the restriction of distance. This study showed that barrier removal could be a primary factor for the evaluation of the impact of telemedicine on the reduction of healthcare inequality (see Figure 17). Barrier removal includes access to health facilities, approaching medical specialists and interactivity of telehealth services. The accessibility of health facilities and specialists is one of the biggest problems facing developing countries like Ethiopia where more than 80% of its population lives in rural areas that have little or no access to essential healthcare services. The three sub-categories of barrier removal are discussed below.

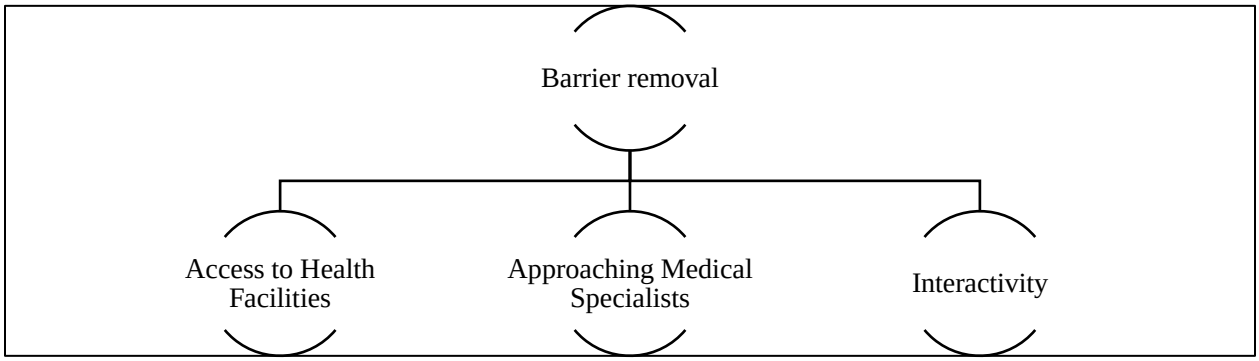

Figure 17: Barrier removal

4.3.1.1 Access to health facilities

The health facility to population ratio in Ethiopia is one of the least in the world. However, according to this research, telemedicine is enabling communities to access the scarce facilities that are mainly found in the big cities of the country. Telemedicine allows remote access of healthcare facilities found in one location by people in other locations, particularly remote communities.

Telemedicine is playing a significant role in Ethiopia where healthcare services and healthcare resources are inaccessible for the majority of the population, and a physician to population ratio is 1:37996 (Federal HIV/AIDS Prevention and Control Office, 2010).

According to this research, telemedicine practices in Ethiopia increase those healthcare, health education and consultation services which were not accessible before the establishment of telemedicine projects. Telemedicine enables students at various Ethiopian universities to attend classes.

> *"... telemedicine increases the access of healthcare service and the small number of healthcare workers. It enables healthcare workers to treat, consult, educate, and monitor many people in many areas at a time" (TP1).*

Telemedicine has enabled access to health facilities such as hospital, health centres and health stations. In the majority of Ethiopia, such facilities are very scarce, particularly in rural areas, as more than 83% of the population lives in remote rural parts of the country.

> *"... in Ethiopia and other developing countries, telemedicine supports the healthcare service delivery, in making healthcare services accessible to people in rural areas, who constitute the majority of the country's population, and healthcare facilities are scarce" (TP3).*

A low number of healthcare facilities implies low healthcare coverage and poor health outcomes. Telemedicine is enabling communities to access scarce health facilities without the restriction of time and distance. This implies that the potential of telemedicine to reduce healthcare inequalities among communities is significant.

Hence, for the evaluation of telemedicine-based healthcare inequality reduction in Ethiopia, access to a health facility is found to be one of the subcategories of the framework.

4.3.1.2 Approaching medical specialists

Most of the research participants agree about the importance of telemedicine's role in accessing the small number of healthcare workers who are predominantly found in big cities of Ethiopia. Although the number of health care workers is increasing, the shortage of medical specialists is still a major challenge that the health system of Ethiopia is unable to address. The health care service accessibility in Ethiopia is one of the least in the world with a physician to population ratio of 1:37996 (Federal HIV/AIDS Prevention and Control Office, 2010).

> *"…telemedicine enhances healthcare access and increases health care service delivery. It enables to access health specialists who are dominantly found in the big cities of Ethiopia" (TP1).*

This idea is further strengthened by research participant six.

> *"…a doctor who is far away from a patient can treat patients remotely. This is particularly important to Ethiopia, where the number of medical doctors is small, the society is geographically disintegrated and road infrastructure is limited. Surprisingly, I saw patients whose cases were being monitored by a dermatologist in India" (TP6).*

From this fact, study participants emphasized the need for expanding telemedicine projects. These days, the number of medical doctors is not increasing, due to the brain-drain many medical doctors who have qualified in Ethiopia move to developed countries where salaries are better than in their home country. However, telemedicine has the capacity to access medical workers from abroad. As a result of this, the capability of telemedicine in approaching medical specialists could be another category for evaluating telemedicine-based healthcare inequality reduction in Ethiopia.

4.3.1.3 Interactivity

In addition to creating access to health facilities and medical specialists, interactivity of telemedicine services has reduced barriers. According to study participants, telemedicine enables real-time two-way interaction or communication between healthcare workers and patients found

in different locations. The capability of making direct interactive contact with international experts increases the choices of local medical specialist and clients.

> *"... It was a great opportunity to interact with experts from different countries without the restriction of distance and time. I have been sharing experiences with foreign healthcare workers without going abroad" (TP2).*

The interactive nature of telemedicine enhances the clients' acceptance of the technology in Ethiopia, as it enables people to access experts from a variety of locations in real-time and preserves the fundamental doctor-patient relationship. Hence, the interactivity of telemedicine plays a significant role in the evaluation of telemedicine-based healthcare inequality reduction in Ethiopia.

4.3.2 Service Quality

According to the analysed data from study participants, the second theme that emerged is telemedicine service quality. In this study, this refers to the assessment of how well a delivered telemedicine service conforms to the expectations of its clients in Ethiopia. This theme includes subcategories such as service consistency, user expectation, program size and client satisfaction (see Figure 18).

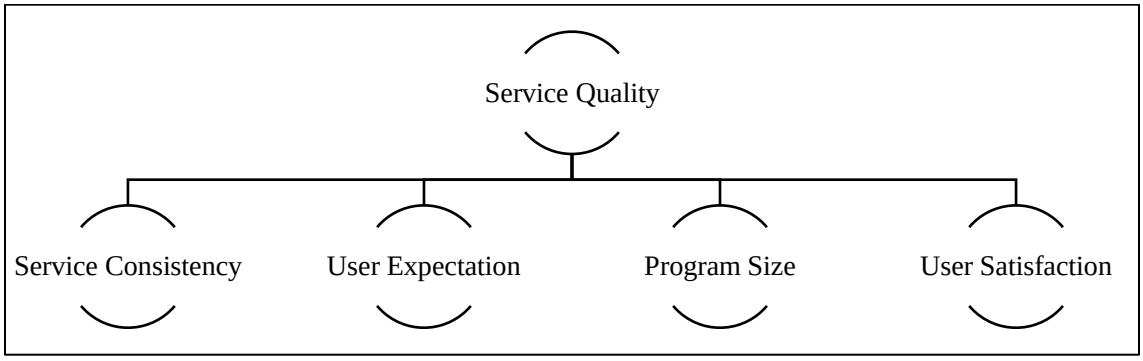

Figure 18: Service quality

4.3.2.1 Service consistency

One of the most important considerations in choosing service providing organizations is the ability of such organization to provide the expected service consistently. In this study, service consistency refers to the reliable provision of the intended healthcare service to clients according to its plan. However, participants of this study consider that some of the services that have been provided by telemedicine services in Ethiopia have been inconsistent. Only the tele-education services which were being delivered in Case 1 and Case 3, have been consistent, the others have been delivered inconsistently. The problem of service inconsistency was more commonly observed on the direct video-transmissions of Case 1, Case 2 and Case 4. At the beginning, services were being done well. Gradually, users ignored the services saying that programs were below their expectations in terms of service type, content and relevance.

> *"…The telemedicine services that currently being delivered are too ordinary for a health specialist. Due to this, some physicians abandoned the service" (TP6).*

In Ethiopia, telemedicine experts have scheduled programs to run using telemedicine services. During this, all concerned technical experts and specialist gather within the telemedicine centre for different purposes. However, the absence of consistent and reliable telemedicine services, discourages healthcare professionals and sometimes they leave the centre without providing the scheduled program.

> *"…in the middle of a video-conference, the Internet connection fails or the electric power supplier stops. Do you feel how this interruption disappoints professionals?" (TP7).*

Of course, telemedicine projects in Ethiopia may face such challenges, but during the data gathering phase of this study, it became clear that the responsible bodies have not taken corrective actions in order to improve the overall performance of such projects. This in turn affects the impact of telemedicine on reduction of healthcare service inequality.

Hence, according to this study, considering the consistency of telemedicine services during the evaluation of telemedicine services has an impact on the significance of telemedicine projects on the reduction of healthcare inequality.

4.3.2.2 User expectation

When a telemedicine project is established, most of the health professionals in Ethiopia expect a lot of services since there are multifaceted problems in health facilities. Both the healthcare workers and clients hope that the intended project will significantly support the healthcare system of their institute. However, the restricted scope of the project causes specialists not to fully utilize the potential of the project.

> *"…health specialists in our hospital underutilized the telemedicine services, after using a few programs" (TP1).*

According to study participants, at the beginning of the telemedicine practices, health professionals were highly interested to use it. However, after few months, they showed less attention to the telemedicine services. This idea is also strengthened by study participant three.

> *"…the telemedicine services are below my expectation. I expected much more from this program…"* (TP3).

They raise different reasons. For example, participant five said the following:

> *"...I like any technology which aids the healthcare service delivery. At the beginning, I was excited, because I was expecting many services but it was providing tele-dermatology and tele-radiology, only for few specializations" (TP5).*

In Ethiopia where the number of healthcare professionals is very small, telemedicine has the potential to reduce this gap by accessing experts globally, but unless professionals use the full potential of the telemedicine projects, these projects cannot fulfil their intended purpose.

Thus, consideration of telemedicine service utilization during the evaluation of a telemedicine-based healthcare service inequality reduction in Ethiopia could result in improvements in telemedicine projects.

4.3.2.3 Program size

The size of the telemedicine program in Ethiopia was the other concept that emerged from the gathered data. In this study, the program size is expressed in terms of the types of services that telemedicine could deliver and the number of telemedicine sites in the country. Most of the respondents agree that the telemedicine services focused on specific programs. For instance, Case 1, 2 and 4 focused only on radiology, dermatology, tele-consultation and tele-education. Case 3 focused on HIV/AIDS and tele-education alone. However, as compared to the healthcare service demands of Ethiopia where the population of Ethiopia is exceeding 100 million, it is very small.

> *"...I would like to appreciate the initiatives, but as compared to the healthcare demand of the country, the telemedicine service must be expanded. You know, the healthcare demand between the rural and the urban communities is incomparable. The rural communities demand essential healthcare services, while urban communities need higher healthcare services" (TP2).*

In most of the developing countries like Ethiopia, it is common for rural communities to travel long distances to get medical service. Hence, according to the study participants, telemedicine supports communities that wish to access healthcare services without traveling long distance. However, the current telemedicine projects in Ethiopia are only providing limited services. For example, a medical director stated the following.

> *"...since the technology is a new aid to the healthcare system, there are many challenges. The first challenge is the mismatch between the expectations of healthcare workers and the service being delivered. It is too low and specialists say "we need more from this technology" (TP11).*

Although the number of telemedicine projects is small compared with the geographical area of Ethiopia, which is 1.1 million square kilometres, and the healthcare demand of the remote communities is large, using the full potential of these sites might improve their support of the current healthcare service. Study participant nine said the following:

> *"...after investing this much on telemedicine projects, I personally expect better healthcare services than what is currently being delivered" (TP9).*

Moreover, according to participant one,

> *"…in case 2, only a few tele-consultations per week have been carried out…" (TP1).*

Hence, gradually health specialists are becoming reluctant to use the facilities of telemedicine. This is because the telemedicine services being delivered do not match their expectations. As a result, program size could be another factor for evaluating telemedicine-based healthcare inequality reduction in Ethiopia.

4.3.2.4 User satisfaction

In developing countries such as Ethiopia, where health facilities and healthcare workers are limited, the provision of essential healthcare services to rural communities is very difficult. In this regard, telemedicine is supposed to play important role in such countries by enhancing the healthcare accessibility in remote areas in order to satisfy the main healthcare demands. The analysis results show that user satisfaction is another subcategory to be considered for evaluating telemedicine projects in Ethiopia. According to this study, user satisfaction arises from accessing reliable healthcare service without moving long distance.

According to the study participants, the satisfaction of telemedicine users in most of the telemedicine projects i.e. Case 1, Case 2 and Case 4 is moderate to low. Study participants responded as follows:

"... as far as my understanding, quality is commonly expressed in terms of satisfying customers, but I do not think that our customers are satisfied because they are not getting enough tele-based services. That means we are not delivering services as per the demand of our clients" (TP3).

"...I know that the quality of our telemedicine projects does not match with what it should be" (TP2).

For service providers such as telemedicine centres, the satisfaction of users determines their future because customer satisfaction produces good feedback from users which can support proper management and the improvement of telemedicine services. Moreover, satisfied users recommend a centre to others.

According to participant four, the acceptance of telemedicine services is reported to be moderate to low.

"Telemedicine service providers have problems in accepting change in process and service delivery manner" (TP4).

Hence, the consideration of user satisfaction in the evaluation of telemedicine-based healthcare inequality may result in improved outcomes.

4.3.3 Synergetic Effect

Healthcare service provision is a collaborative work that requires the contribution of every healthcare worker. Synergetic effect refers to the potential of telemedicine in allowing stakeholder to work collaboratively without the restriction of distance. The analysed data shows that telemedicine practices improve the relationship and communication between users such as institutes, patients, and professionals. In this study, the synergetic effect includes subcategories such as inter-institute connection, patient-to-professional contact and inter-professional relationship (see Figure 19). Hence, the synergetic effect is another core insight emerged from the

interviews of study participants. Each of the subcategories in that synergetic effect is described as follows:

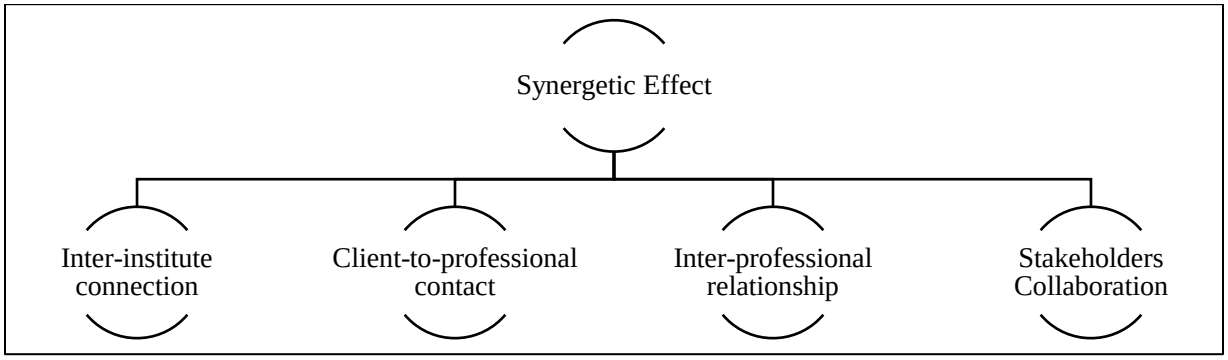

Figure 19: Synergetic effect

4.3.3.1 Inter-Institute connection

Health institutes carryout various health matters jointly. However, according to this study, telemedicine enhances the link among health institutes such as hospitals, information and communication technology organizations, governmental and non-governmental organizations, and enable them to communicate, especially when there are emergency scenarios such as disease outbreaks.

Since the implementation of telemedicine, Ethiopia has established relationships with foreign organizations from India and the USA. This in turn has helped them to build the capacity of their staff through training.

> *"...because of these telemedicine projects, we have been establishing relationship with different healthcare organizations. For Example, the first telemedicine project interconnected ten Ethiopian hospitals and an Indian telemedicine centre" (TP1).*

A case found in one telemedicine site has the potential to be seen by other inter-linked institutes and specialists, who can provide their own suggestions. According to the study participants, this opportunity has improved their lessons-learned from the project. Healthcare workers can conduct

discussions on similar case from different sites during tele-conferencing sessions. Despite a specialist's absence, another specialist from a different site can provide consultations for patients with similar cases.

Although all public institutes such as hospitals, health centres, health posts and health stations are under the umbrella of the Ministry of Health (MoH), the inter-institution communications before the establishment of the telemedicine centres were very limited. This technology has provided a means for exchanging health care and management information between health organizations. According to study participant three

> *"...through this technology, we have been using the opportunity of exchanging experiences, and lessons-learned between hospitals" (TP3).*

Institutional connection could be mandatory for some healthcare decisions as stated by a research participant.

> *"...in health organizations, communication is very important, in making the right decision at the right time, especially during disease outbreaks" (TP5).*

Likewise, the telemedicine-based inter-institute connection created additional opportunities such as research and education that are being carried out between local and foreign institutes.

4.3.3.2 Client to professional contact

Although the nature of the relationship between clients and healthcare workers has been given the least attention in developing countries such as Ethiopia where healthcare coverage and the number of health specialists is limited, this study shows that telemedicine empowered client to professional contact. For the telemedicine practices, the common clients include patients, healthcare workers, and health students.

The small number of healthcare professionals who are mainly found in big towns are accessible though this technology. According to the Federal HIV/AIDS Prevention and Control Office (2010) report, the physician to population ratio then was 1:37996. Patients also had the chance to make contact with specialists found outside the country. Conversely, health professionals could treat, consult and educate more patients.

> *"...in our country, the number of medical doctors is very small as compared to the alarmingly increasing population. It is becoming difficult to be examined by a specialist in most of the health organizations, even in towns. Usually, patients access general practitioners or they have to wait for hours..." (TP4).*

At the same time professionals are consulting with large number of clients remotely. For instance, in Case 1, there were MSc students who attend classes in Addis Ababa and Harommaya Universities found in Ethiopia. However, the professors who delivered the courses were from Hyderabad (India). As stated by study participant nine,

> *"... at the same time, health professionals can consult, teach large number of clients remotely" (TP9).*

With the support of telemedicine, the distance constraint has been reduced as stated by study participants.

> *"...since telemedicine reduces the distance barrier between patients and physicians, it enables patients remotely contact their doctors easily than the face-to-face contact" (TP8).*

Also, clients express their ideas more freely via the telemedicine technologies than in face-to-face communications. According to respondents, the technology empowered clients to communicate with professionals freely.

> *"...our clients feel free during video-conferences; raise additional questions; run discussions better than the usual in person (face-to-face) communication. And this enables our clients to improve their understanding and experience" (TP3).*

Similarly, this study shows that telemedicine has improved trust between clients and professionals because clients in remote areas have been able to access specialist from big cities and from abroad; however, it must be remembered that the highest qualified healthcare professionals in health centres in most rural areas are nurses. This in turn increases the acceptance of telemedicine services by rural clients.

In Ethiopia, patients from rural areas leave urban health centres before finishing their treatment because they cannot afford the cost of living in the big cities for two or three months. However, telemedicine has improved client to professional contact as well as patient monitoring and control since it has enabled patients to access medical care in remote areas.

> *"It enables healthcare workers to treat, consult, educate, and monitor more people in more areas at a time. Telemedicine significantly helps for enhancing patient access to physician" (TP1).*

4.3.3.3 Inter-professional relationships

In countries like Ethiopia, when healthcare professionals from different disciplines work jointly, it is easier to form an improved comprehensive view of patient care, especially for those in remote areas. According to this study, the telemedicine technology has enabled healthcare professionals to establish new and enhanced relationships with professionals situated in other hospitals both inside and outside Ethiopia. This has further helped the professions to increase their professional integrity. For instance, participant two states

> *"...I had the opportunity to discuss about tele-dermatology cases with new physicians found in Indian telemedicine sites" (TP2).*

Increased interaction between medical professionals, sharing ideas about patient treatments and working together using telemedicine, maintains the continuity of healthcare in Ethiopia. This idea is also furthered by another participant.

"... It was very interested to discuss about a topic with many physicians found in different parts of Ethiopia" (TP5).

Inter-professional relationships further enabled them to make shared decisions.

"...Telemedicine enables to well-informed decisions. Expertise explanations from different sources on a specific case is important for informed decision making, and sharing experiences" (TP7).

In the healthcare system, poor communication among health professionals can be one cause of their lack of medical care and poor performance. Hence, using telemedicine for inter-professional communication will result in effective teamwork and good working relationships that can reduce medical errors and improves health outcomes.

4.3.3.4 Stakeholders collaboration

Although healthcare services are collaborative, without the collaboration of stakeholders, according to this study, telemedicine service delivery in Ethiopia is unthinkable. The key telemedicine stakeholders include telemedicine experts, healthcare workers, ICT experts and researchers, medical directors and telecommunication managers. The analysed data shows that the combined effort of stakeholders plays a significant role if the technology is to provide reliable and sustainable services for all communities. According to respondents, for the evaluation of a telemedicine project, there is a need for a collaboration effort from private, public, governmental and non-governmental organizations to support the telemedicine services in order for them to deliver good reliable services. For instance, study participant eight said the following.

"...one of the most serious problems in our country, concerning ICT services, emanates from lack of coordinated effort from its stakeholders. The proverb 'two heads are better than one' really must be practices in our sites" (TP8).

Furthermore, in Ethiopia, collaborative work breaks down traditional barriers of communication and increases a dynamic dialogue with all telemedicine stakeholders. This also increases the engagement of healthcare workers and strengthens the long-term relationship with key stakeholders.

Almost all respondents agree that telemedicine, medical, public health, ICT experts and researchers have to work collaboratively for the revival of the underutilized telemedicine services.

> *"…for an effective healthcare service provision, there has to be collaborative work between universities, research centres, ICT offices and health organization" (TP7).*

Thus, collaboration of telemedicine stakeholders is one of the identified subcategories that could be considered in evaluating telemedicine-based healthcare inequality reduction in Ethiopia.

4.3.4 Localization

Although telemedicine projects are established to remove the barriers between health facilities and clients in remote areas, the implementation of such new technologies is facing many challenges. According to this study, localization is the other theme, that emerged from the gathered data, that impedes the intended outcome of telemedicine services in Ethiopia. In this study, localization refers to customizing telemedicine services to suit the community in Ethiopia. In countries like Ethiopia where there are more than 80 ethnic groups, speaking more than 76 languages and having individual social styles, then the localization of telemedicine services, their rules and procedures play an important role. According to this study, a telemedicine project is expected to be tailored to fit with the three subcategories of cultural influence, social condition and language of the area of the country in which it operates (see Figure 20).

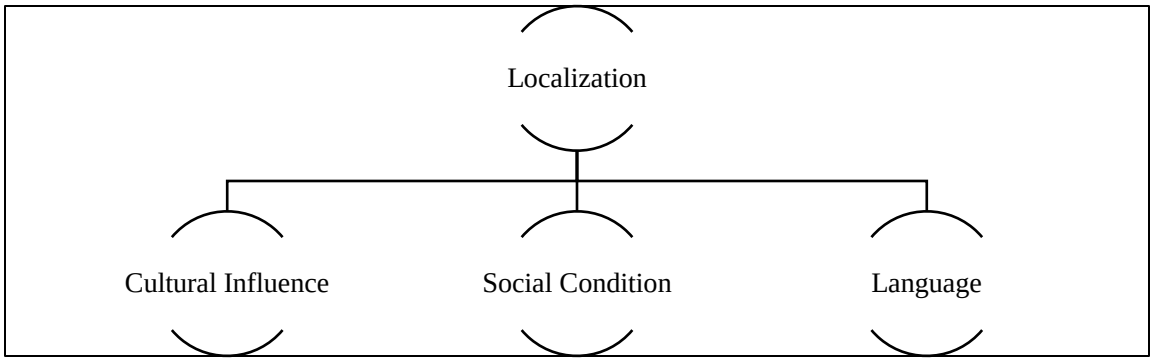

Figure 20: Localization

4.3.4.1 Cultural influence

Culture is considered to be an invisible bond that helps people to come together. In countries like Ethiopia where very diversified communities live together, understanding the cultural values and believes of communities is a priority because they usually resist the acceptance of any new technology that they consider to be contrary to their culture.

According to this study, telemedicine practitioners in Ethiopia have been facing challenges related to the culture of remote communities. Patients in rural areas prefer healthcare professionals who are familiar with their culture. Specially, if Ethiopian healthcare professionals are not involved, due to cultural differences, it is very challenging to communicate with rural communities. People in rural areas of Ethiopian do not expose themselves to anyone unless they trust that person. This is a very challenging factor especially in the case of telemedicine projects where patients are being treated by foreign specialists through such technologies. Participant five made the following statements.

> *"... patients in rural areas do not like to expose their body for a person who does not understand their culture. They do not like to be touched by anyone, especially a foreigner unless the patients are convinced by other healthcare workers who know understand the culture of the patients" (TP5).*

Study participant nine strengthens this idea.

> *"…the culture in rural areas has been challenging us very much. We have been working with local officials in order to consult and educate remote communities" (TP9).*

In Ethiopia, culture significantly influences the implementation of new technologies because it interacts with other parameters such as race, religion and socioeconomic status of the people. Although there are more than 80 ethnic groups in Ethiopia, most of them are found in rural areas that are populated by uneducated people with low economic status. However, these communities give priority to their cultural values before any other benefits. For example, pregnant women in the Afar region of Ethiopia need to be treated only by Afar healthcare works.

Hence, the consideration of cultural influence for the evaluation of telemedicine-based healthcare inequality reduction is expected to significantly affect the healthcare outcomes in Ethiopia.

4.3.4.2 Social conditions

The other identified subcategory in localization is social condition of telemedicine users. According to this study, social condition refers to how the Ethiopian people live and work, how communities support each other, and the level of education.

In order to achieve the objectives of a telemedicine project, according to study participants, consideration of the social conditions such as social events, ceremonies, and public holidays in remote communities play a significant role. Study participant seven states the following.

> *"…to educate and consult rural communities in health matters, we use social events like ceremonies and public holidays. Most of the rural communities are illiterate farmers and we use different mechanisms to provide health education and consultation services" (TP7).*

It is very difficult to gather Ethiopian rural communities together for various purposes unless someone knows their social conditions. Nowadays, healthcare workers who are familiar with the

social events of such communities are providing health education and training with the support of governmental and non-governmental agencies. According to respondent one,

> *"…since healthcare extension workers understand the social aspects of rural communities, they has been playing a significant role in changing the attitude of rural communities" (TP1).*

In rural areas, it is common to hear announcements on agriculture, health and political issues at the end of religious events in churches and mosques. Any gathering out of the common ones is considered to be a waste of time for farmers and they do not come to attend anything unusual.

There are two commonly known social gatherings of Ethiopian people namely "Edir" and "Ekub". Edir is an association that has its own rules and procedures. It may consist of hundreds of members. Its members gather monthly and pay a fixed amount of money. Its primary purpose is to handle funeral related responsibilities after the death of a member of the association and his or her family members. It also supports the deceased family. Healthcare workers use this social occasion as a good opportunity to access many rural communities at a time and transfer the needed information. Ekub is also another association having its own rules and regulations. It may have five to thirty or more members but usually fewer than seventy. The members usually gather every Sunday. The members pay a fixed amount of money to the chairperson of the association. Then, the chairperson conducts a simple random sampling technique to draw the winner of the week and the collected money is given to the winner. They do this procedure every week until all members have had the chance to win. This association is very important to its members as it supports them economically. For instance, a famer may have a plan to buy a horse this year but he may not have enough money now. If he wins the Ekub, he can buy the horse now and he will pay every week until the end of the Ekub. Hence, healthcare workers also use this opportunity to access people.

A telemedicine project that does not consider the social conditions of rural communities may not achieve its objectives. Thus, for the evaluation of telemedicine-based healthcare inequality reduction, the social condition of users in particularly remote communities have to be given due attention.

4.3.4.3 Language

In relation to localization, the analysis result shows that language is another subcategory that significantly influences the telemedicine practices in Ethiopia.

Although Amharic and Oromoffa are the two most spoken languages in Ethiopia, there are seventy-seven locally spoken languages. Most of these languages are spoken in the rural areas of the country. If healthcare workers cannot communicate with patients from these areas, then service providers at the main healthcare centre are challenged.

Most of the time, healthcare specialists work with the support of translators. Currently, health extension workers fill this role because they are first recruited from their respective communities and are familiar with the local language. However, health extension workers are not involved in all telemedicine sites in Ethiopia.

Moreover, as most of the rural communities are uneducated, the physician-patient language is the other problem. Patients from rural areas need plain language that they can understand easily. The inclusion of technical words confuses patients. Study participant three said that

> *"…language is a common challenge in rural health centres" (TP3).*

Respondent nine also supports this idea,

> *"… when physician ask patients from a rural area, most of the patient say 'what do you mean?' So, physicians need the support of other people who know each other and mediate the physician-patient communication." (TP9).*

Hence, for the evaluation of the impact of telemedicine on healthcare inequality reduction in Ethiopia, as per this study, the use of localized language between patients and physicians is required.

4.3.5 Technical Setup

From the inductively analysed data of this study, technical setup emerged as another theme for the evaluation of telemedicine-base healthcare inequality reduction in Ethiopia. In this study, the state of the technical setup ensures that the proper telemedicine technical requirements are ready for smooth telemedicine service provision.

A telemedicine service provider cannot be fit for use, provide quality service and show its synergetic effect if its technical setup is poor. Research participants admitted that, in Ethiopia, unreliable telecom networks, Internet and electric power supply has been challenging the telemedicine service provision considerably.

> *"We are not currently using good quality technologies for capturing better quality images and videos. In addition, it is difficult to transmit data, and run the telemedicine consultations and treatments because of the unreliable electric power supplies, poor communication networks" (TP1).*

For a sustainable telemedicine service provision, evaluation of the technical setup of telemedicine projects is required. Therefore, as this study shows, technical setup is one of the main themes or factors for evaluating the impact of telemedicine on healthcare inequality reduction. This theme, technical setup, emerged from the four subcategories: telecom facilities, Internet connection, reliable electric power supply and availability of technical experts (see Figure 21). The four subcategories are illustrated below.

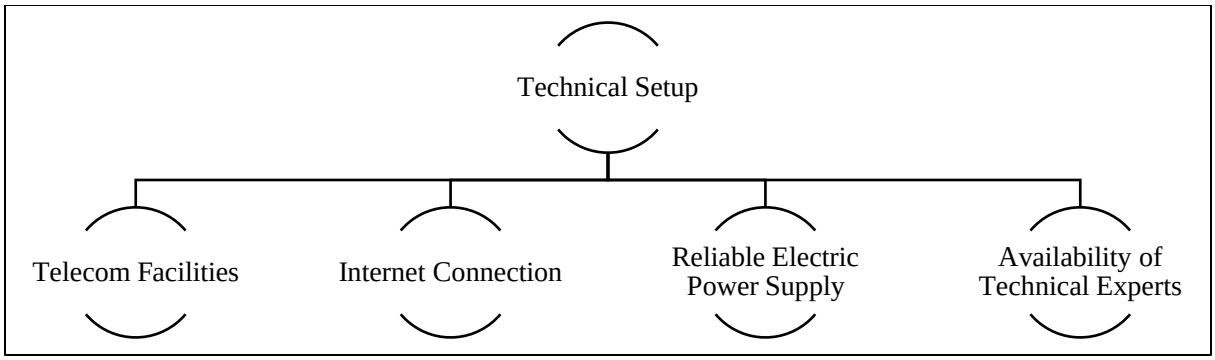

Figure 21: Technical setup

4.3.5.1 Telecom facilities

According to participants, telecom is the backbone of any ICT-based services. Like other sectors in Ethiopia, health institutions are being automated to handle their routine operations in a computerized manner for improved services.

The increasing role of telecom services in Ethiopia is enabling the accessibility of health and education services for remote communities disadvantaged by geography. The technology has made it easier for these communities to access their healthcare providers without travelling long distances. They can communicate with their health extension workers using their mobile phones.

However, respondents raised the point that fluctuations in telecom services, making them unreliable, have been a big problem. The challenge has been particularly serious when a failure of the telecom service occurs during live satellite transmissions between at least two or more sites. This situation in turn, discourages clients from abroad.

> *"…telecom is the backbone of any communication system. Being the only service provider, Ethio-Telecom has been delivering telephone, telegram, fax and the Internet services as much as possible. However, the demands of organizations do not match with the service provision of Ethio-Telecom. We usually complain about the service, when it stops working or the network is too busy. Lots of 'Opps!' appear when the Internet connection gets down" (TP4).*

Similar responses also strengthened this concept

> *"Internet connectivity issues such as low band-width and network infrastructure should be improved. There is lack of reliable and affordable telecommunication service, and problems on the electric power suppliers" (TP6).*

The telecom services are enabling underserved communities to get rapid responses, better monitoring, improved coordination and management. Therefore, the telecom facilities have to be considered during the evaluation of the impact of telemedicine on healthcare inequality reduction.

4.3.5.2 Internet connection

Access to an Internet connection is becoming vital for progressive communities. In Ethiopia, people having access to a broadband Internet connection are experiencing economic, social and educational advantages. In the case of developing countries like Ethiopia, the Internet also has the potential to save lives of geographically disadvantaged communities. However, for many rural areas of Ethiopia, access to a broadband Internet connection is a serious problem.

For reliable telemedicine service provision, the availability of an uninterrupted Internet connection is one of the preconditions. According to this study, Internet connection interruption is one of the factors that impedes the potential advantages of telemedicine services in Ethiopia. Almost all study participants agree about the challenge of an unreliable Internet connection. The modern telemedicine technology uses the Internet as its means of communication. It is a common barrier for both synchronous (direct satellite transmission) and asynchronous (store-and-forward) types of telemedicine services.

> *"…whilst delivering telehealth services, Internet stops and disappoints me. It may stop working for hours, or the whole day. Now-a-days, I am accustomed to this problem" (TP5).*

According to study participants, the Internet connection problem has a negative effect on the feelings of healthcare workers because they come to the telemedicine centre knowing that their scheduled patients located in different areas are waiting for them.

> *"…I knock my table angrily when the Internet connection accidentally stops. I bring other tasks that I will accomplish if there is no Internet connection" (TP6).*

A telemedicine service provider has to have reliable Internet connections in order to better use the potential of telemedicine services. Thus, a reliable Internet connection has to be included during the evaluation of telemedicine-based healthcare inequality reduction in the case of Ethiopia.

4.3.5.3 Electric power supply

With the increasing number of health technological devices, the electric power consumption of health institutes is also increasing. To run medical facilities and ensure access to healthcare, access to electricity is essential, especially in remote areas. An unstable electric power supply is a common challenge in Ethiopia.

The interview data revealed that fluctuation of the electric power supply was another common barrier of the telemedicine practices of Ethiopia. It is unthinkable to have telemedicine services in general without reliable electric power sources.

> *"...reliable electric power supply is one of the preconditions for a telemedicine service provision. However, it frequently stops. It is difficult to tell you the feeling of professionals and medical students when their activities are interrupted, due to fluctuation of electric power suppliers" (TP6).*

Nowadays, it is common for hospitals to have an electric power generator or an alternative low-cost power source such as low-cost off-grid solar panels and wind energy sources. However, smaller health facilities such as health centres, health stations and health posts do not have the

backup of these alternative. As a result, laboratory tests cannot be done unless there is electric power.

> *"…It is painful to stop working due to serge and blackouts of electric power suppliers while diagnosing patients who need immediate treatment" (TP10).*

Hence, for an effective telemedicine service provision in the context of developing countries, an uninterrupted electric power supply must be secured. Hence, for the evaluation of telemedicine-based healthcare inequality in Ethiopia, the inclusion of a reliable electric power supply plays an important role.

4.3.5.4 Technical experts

For reliable telemedicine service provision, according to this study, the availability of a telemedicine technical expert is one of the prerequisites of the service. In Ethiopia, although there are only a few telemedicine technical experts, they have the potential to offer low-cost high-tech solutions by solving problems quickly. However, according to the analysed data, there is shortage of trained telemedicine experts, especially in telemedicine sites outside of the capital city of Ethiopia, Addis Ababa. According to study participant two,

> *"…in this site, we do not have enough number of telemedicine technical experts. Look at that technical expert, he came from India. He has been serving our hospital for more than a year. Now, we do not have local technical experts who will replace him, in the long run" (TP2).*

The availability of a trained technical expert enables health institutes to provide reliable telemedicine services and to deliver high-performance outcomes by providing maintenance services at the right time, but the shortage of such experts will be addressed soon. According to respondent three,

"…we plan to train local telemedicine technical experts in order to solve the shortage of trained experts, in our site" (TP3).

Therefore, the availability of trained telemedicine technical experts is found to significantly affect the evaluation of telemedicine-based healthcare inequality reduction in Ethiopia.

4.3.6 Resource Utilization

For an effective telemedicine-based healthcare service delivery, the availability of the required resources is a major determinant. From the inductively analysed data, resource utilization has emerged as another theme of the study. According to this study, resource utilization denotes the use of health-related resources, basically human, physical and time, and the accumulated knowledge of health institutes and healthcare professionals in the telemedicine sites (see Figure 22).

Shortage of resources is one of the problems that the Ethiopian healthcare system is facing. However, telemedicine shows good resource utilization of the small number of those expensive resources. To evaluate the impact of a telemedicine on healthcare inequality mitigation, resource utilization has to be included. Discussion of these subcategories is presented as follows.

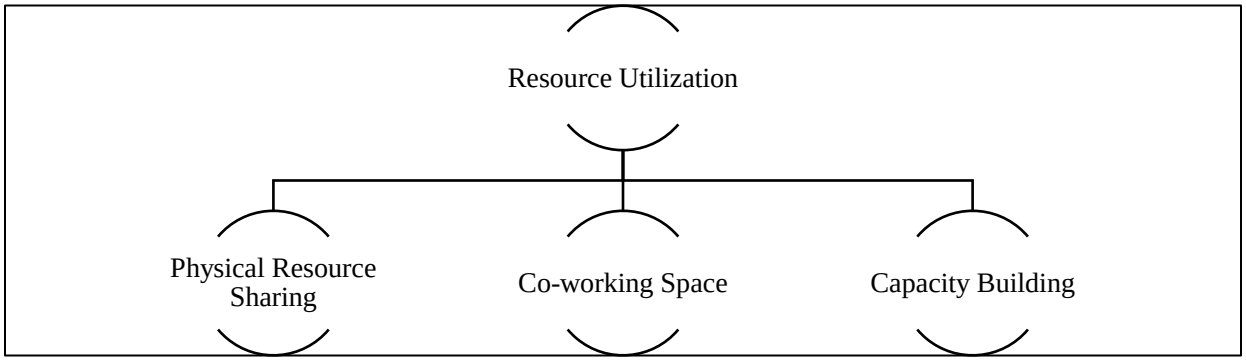

Figure 22: Resource utilization

4.3.6.1 Physical resource sharing

It is very difficult to establish health facilities in every community for developing countries like Ethiopia because health equipment is too expensive and unaffordable for every health facility. Such equipment is mainly found only in a few referral hospitals. Hence, study participants stressed that these expensive physical resources that are found in a few facilities should be shared with clients who are facing geographical and distance challenges using telemedicine.

> *"...one telemedicine centre can transmit its services to several remote telemedicine sites. For example, in case 1, the head telemedicine centre is found in Hydra bad, India, and it delivers services to ten telemedicine sites, in different parts of Ethiopia. In this case, the ten sites have been sharing the resources of the main service centre" (TP1).*

Telemedicine creates a common support service for the participation of healthcare providers and strengthens cooperation between professions, introducing new communication possibilities. In addition to reducing the geographical barrier between communities, telemedicine in Ethiopia reduces wastage of resources and duplication of processes. A medical director strengthens this idea saying that

> *"... telemedicine reduces unnecessary duplication of medical resources, that are especially expensive" (TP4).*

Hence, consideration of resource utilization in telemedicine-based healthcare inequality reduction has the potential to improved telemedicine practices and healthcare outcomes.

4.3.6.2 Co-working Space

In developing countries such as Ethiopia where shortage of healthcare workers is a common challenge, good workforce management can help to get more out of less. This has been possible when shared co-working space is created within the Ethiopian healthcare system. Co-working space refers to the potential of telemedicine in creating common healthcare serving proving

environment among workers, patients and students whether they are within or outside of a country. In Ethiopia, health specialists are mainly found in big towns. This has resulted in poor health conditions in rural and sub-urban areas. However, the data from research participants shows that telemedicine enables the sharing of a member of the health workforce or a health specialist and their time, anywhere and anytime.

According to participants, telemedicine is enabling health workers to share and network their expertise across different institutes and countries.

> *"...Ethiopian medical specialists and students access training courses from specialists in the USA via direct satellite video-conferencing" (TP3).*

Moreover, telemedicine strengthens team working between healthcare workers, and enables them to be quicker and more effective in the delivery of their healthcare service. As a result, telemedicine is empowering health workers by giving them experience and a more flexible and voluntary work style and schedule. This increases the number of contingent professionals.

> *"Dermatologists and radiologists read x-ray results that are received from Ethiopia. Then, they forward their recommendations, referral requests and prescriptions from India to Ethiopia" (TP1).*

The establishment of telemedicine is enabling healthcare workers in Ethiopia to use the telemedicine services concurrently. The graduate students in different locations in Ethiopia have been attending classes being broadcasted from USA and India. This has created the opportunity to share common core values between the participants inside and outside Ethiopia.

Hence, the consideration co-working space for the evaluation of telemedicine-based healthcare inequality reduction in Ethiopia, according to this study, has the potential to provide improved results.

4.3.6.3 Capacity building

The introduction of ICT in the Ethiopian healthcare system improves collaboration among multiple healthcare workers in different locations through telecommunication, and this opportunity is currently providing foundations for knowledge sharing. According to study participants, they have been benefited from telemedicine, particularly in terms of building capacity of health specialists and healthcare workers.

> *"…I have been improving my knowledge about HIV/AIDS through continuous discussions with specialists in the USA" (TP3).*

Transferring knowledge to physicians and healthcare workers in Ethiopia is benefiting health institutes in different ways. For example, their employees are accessing professional training courses without going to abroad, and this reduces travel and other indirect costs. The healthcare workers also provide healthcare services at the end of every training session to their respective health institutes in Ethiopia. According to a participant, this opportunity may reduce the shortage of trained technical experts too.

> *"…lack of well-trained technical expert. Training of technical experts has been provided in very small number of hospitals and universities" (TP1).*

Moreover, the technology enabled these interviewees to participate in scientific arguments and professional discussion on health matters between Ethiopian professionals and foreigners. These interviewees are delighted to be able to carry out academic discourses with other health researchers. Hence, it can be seen that a consideration of capacity building for evaluating telemedicine-based healthcare inequality reduction in Ethiopia plays an important role.

4.3.7 Managerial Readiness

Concerning the telemedicine practices in Ethiopia, in the inductively analysis of interview results, managerial readiness emerged as the last theme of the study. For the overall success of

telemedicine practices in Ethiopia, according to this study, managerial readiness plays vital role. Hence, to evaluate telemedicine-based healthcare inequality mitigation in Ethiopia, according to this study, the inclusion of managerial readiness as a core theme, has a significant potential effect. Managerial readiness, in the study involves the arrangement of telemedicine requirements, specifically making policies, budget allocation, goal setting and commitment of stakeholders (see Figure 23). Details of these subcategories are discussed below.

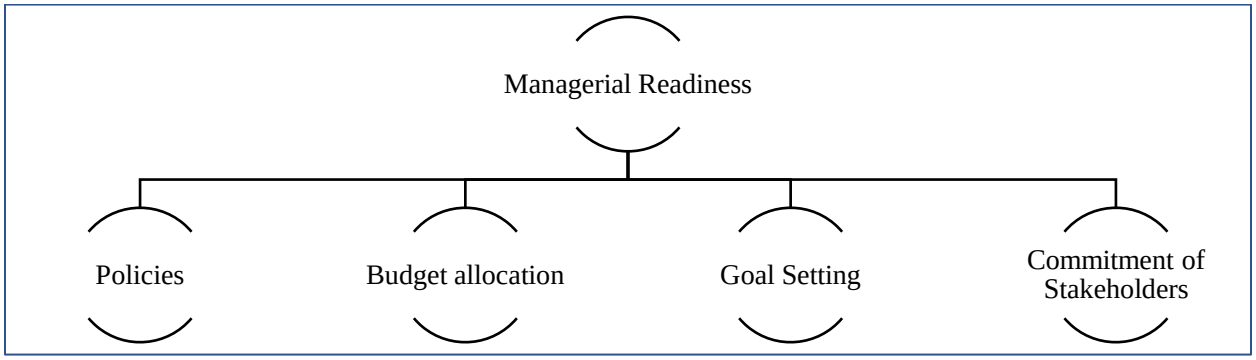

Figure 23: Managerial readiness

4.3.7.1 Policies

For the proper administration of a telemedicine project in Ethiopia, according to this study, health informatics practitioners and ICT experts stressed the need for firm specific ICT policies in general and for telemedicine in particular.

The readiness of health organizations for the successful implementation of telemedicine starts by having detailed policies. However, respondents frequently raised lack of policies as a challenge.

> *"… there must be detailed ICT and telemedicine policies that can be used by any health organization" (TP9).*

Development of telemedicine policies and procedures pertinent to each telemedicine site and host in Ethiopia is important for the proper administration and control of the telemedicine service delivery.

Concerning telemedicine, Ethiopia does not have a policy. But there is a general ICT policy prepared by the Ethiopian Federal Ministry of Health.

> *"... at ministry level, there is ICT policy, formulated as a strategic plan, but it lacks to be detailed" (TP11).*

However, according to telemedicine experts, the development of detailed policies on clinical consultations, scheduling educational and training events, informed consent, procedural policies and patient privacy and confidentiality considering the health setting of Ethiopia, have to be given high priority.

Hence, the availability of working detailed policies and procedures on telemedicine and ICT in Ethiopia has to be considered while evaluating the telemedicine -based healthcare inequality reduction in the country.

4.3.7.2 Budget allocation

It is obvious that the budget being allocated in developing countries like Ethiopia is not enough to address all of the persistent challenges. As stated by respondents, all of the telemedicine projects were initiated by foreign organizations. The contribution of the local government was simply on establishing the telecommunication infrastructure and networking tasks. After its establishment, the involvement of the government and other bodies in allocating enough budget for maintenance, service improvement and monitoring and control has been limited.

> *"...the technologies being used by telemedicine services need to be upgraded, because the latest telehealth products are bringing additional and new healthcare services. ICT technologies are supporting the healthcare system. The evolution of this technology is amazing. It changes every day, and every new version comes with new features. However, our ICT facilities, are not up-to-date. I think, the administrators did not enough budget to purchase these new products" (TP1).*

The coverage of the four telemedicine projects is small as compared to the geographical area and healthcare service demand of the country. Thus, respondents stressed the need for the expansion of the current telemedicine initiatives to the rest of the country, especially those rural areas which need immediate action.

> *"…when a certain new technology comes, first it serves the urban areas. Why? It is amazing. Telemedicine is supposed to support healthcare systems of rural communities but it has been exploited by urban dwellers" (TP10).*

Despite the initial high cost of telemedicine sites, according to a respondent, this sort of healthcare can lower health costs, especially in Africa, if health institutes allocate enough budget to run the telemedicine facilities smoothly and also work on improving the healthcare services in Ethiopian rural areas.

Hence, consideration of the budget allocation of health institutes for telemedicine projects during the evaluation of telemedicine-based healthcare inequality in Ethiopia is vital.

4.3.7.3 Goal setting

Although the introduction of telemedicine into the healthcare system of Ethiopia spans more than a decade, the lack of common goals among the telemedicine stakeholders has been challenging telemedicine projects.

According to the responses of research participants, for an effective telemedicine service delivery in Ethiopia, organizations such as telecommunication, ICT agencies and health organizations must set common goals concerning ICT assimilation in their operations.

> *"…unless we come together and develop telemedicine goals, procedures and plans, it will be very difficult to strengthen the entire system in isolation. You know, some organization say that this is the responsibility of telecom service provider, not ours" (TP5).*

Setting common goals, procedures and plans for all telemedicine stakeholders strengthens the telemedicine healthcare service provision in Ethiopia.

Hence, the inclusion of this subcategory into the evaluation of telemedicine-based healthcare service inequality reduction in Ethiopia improves the evaluation results.

4.3.7.4 Commitment of stakeholders

The implementation of new technologies, such as telemedicine, especially in developing countries, faces many challenges. The study reveals that the telemedicine practices in Ethiopia have been facing technical and administrative challenges. A lack of commitment from authorities to address these challenges, negatively affects their services throughout the country.

> *"...we sometimes encounter technical problems that require immediate solution, especially during live video-conferencing, and we request the concerned administrative units, but it takes time to resolve the problem" (TP3).*

Study participant eight also strengthens this idea as follows.

> *"...I really hate those bureaucratic processes that a purchaser passes to purchase an equipment. Even after purchasing the item, there are also several processes to be passed in the store system. This delays to restart the telemedicine services" (TP8).*

According to the responses of study participants, administrative commitment on addressing telemedicine challenges would enhance the performance of telehealth centres.

Hence, in evaluating the telemedicine-based healthcare inequality reduction in Ethiopia, the commitment of administrators in confronting frequent telemedicine challenges, improves results. Furthermore, the researcher has examined relevant literature on frameworks for the evaluation of telemedicine systems. This has helped the researcher to see the newly identified insights that were not seen by previous researchers.

Accordingly, here are the most recent telehealth frameworks:

- Chang (2015), used a three-dimensional evaluation that includes six constructs to evaluate telemedicine programs. The constructs are human (service provider and patient/client) system (organization and technology) and environment (society and rules and policies).
- Dattakumar (2013) developed another telemedicine evaluation model that included patient control, clinician quality of care, organization sustainability, and technology capability.
- Bashshur et al. (2011) designed a three-dimensional model that includes functionality (consultation, diagnosis, monitoring, mentoring), technology (modes, network design, connectivity), and applications (treatment modalities, medical specialty, disease types, sites).
- Kifle et al. (2008) developed another framework which consisted of telemedicine capabilities, social outcomes, social values, ICT policy, e-health policy, data security and ICT infrastructure.
- Ohinmaa and Reponen (1997) developed a telemedicine assessment framework by using constructs such as performance measures, outcome measures, summary measures, operational considerations, and other issues such as confidentiality and legal issues.

These telemedicine evaluation frameworks were developed on the basis of previous works and in consideration of particular contextual issues. Most of them were developed in the context of developed countries using pre-supposed theories and quantitative approaches.

Unlike these studies, this current research focuses on the qualitative investigation of real-lived experiences of telemedicine experts in the context of a developing country. In addition to this, this study has been carried out from the perspective of healthcare inequality reduction and without a pre-supposed theory. As a result, new insights such as barrier removal, service quality, synergetic effect, technical setup, localization, resource utilization, and managerial readiness have emerged, after inductive analysis of the data. Moreover, most of the sub-categories in each of these themes are also new issues that were not identified by previous researchers.

The inclusion of these new insights has a significant role in contributing into telemedicine evaluation literature. Besides, the new framework will have a strong significance in the context of

developing countries, where socio-economic factors affect the implementation of telemedicine projects.

4.4 Summary

In this chapter, first the occurrences of the inductively emerged themes and their contextual descriptions were presented. Then, the thematic analysis of the core themes, namely barrier removal, service quality, synergetic effect, technical setup, localization, resource utilization, and managerial readiness and their respective subcategories was presented.

In Chapter 5, there will be a discussion of the major findings of the study, an explanation of the meanings of these findings and of their importance related to similar studies. In addition, the relevance of the study findings, the presentation of an improved telemedicine evaluation framework, an acknowledgement of the study's limitations and a look at future research directions, are included.

Chapter 5 DISCUSSION AND CONCLUSION

In Chapter 4, the results of the study were presented. The emergent themes that arose through inductive analysis were presented with supporting citations from the narratives of participants. In Chapter 5, the findings of the study are discussed and concluding statements are presented. In this chapter the limitations of the study, its implications for policy, practice and research and recommendations for future research are mentioned.

5.1 Introduction

Research findings show that several telemedicine evaluation frameworks have been suggested by organizations and individuals. These frameworks have been used to improve the healthcare service provisions of nations. There is evidence to confirm the contributions of these theories or frameworks for telehealth when implemented and evaluated particularly in rural areas where health facilities are scarce. Although such theories have been developed on the basis of previous theories, the perspective of this study differs from them in the following ways:

1. This study is carried out to develop a telemedicine evaluation framework that will be used for the evaluation of telemedicine-based healthcare inequalities reduction, particularly in the case of developing countries. However, most of the previously developed theories focussed on the telemedicine implementation frameworks in the case of the developed world.
2. Previous studies were quantitative studies using existing theories. However, unlike them, this study is conducted without presumed theories, rather it focusses on the real-lived experiences of healthcare workers who are involved, on a day to day basis in telemedicine projects. The qualitatively gathered data is inductively analysed using a grounded theory approach to identify emerging themes.

3. In the case of developing countries, not enough studies have been carried out on telemedicine evaluation frameworks in general and none have focussed on the reduction of healthcare inequalities in particular.
4. This study focussed on contextual issues in Ethiopia where the majority of the Ethiopian population lives in rural areas where they face huge healthcare service inequalities as compared to those who live in big cities of the country.

Although there are common contributions of telemedicine in the healthcare service provision, the findings of this study show that in the context of developing countries like Ethiopia, a framework for evaluating telemedicine-based reduction of healthcare service inequalities has to include themes such as barrier removal, service quality, synergetic effect, localization, technical setup, resource utilization and managerial readiness. In the context of developing countries, consideration of these inter-related themes in the evaluation of telemedicine services on the reduction of healthcare inequalities, have the potential to result in improved evaluation results.

According to this study, telemedicine enables the reduction of telemedicine barriers and empowers healthcare service accessibility, specifically it improves health facility and medical specialist accessibility of resource-constrained remote communities in Ethiopia. Telemedicine barrier removal denotes removing the healthcare obstacles of remote communities and making healthcare facilities and workers reachable to communities that demand healthcare services without the restriction of distance. Telemedicine basically improves users to access healthcare professionals, especially health specialists who are usually found only in the big cities of Ethiopia. This benefit is also supported by other studies showing that telemedicine can allow equitable and universal access to healthcare services. In Ethiopia, the role of such technology is helpful for rural communities which constitute more than 80% of the country's population. These communities live

in areas that are referred to as resource poor areas which suffer from a shortage of healthcare facilities and health workers. Hence, telemedicine has the potential to play a significant role in the reduction of healthcare inequalities in Ethiopia as there is high healthcare disparity between rural and urban communities in the nation.

5.2 Telemedicine Evaluation Framework

Telemedicine services have been implemented in the healthcare system of nations to support and extend healthcare service accessibility by isolated and remote communities. Although most of such service implementations are found in the developed countries, a few decades ago, telemedicine services were launched in the developing nations like Ethiopia. The implementation of telehealth services in low-income countries where health facilities are scarce, plays an important role in the provision of basic health services, consultancies and educational services to communities on essential health issues (Nouhi et al., 2012).

With this intention, telemedicine projects were implemented in Ethiopia to provide telehealth services to remote communities. As a result, a new telemedicine evaluation framework that can be used for the evaluation of telemedicine-based healthcare inequality reduction in Ethiopia is developed. The framework consists of seven themes namely barrier removal, service quality, synergetic effect, localization, technical setup, resource utilization and managerial readiness. The framework also includes twenty-five subcategories (see Figure 24).

Barrier removal refers to the capacity of telemedicine service to eliminate healthcare service challenges to increase healthcare service reachability by remote communities that suffer from shortage or absence of health facilities and medical specialists. In this study, barrier removal includes three subcategories such as accessing health facilities, approaching medical specialists and interactivity.

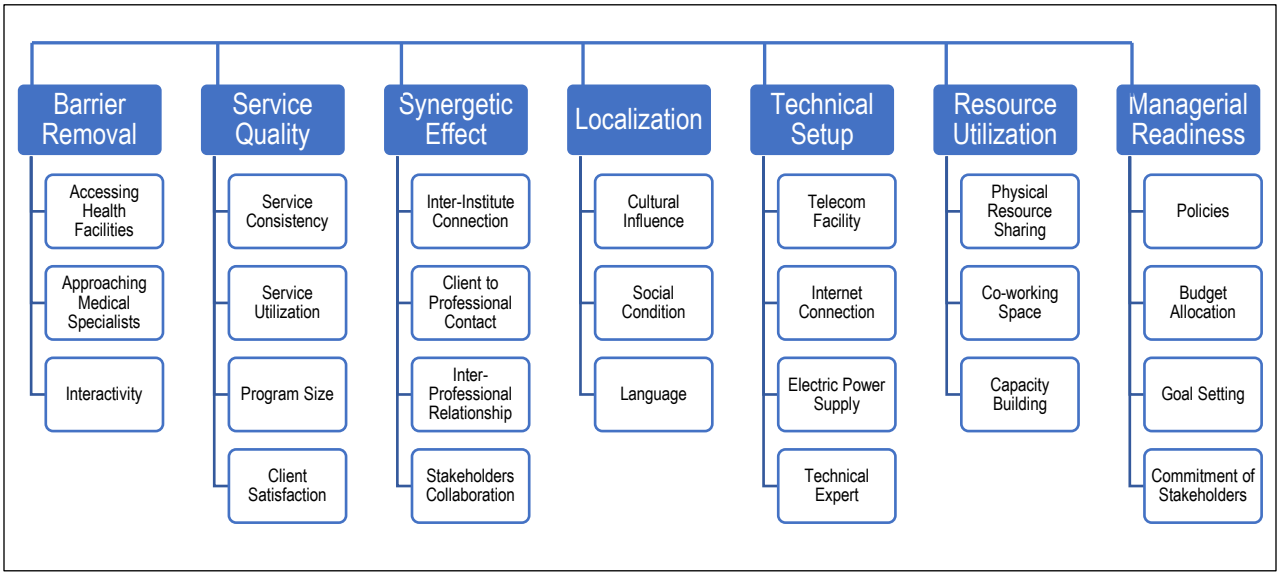

Figure 24: Telemedicine Evaluation Framework

The potential of telemedicine projects in making healthcare facilities accessible to remote communities is one of the factors that enhance the reduction of healthcare service inequalities. Health facilities such as hospitals, health centres, health stations and expensive health equipment are mainly found in big cities of Ethiopia, to which remote communities do not have access; however, telemedicine has enabled remote communities to access such facilities removing the distance barrier and it reduces the time and cost for clients who would otherwise have to travel long distances to get medical services (Moffatt and Eley, 2010). This has a positive effect on the reduction of healthcare inequalities.

Moreover, according to this study, telemedicine enables clients to approach medical specialists that are mostly found in health facilities of big cities of Ethiopia. Similarly, telemedicine helps clients in remote areas to access specialists from abroad and this gives them access that is equal to clients in urban areas. This assists the reduction of healthcare inequalities between remote communities and their counter parts.

Besides, the interactive nature of telemedicine services particularly in tele-education and tele-consultation has the capacity to motivate its users in rural areas of Ethiopia. Hence, an evaluation framework for the telemedicine-based reduction of healthcare inequalities has to primarily assess its potential to reduce barriers and enhance healthcare accessibility by remote communities.

In this study, service quality denotes reliable provision of telemedicine services that satisfies the healthcare demands of remote communities in Ethiopia. Service quality includes telemedicine service consistency, its utilization, client satisfaction, and program size. According to this study, if a telemedicine centre provides a consistent, useful and satisfying service to remote communities, it will have a high potential to reduce healthcare inequalities. Although telemedicine has the potential to deliver healthcare services anywhere and anytime, according to this study, the services have been inconsistent and this in turn demotivates clients (Niyato et al., 2007). Hence, telemedicine service consistency has to be included in the evaluation of telemedicine-based reduction of healthcare inequality.

The other subcategory that has to be used in the telemedicine evaluation framework is the utilization of telemedicine services. According to this study, although telemedicine has multifaceted services, healthcare workers have underutilized the telemedicine services in the four telemedicine projects. As a result, underutilization has its own adverse effect on the reduction of healthcare inequalities in the nation. Hence, the telemedicine evaluation framework has to assess how healthcare workers are using telemedicine services.

Telemedicine service quality is also affected by the size of programs being delivered by the telemedicine project. In Ethiopia, although telemedicine projects have the ability to offer many telehealth services, currently, only a few telemedicine services such as tele-dermatology, tele-

radiology, tele-education and tele-consultation are being delivered. Hence, medical specialist who are out of these domains abandon the system and do not have a good opinion of the facility.

Telemedicine service quality can also be assessed using client satisfaction. According to this study, since telemedicine services are inconsistent, underutilized and only run a few programs, client satisfaction is rated as low to moderate. The evaluation of client satisfaction helps to get feedback and to take corrective actions and to revise strategic plans (Isabalija et al., 2011). Hence, a telemedicine service quality is another determinant in formulating a framework for evaluation of telemedicine-based reduction of healthcare inequalities.

Since telemedicine is an inter-disciplinary activity that requires collaboration of all stakeholders, if it is appropriately delivered, it has the potential to reduce healthcare inequalities between communities. Synergetic effect includes inter-institute connection, client-to-professional contact, inter-professional relationship and stakeholder collaboration. Collaborative work results in better outcomes than would otherwise be expected which is reminiscent of the quotation of Aristotle "the whole is greater than the sum of its parts."

Inter-institute connection refers to the ability of telemedicine to connect health institutes within or outside of a country, and results in better collaborative works. In this study, for instance, ten local hospitals were interconnected to use telemedicine services. Moreover, they were also interconnected with a telemedicine service provider in India.

The other effect of telemedicine, according to this study, is its ability to create client-professional contacts no matter how far apart they are from each other. For instance, patients in Ethiopia were treated and consulted by specialists from India in an interactive way of telemedicine service. Thus, telemedicine enhances the client-to-professional contact which in turn motivates clients to utilize

the technology. Hence, a telemedicine evaluation framework has to assess the potential of telemedicine to enhance client-to-professional contact.

Besides, according to this study, a good inter-professional relationship has been shown to exist between healthcare professionals, which has the effect on telemedicine of the reduction of healthcare inequalities. The interrelationship between local healthcare workers that are found in different locations has been empowered. Moreover, the relationship between local and foreign healthcare professionals has been created by telemedicine which has assisted health facilities to use the opportunity to strengthen their healthcare service delivery in remote areas (Martin-Sanchez et al., 2004). Hence, this facilitates the healthcare inequality mitigation between communities.

Generally, telemedicine requires collaborative work in order to fully use its potential and reduce the healthcare inequalities. Thus, there must be collaboration of telemedicine stakeholders to address the challenge of healthcare inequality in remote areas. Hence, a telemedicine evaluation framework has to evaluate the synergetic effect of telemedicine service to achieve its target of reducing healthcare inequalities between individuals, communities, regions and countries.

Localization, in this study, refers to the process of tailoring services, processes and procedures to the context of a particular location or community. According to the study participants, unless a technology is localized, and takes into consideration contextual issues such as cultural and social conditions of a particular community, it will not be used effectively by clients. Localization in this study involves cultural influences, social conditions and language.

When telemedicine projects are implemented, consideration of the culture of the community that will use the technology is important as shown in this study. For instance, in Ethiopia where more than 70 ethnic groups live exercising varied cultures, implementation of such technologies faces

challenges, unless the technologies are designed to match with the culture of those communities, especially in remote rural areas.

Therefore, in order to effectively utilize the potential of telemedicine in culturally diversified remote communities, assessment of cultural influences must be done before the implementation of telemedicine projects.

Similarly, the social conditions of communities must be included during the evaluation of telemedicine projects. Social conditions include how people work, educate and support neighbours. This factor assists healthcare workers during health education and consultation services. In Ethiopia, healthcare extension workers educate remote communities at social meetings such as on public holidays, in churches, in mosques, and those of the community associations "Edir" and "Ekub". If a healthcare worker does not understand when and where these social gatherings take place, in Ethiopian rural areas, he will not be able to deliver any service.

Furthermore, for an effective telemedicine implementation, understanding the language being spoken by a community is necessary because there should be appropriate communication between professionals and remote communities. In Ethiopia where more than seventy languages are spoken, the implementation of telemedicine will not be effective if language is a barrier between clients and healthcare workers.

Hence, a telemedicine evaluation framework that assesses the telemedicine-based reduction of healthcare inequalities has to localize or contextualize (Guo-hong, 2007) cultural issues, social conditions and language of communities in a particular setting.

According to this study, for proper delivery of telemedicine services, the technical setup of the telemedicine service must be evaluated. Technical setup, in this study, includes telecom facility, Internet connection, electric power supply and technical expert.

A reliable telecom service is the basis for telehealth service provision. It interconnects the various telemedicine stakeholders and enables them to send, receive, call, SMS and live stream patient data. However, due to the frequent interruption of telecom services the communication between hosting hospitals and clients is frequently disconnected and this demotivates service providers and clients. Moreover, most of the telemedicine service providers, in Ethiopia, use the Internet to send and receive patient information; however, when there are telecom disruptions, all of the Internet-based services stop. Sometimes it takes hours to get an Internet connection again.

Thus, in the case of developing countries like Ethiopia, telemedicine services are compromised by unreliable electric power supply. It is persistent problem of the country; however, it is particularly challenging in remote areas. Now-a-days, alternative sources of electric power such as portable generators and solar panels are being used. Furthermore, for an effective telemedicine service provision, the presence of a telemedicine technical expert is another important input; however, some telemedicine services in Ethiopia have been challenged by the shortage of telemedicine experts. Generally, without an appropriate technical setup of a telemedicine service provider, it is difficult to deliver proper telemedicine services (Karim et al., 2013). Hence, a telemedicine evaluation framework has to assess the technical setup of a telemedicine project in order to see its effect on healthcare inequality reduction.

In the case of developing countries where resources are scarce, according to this study, a telemedicine evaluation framework has to assess the telemedicine resource utilization of the

project. Resource utilization includes the use of physical resources, co-working space and capacity building.

One of the benefits of telemedicine is its ability to share physical resources found in one hospital with others wherever they are (Balch, 2008). The healthcare system mainly uses expensive equipment; however, these tools cannot be accessed by remote communities unless telemedicine is implemented. Clients in remote areas use the healthcare professionals in big cities. Similarly, the time that a medical specialist spends for treatment, education or consultation reduces as he can concurrently deliver the service to many telemedicine sites (Demaerschalk et al., 2010). Furthermore, medical specialists transfer their knowledge to other professionals in remote areas via telemedicine (Andreassen and Dyb, 2010). In Ethiopia, according to this study, medical students attend some of their classes at telemedicine centres or virtual classes and their professor teaches them from outside of the country. Hence, for the evaluation of a telemedicine-based evaluation healthcare inequality reduction, especially in the case of developing countries, resource utilization of the project has to be considered.

Managerial readiness, in this study, refers to making administrative requirements of telemedicine ready head of time. In this study, managerial readiness includes subcategories such as making detailed ICT and telemedicine policies, allocating budget, setting goals and commitment of stakeholders that hinder telemedicine services.

The absence of detailed ICT and telemedicine policies, according to this study, has been challenging telemedicine providers, clients and non-governmental organizations that need to extend or establish new telemedicine services. Besides, due to a shortage of budget, some telemedicine projects in Ethiopia have been unable to improve their services. Healthcare institutes

in developing countries do not set clear goals on the reduction of healthcare inequalities though it is persistently challenging them.

The top-level managers, according to this study, lack commitment to confront those telemedicine challenges. As a result, telemedicine projects are not using their full potential of reducing healthcare inequalities although promising prospects are being shown (Nchise et al., 2012). Hence, in order to evaluate the effects of telemedicine projects on the reduction of healthcare inequalities in the case of developing countries like Ethiopia, a telemedicine evaluation framework has to assess the managerial readiness in formulating telemedicine policies, setting goals, allocating budget, and addressing challenges.

5.3 Study Limitations

It should be stressed that this study has been primarily concerned with the evaluation of telemedicine-based reduction of healthcare inequality in Ethiopia. However, the researcher believes that the inclusion of cost-benefit analysis would be a worthwhile contribution for the stakeholders of the telemedicine practices of Ethiopia.

The other limitation was the inability to have field-observation of telemedicine sites outside of Ethiopia. The researcher was unable to get the opportunity of observing telemedicine projects in other developing and developed countries. This would be helpful for comparative analysis of telemedicine projects.

Through the course of this dissertation, the researcher faced a few limitations. Since almost one third of the research participants were medical doctors and medical directors, they were too busy to schedule and carryout the full interview since it took more time than planned. Secondly, the fluctuation of electric power supply and Internet connection disrupted this work frequently. The third limitation was that the researcher was interested to include the cost benefit analysis of these

projects after the respondents' answers signified new insights; but it is beyond the scope of this project. The researcher believes that the cost aspect needs further quantitative investigation that could be done in future pieces of research. Moreover, in future research works, confirmation of the framework and the addition of metrics could be done.

5.4 Revisiting the research questions

The study was set out to appraise the practices of telemedicine in the healthcare services of Ethiopia. It has also sought to know whether telemedicine services could result in a reduction of healthcare inequalities, particularly in rural communities.

The general theoretical literature on this matter and specifically in the context of developing countries, like Ethiopia, is unsatisfying on several vital questions within telemedicine discourses. Hence, this study sought to answer the following research questions:

1. *How should telemedicine practices on the reduction of healthcare inequality be evaluated in Ethiopia?*

Although previous studies have been shown different types of telemedicine evaluation frameworks, most of them lack consideration of contextual issues without restrictions. Hence, the evaluation of a telehealth program requires basically consideration of contextual issues as this study discovered. Through qualitative investigation of the personal lived-experiences of telehealth experts within the telemedicine context in Ethiopia, an improved telemedicine evaluation framework that will help to know how to study the telemedicine-based healthcare inequality reduction in Ethiopia is proposed. This framework constitutes themes such as barrier removal, service quality, synergetic effect, localization, technical setup, resource utilization and managerial readiness. These themes and their subcategories must be studied to evaluate a telehealth program

in the context of Ethiopia in order for health institutes to be effective and efficient in their objective of reducing healthcare inequality through the support of telehealth.

2. *What insights does an evaluation of telemedicine in Ethiopia provide in terms of the reduction of healthcare inequality in the country?*

This study has identified insights such as service barrier removal, service quality, synergetic effect, localization, technical setup, resource utilization and managerial readiness that affect the evaluation of telemedicine practices in reducing healthcare inequalities in the country.

Each of these concepts, according to the responses of research participants, affect the intention of a telemedicine project to reach a large number of communities irrespective of geographical challenges especially for under-serviced/ disadvantaged communities.

According to the insights revealed so far, telemedicine is found to be an enabler in providing accessibility of healthcare services. Telemedicine plays a significant role in creating better access to healthcare services for communities, healthcare workers and medical students regardless of socio-economic, regional, cultural, or gender differences. Since telemedicine solves the distance factor between clients and service providers, it is a preferable technology. It enables access to health facilities such as hospitals, health centres, health stations and health posts, healthcare professionals, especially specialists, who are usually concentrated in big towns. Due to lack of access to healthcare facilities, basically childhood and maternal mortality is very high in developing countries. The role of telemedicine is tremendous for developing countries like Ethiopia where more than 80% of its population, 75 million, lives in rural areas without access to even the essential health services. Accordingly, for the evaluation of telemedicine-based reduction of healthcare inequalities by reducing inaccessibility of healthcare services is found to be one major finding.

In a similar manner, the study found out that user connectivity could be used for the evaluation of telemedicine-based reduction of healthcare inequality. The effect of telemedicine on making connectivity between healthcare users is very high. The communications between both local and foreign health institutions was significant and this in turn created other opportunities such as new training courses and experience sharing. Telemedicine has created new client-to-professional and professional-to-professional relationships within and outside the country. Hence, user connectivity is another criterion to be used for the evaluation of telemedicine on healthcare inequalities.

Correspondingly, the telemedicine projects in Ethiopia have shown that resource sharing is another effect of appropriate use of this technology in healthcare matters. It enables the sharing of the small number of specialized human resources and the very expensive health physical resources. Moreover, it enables the sharing of knowledge and lessons learned from the use of this technology in resource-limited and geographically challenged communities. As a result of this, sharing resources is another insight that could be used for evaluation of telemedicine practices.

However, for a successful tele-based medical service delivery, the readiness of healthcare telemedicine infrastructure has to be given the highest priority. This study revealed that for Ethiopian telemedicine practices, there were some challenges in this regard. There are fluctuations associated with telecom networks, Internet connectivity and electric power supply. This disrupts the operations of experts, leaving tele-based healthcare service providers feeling disappointed and this in turn affects telemedicine-based healthcare services. Thus, infrastructural readiness is another insight that could be used for the evaluation of telemedicine-based reduction of healthcare inequality in Ethiopia.

Similarly, a lack of institutional commitment could be used for the evaluation of telemedicine practices. This insight is also observed from the analysed data on telemedicine practices in

Ethiopia. Corresponding to institutional commitment, service inconsistency, an inability to deal with technical challenges, problems with budget allocation and lack of detailed policy were all found to be the barriers that require immediate institutional commitment for effective telemedicine practices.

Moreover, the attitude of healthcare workers toward telemedicine services could be another factor for evaluation of telemedicine-based reduction of healthcare inequality. In this study, health professionals showed a poor attitude towards telemedicine services. They underutilize the service because, the telemedicine practices, especially in case 1, 2 and 3 were below what the health professionals expected. There is a mismatch between the telemedicine projects program size and quality and the expectations of the healthcare professionals. Hence, they underutilized the services as compared to case 4 which exploited is well used.

Moreover, collaborative work or synergy is another main issue coined from the gathered data that could be used for the evaluation of telemedicine-based reduction of healthcare inequality. This study has clearly shown that the stakeholders' collaborative effort in all aspects of telemedicine has been low. Hence, the effectiveness of almost all telemedicine practices is low.

3. *How do these insights inform a framework for improving the telemedicine practices in reducing healthcare inequality in Ethiopia?*

The findings expand the existing insights into telehealth in the Ethiopian context and they address a literature gap in telehealth evaluation. This will help future researchers and telehealth evaluators to use an improved telehealth evaluation framework.

Generally, it can be concluded that within the context of the Ethiopian telemedicine practices, telemedicine has had an effect on reducing healthcare inequalities. This is revealed from the

emerged insights of the study. Hence, these insights: barrier removal, service quality, synergetic effect, localization, technical setup, resource utilization and managerial readiness constitute a framework could be applied to evaluate telemedicine-based healthcare service inequality reduction within a particular context.

Implications for Policy, Practice and Research

This study has identified seven insights that could be used for the evaluation of telemedicine-based reduction of healthcare inequality in Ethiopia. Moreover, the study has the following implications that could be applied for policy, practice and research purposes.

Since telemedicine has a positive effect on the reduction of healthcare inequalities between communities, the country has to have a policy for the expansion of this technology in remote areas of the country.

The telemedicine initiatives have been challenged by infrastructural barriers such as failure of telecom services, connection problems of the Internet, and unreliable electric power supply. These barriers need immediate action from the concerned bodies such as the Ministry of Health (MoH), Ethio-Telecom, Ethiopian Electric power Agency. In addition, clear policies for telemedicine and ICTs in healthcare institutions need to be prepared.

In order to evaluate a telemedicine practice on the reduction of healthcare inequalities between communities, telemedicine practitioners can use the framework that emerged from this study. The framework consists of barrier removal, service quality, synergetic effect, localization, technical setup, resource utilization and managerial readiness; and the sub-categories of these themes could have the potential to play significant role to evaluate a practical telemedicine initiative.

This study stresses the need for further studies concerning three main points: (1) the benefits of having telemedicine and ICT policies (2) cost benefit analysis on telemedicine practices within the Ethiopian context (3) adoption strategies for telemedicine in developing countries.

5.5 Contribution

Previous empirical studies and theories have contributed to the understanding of how telemedicine services could be implemented so as to enhance accessibility of healthcare services to remote communities. This study also contributes to the understanding of the question of how telemedicine practices should be evaluated in order to reduce healthcare inequality at community level.

5.5.1 Whetten based study contribution

The theoretical contribution of this study is presented according to Whetten's (1989), recommendations. Whetten suggests that the theoretical contribution of a study is made up of three main components namely – what, how and why.

- *What?* This study has brought a new framework that could be used for evaluating telemedicine-based healthcare inequality reduction for geographically disadvantaged and resource constrained remote areas in developing countries like Ethiopia. The conceptual framework consists of inductively emerged empirically rich insights such as barrier removal, quality of service, localization, technical setup, synergistic effect, resource utilization and managerial readiness. The study has been conducted in the context of a developing country, Ethiopia. The framework also consists of new insights or subcategories that have not been identified by previous researchers, and this is a new theoretical contribution to the field of telehealth evaluation. Moreover, unlike the previous studies, the integrated use of case studies, interviews and field notes has brought new insights that could contribute to the literature in general and telemedicine practitioners in

particular. Since telemedicine is playing an important role by making healthcare practices accessible for remote communities, the implementation of telehealth projects in Ethiopia is supposed to continue. Thus, this framework will be a contribution for evaluating the implementation of such projects in the developing world. This study also has implications for the building of new knowledge and skills in telemedicine practices for telemedicine clients, managers, health informatics experts and ICT professionals.

- *How?* This study developed a new conceptual framework that consisted of seven theme and twenty-five interrelated subcategories that emerged from the inductive analysis of the qualitative data, through the use of the methodology of grounded theory. In order to evaluate telemedicine service provisions in developing countries, consideration of the seven themes and their subcategories will bring improved results. The interrelatedness of the themes is discussed in the following paragraph.

  In this study, telemedicine has the potential to remove the healthcare services barriers and enhance provision of telehealth care services as per the demands of communities, through better accessibility to healthcare facilities and workers, the reduction of healthcare service inequalities without the restriction of distance and increasing interactivity of the telehealth care system of Ethiopia. The removal of telemedicine barriers can potentially improve the telemedicine service provision. In Ethiopia, according to this study, the inclusion the interrelated subcategories of telemedicine service quality such as service consistency, service utilization, program size and user satisfaction during the evaluation process will contribute to an improved result. In addition to improving healthcare service quality, telemedicine also creates, according this study carried out in Ethiopia, a synergetic effect which is the inter-relationship and communication among the telemedicine main

stakeholders such as health institutions, patients and healthcare professionals. However, telemedicine's potential may not be obtained unless its implementation is contextually localized. Telemedicine services must be customized to meet the context of a particular community, language or community's "look and feel" to be accepted and utilised by clients and healthcare workers. Moreover, for a successful telemedicine service provision, its technical setup must be given due attention. It includes establishing dependable telecommunication network, Internet connection, electric power supply and technical expert. In addition to the technical setup, the evaluation of telemedicine practices in developing countries like Ethiopia has to consider the resource utilization of the projects. This includes the use of health-related resources physical resources, co-working space, time and knowledge of health institutes and healthcare professionals. Finally, for the overall performance of the telemedicine practices in Ethiopia, managerial readiness is found to be an important determinant. Managerial readiness refers to the overall arrangement of healthcare institutes' requirements for an effective telemedicine service delivery in terms of firm policy formation, budget allocation, setting common goals and commitment of stakeholders.

Hence, for an effective telemedicine evaluation in the context of developing countries like Ethiopia, the inclusion of these interrelated seven themes and the twenty-five subcategories will give organizations an improved evaluation result.

- *Why?* Although the Ethiopian health system is showing signs of improvements, healthcare service coverage is still one of the main problems in Sub-Sahara African countries. The lack of communication between healthcare providers is one of the many problems plaguing the healthcare information systems of many developing countries. Healthcare inequality is

one of the serious challenges of most developing countries where the essential healthcare services are inaccessible. The problem is aggravated by a shortage of physicians and health facilities, lack of transportation, and scattered settlements. Thus, in order to serve remote communities, four telemedicine projects have been implemented in Ethiopia. The main driving forces to carry out this study were, the limitations of the available telemedicine evaluation frameworks, particularly lack of understanding the context of developing countries and the effect of telemedicine on mitigation of healthcare inequalities, are a well-known challenge. Therefore, a new framework on the evaluation of telemedicine-based healthcare inequality reduction in Ethiopia, a Sub-Saharan African country (which is an under-researched context) will contribute to the discipline of Information Systems and at the same time will contribute to the improvement of the lives of these underserved communities.

The contribution of the study may also be presented in the form of three main components such as theoretical, methodological and practical contribution.

5.5.2 Theoretical contribution

Previous empirical studies and theories contribute to the understanding of how telemedicine practices could be implemented to support healthcare services. This study contributes to the understanding of the question of how telemedicine practices can be evaluated, to support the healthcare service and reduce the healthcare inequalities in resource constrained communities in Ethiopia.

This study brings a new conceptual framework that consists of seven emerged themes: barrier removal, service quality, localization, technical setup, synergetic effect, resource utilization and

managerial readiness. This framework could be used during evaluation of telemedicine-based healthcare inequality reduction in other developing countries like Ethiopia.

Although there are limited theories on telemedicine evaluation, this study brought new insights that were not seen by previous researchers, and this is one of the main theoretical contribution to future researchers and academia in the telehealth discipline. Moreover, this study contributes to making a knowledge contribution to existing telemedicine knowledge and discourse about telemedicine in academic literature.

5.5.3 Methodological contribution

The use of grounded-theory to inductively analyse the qualitative data gathered from telemedicine experts, public health workers, medical doctors and health informatics experts, in the study of telemedicine-based healthcare inequality reduction in Ethiopia, was a new approach in the study area and this resulted in the emergence of new insights.

Although researchers such as Chang (2015), Dyrvig et al. (2014, Dattakumar (2013), Khoja et al. (2013), Bashshur et al. (2011), Kifle et al. (2008), Aoki et al. (2003), Ohinmaa and Reponen (1997) carried out studies on telemedicine evaluation, none of them applied the methodology of grounded-theory, in contrast most of them used a quantitative approach and tested existing theories. The use of grounded theory enabled the researcher to identify new insights from the primary data gathered during a field survey in Ethiopia.

Moreover, case studies, interviews and field notes were integrated to produce enriched data.

5.5.4 Practical contribution

The development of this framework will be a great contribution to academics and practitioners, including policy makers, as the framework brings new insights that need special consideration.

First and foremost, the result of this study could be a great contribution to the four telemedicine sites in Ethiopia because of the following three reasons:

- From the study decision makers of the telemedicine sites can see the status of their telemedicine sites, limitations, strength and the feedback of their clients
- On the basis of the result of this study, the managers of the telemedicine sites may prepare strategic plans to improve the telemedicine practices.
- It shows how to measure their performance particularly in relation to the reduction of healthcare inequality issue

Since this study is conducted in the context of a developing country, the conceptual framework can be used to evaluate telemedicine practices in similar context.

5.6 Recommendations

Based on the findings of this study, the following recommendations under the areas of policy and future direction, reliability, scope and collaborative approach are presented:

- *Policy and future direction*
    - The need for detailed ICT policies at operational levels are required for the smooth service delivery of wide scale telemedicine projects.
- *Reliability*
    - It is also shown that telemedicine has enabled medical specialists to share knowledge and experiences between local and foreign healthcare workers, medical students, administrators and other clients. Hence, this technology needs to be integrated well into the existing healthcare system, in order to retain healthcare workers by improving their connectivity with other service providers and to give them access to knowledge services that they need.
    - In order to empower the utilization of telemedicine by health specialists, both local and foreign health organizations need to improve the quality of current telemedicine services and the size of their programs.

- The Federal Ethiopian Ministry of Health, the Ministry of Ethio-Telecom and the Ministry of Electric Power have to work collaboratively to improve the infrastructural limitations observed in these telemedicine projects.
- Future researchers are recommendation to explore how the methodology can be expanded in order to include the various telemedicine stakeholders.

- *Scope*
  - Since telemedicine has already been shown to have a positive impact on the reduction of healthcare inequalities among communities in terms of enhancing access to healthcare facilities and healthcare workers, it has to be improved to serve even more rural communities which are very far from access basic healthcare services.
  - The scope of these telemedicine projects is too narrow when compared to the country's geographical area and its demand for healthcare coverage. Hence, it would be beneficial to increase the size of these projects and to include more districts, especially those far away from the big towns of the country.
- *Collaborative approach*
  - In order to set up, implement, monitor and control an effective telemedicine project, cooperation among stakeholders such as researchers, investors and decision makers is needed.

5.7 Summary

In Chapter 5, the findings of the study are discussed and concluding statements are presented. In addition, the limitations of the study, its implications for policy, practice and research and recommendations for future research are mentioned.

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Appendix A

University of South Africa (UNISA)
College of Science, Engineering and Technology
School of Computing

Informed Consent Form for Interview

Research title: Impact of Telemedicine on Healthcare Inequality in Ethiopia: A Multi-Case Study

MW Temesgen (Student)
+251913841688
47245751@mylife.unisa.ac.za
Prof HH Lotriet (Supervisor)
+27124292132
lotrihh@unisa.ac.za

I am PhD student in Information Systems at University of South Africa (UNISA). I am studying the impact of Telehealth/telemedicine on healthcare inequalities mitigation. To achieve this purpose, you will be asked some questions about Telehealth practices based on your experiences on health informatics. This interview is designed to be a half hour in length. However, please feel free to expand on the topic or talk about related ideas. Also, if there are any questions you feel you cannot answer or that you do not feel comfortable answering, feel free to indicate this and we will move to the next question.
All information that you provide will be kept confidential. Only the researcher and faculty supervisor mentioned above will have access to this information. This interview is designed to learn first-hand information about this topic. Upon completion of this research, all data will be stored in secure location.
Participant's agreement:
I am aware that my participation in this interview is voluntary. If, for any reason, at any time, I wish to stop the interview, I may do so without having to give an explanation. I understand the intent and purpose of this research.
I am aware the data will be used for a PhD dissertation. I have the right to review, comment on, and/or withdraw information prior to the paper's submission. The data gathered in this study are confidential and anonymous with respect to my personal identity unless I specify/indicate otherwise. I grant permission for the use of this information for a PhD dissertation alone.

Additional conditions (if any)

_____
_____
_____

I have read the above form, and, with the understanding that I can withdraw at any time, and for whatever reason, I consent to participate in today's interview.

Thank you.

Appendix B

Interview Questions for Telemedicine Experts

1. Would you please tell me the importance of Telemedicine for Ethiopian healthcare system?
2. What strong sides does it have particularly for resource constrained/ isolated/ geographically challenged communities?
3. What would be the weaknesses of Telemedicine in Ethiopian context?
4. Do you think that the technology used by this telemedicine service is appropriate in the context of Ethiopia?
5. Is it necessary to have the telemedicine services in Ethiopia?
6. Which type of telemedicine service do you think will be most suitable in the context of Ethiopia?
7. Are you satisfied with the ongoing telemedicine services in Ethiopia?
8. What can be further done to better implement the ongoing telemedicine services?
9. How do you describe the contribution of these telemedicine activities in fair healthcare service provision?
10. Do you believe that healthcare service inequality exists between individuals, regions, economic classes, gender, or age groups in Ethiopia?
11. Do you think that Telemedicine has the capacity to reduce healthcare service inequality?
12. If you think so, question 11 above, how does it reduce healthcare service inequality?
13. How does Telemedicine support:
    a. Individuals/patients/clients?
    b. Healthcare workers?
    c. Communities?
    d. Government in Ethiopian context?
14. Why telemedicine service is needed in the Ethiopian context?
15. How are telemedicine services conducted in Ethiopia? (In term of place, and its implementation modality and networking)

16. What are the strategies taken by the Tel-Med stakeholders for its implementation?
17. What types of service are mainly focused by the telemedicine program?
18. Is it necessary to further extend the telemedicine service in Ethiopia?
19. How is the attitude of the telemedicine service users?
20. What types of human resource are mainly involved in implementation of telemedicine services?
21. Are the services used reliable and easy to use?
22. How is the user volume (how many users)?
23. How often do you use the telemedicine services?
24. What problems are you presently facing in the overall implementation of the telemedicine activities? How it can be improved?
25. Do you think that ongoing telemedicine service is effective in Ethiopia?
26. How do you evaluate the overall performance of your telemedicine site?

Appendix C

Additional Interview Questions for other Experts (MD, HI, PH, ICT)

1. Would you please tell me the importance of Telemedicine for Ethiopian healthcare system?
2. What strong sides does it have particularly for resource constrained/ isolated/ geographically challenged communities?
3. What would be the weaknesses of Telemedicine in Ethiopian context?
4. Do you think that the technology used by this telemedicine service is appropriate in the context of Ethiopia?
5. Is it necessary to have the telemedicine services in Ethiopia?
6. Which type of telemedicine service do you think will be most suitable in the context of Ethiopia?
7. Are you satisfied with the ongoing telemedicine services in Ethiopia?
8. What can be further done to better implement the ongoing telemedicine services?
9. How do you describe the contribution of these telemedicine activities in fair healthcare service provision?
10. Do you believe that healthcare service inequality exists between individuals, regions, economic classes, gender, or age groups in Ethiopia?
11. Do you think that Telemedicine has the capacity to reduce healthcare service inequality?
12. If you think so, question 11 above, how does it reduce healthcare service inequality?
13. How does Telemedicine support:
    a. Individuals/patients/clients?
    b. Healthcare workers?
    c. Communities?
    d. Government in Ethiopian context?

Appendix D

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Dear Mr. Mekonnen Wagaw Temesgen (47245751)

Date: 2016-02-16

Application number:
015/MWT/2016/CSET_SOC

REQUEST FOR ETHICAL CLEARANCE: (The Impact of Telemedicine on Healthcare Inequality in Ethiopia: a Multi-Case Qualitative Study)

The College of Science, Engineering and Technology's (CSET) Research and Ethics Committee has considered the relevant parts of the studies relating to the abovementioned research project and research methodology and is pleased to inform you that ethical clearance is granted for your research study as set out in your proposal and application for ethical clearance.

Therefore, involved parties may also consider ethics approval as granted. However, the permission granted must not be misconstrued as constituting an instruction from the CSET Executive or the CSET CRIC that sampled interviewees (if applicable) are compelled to take part in the research project. All interviewees retain their individual right to decide whether to participate or not.

We trust that the research will be undertaken in a manner that is respectful of the rights and integrity of those who volunteer to participate, as stipulated in the UNISA Research Ethics policy. The policy can be found at the following URL:
http://cm.unisa.ac.za/contents/departments/res_policies/docs/ResearchEthicsPolicy_apprvCounc_21Sept07.pdf

Please note that the ethical clearance is granted for the duration of this project and if you subsequently do a follow-up study that requires the use of a different research instrument, you will have to submit an addendum to this application, explaining the purpose of the follow-up study and attach the new instrument along with a comprehensive information document and consent form.

Yours sincerely

Prof Ernest Mnkandla
Chair: College of Science, Engineering and Technology Ethics Sub-Committee

Prof IOG Mochie
Executive Dean: College of Science, Engineering and Technology

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2016 -02- 24
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College of Science, Engineering and Technology

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College of Science, Engineering and Technology
The Science Campus
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Florida Park, Roodepoort
Private Bag X6, Florida, 1710
www.unisa.ac.za/cset

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Appendix E

BiT

Bahir Dar Institute of Technology - Bahir Dar University
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Faculty of Computing
የኮምፒዩቲንግ ፋኩልቲ

Ref No.FC/2016/166

Date: 02/04/2016

To Whom It May Concern

This is to confirm that MW Temesgen is a student of PhD Information Systems at University of South Africa, UNISA. He is conducting a research entitled *"The Impact of Telemedicine on Healthcare Inequalities in Ethiopia: a Multi-case Study"* under the supervision of Prof. HH Lotriet, Head Research and Graduate Studies: College of Science Engineering and Technology, University of South Africa, UNISA. For the fulfillment of his PhD degree, Mr. MW Temesgen needs to collect data from your organization; your cooperation will be highly appreciated.

Best Regards,

Seffi Gebeyehu

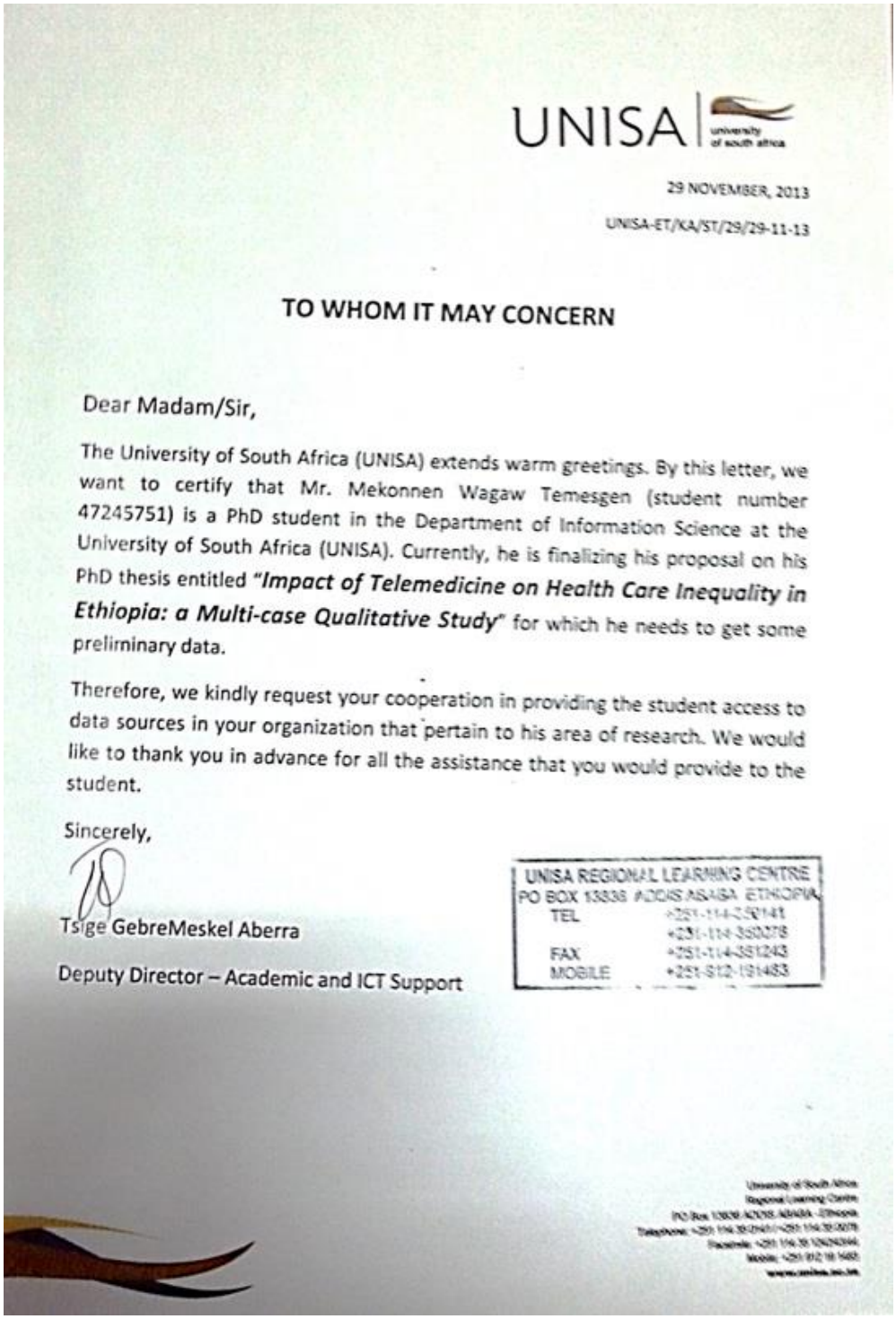
Dean of Faculty of Computing

In Reply, Please Quote Our Reference Number

Contact Us: Tel: +251-582-200610 Fax: +251-582-264471 PoB:26 Web: www.bit.bdu.edu.et

Bahir Dar Ethiopia

Appendix F



UNISA | university of south africa

29 NOVEMBER, 2013

UNISA-ET/KA/ST/29/29-11-13

TO WHOM IT MAY CONCERN

Dear Madam/Sir,

The University of South Africa (UNISA) extends warm greetings. By this letter, we want to certify that Mr. Mekonnen Wagaw Temesgen (student number 47245751) is a PhD student in the Department of Information Science at the University of South Africa (UNISA). Currently, he is finalizing his proposal on his PhD thesis entitled "***Impact of Telemedicine on Health Care Inequality in Ethiopia: a Multi-case Qualitative Study***" for which he needs to get some preliminary data.

Therefore, we kindly request your cooperation in providing the student access to data sources in your organization that pertain to his area of research. We would like to thank you in advance for all the assistance that you would provide to the student.

Sincerely,

Tsige GebreMeskel Aberra

Deputy Director – Academic and ICT Support

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