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In search of Insights from Community of Practice and Use of Telemedicine in Low income Countries: The case of Ethiopia

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ABSTRACT

The use of ICT for exchange of medical records in provision of health care services appears to be a viable option for enhancing the capacity of low income developing countries struggling with shortage of qualified medical personnel. This study seeks to gain a preliminary assessment of whether health professionals who work in the health facilities covered by the Ethio-Indian Telemedicine program have adopted and used the Telemedicine technology to enhance health care services. Among other things, the study also aims to understand the extent to which health professionals in the study area consider Telemedicine as a viable option for delivery of health care services. Survey will be conducted to gather information from users in the study area. The study is primarily informed by literature on Community of Practice, Unified Theory of Acceptance and Use of Technology, and Case Study Research.

Keywords

Telemedicine, TAM, UTAUT, Community of Practice, Case Study Research, Developing Countries, Low Income Countries, Ethiopia.

INTRODUCTION

There is a growing belief that African countries would have a chance to address shortage of qualified medical personnel and health facilities problems using telemedicine (ITU, 2002). Exploring the potential of emerging technologies such as telemedicine and outlining strategies regarding the introduction and a better informed use of the technology will play a vital

role in improving health care services. This working paper is designed to provide a foundation for further research on sub-Saharan Africa's fledgling telemedicine initiatives, with the case of Ethiopia as the primary focus. What is proposed and learned could be applied to other developing countries. The next section of the paper is provides some background on Ethiopia. It is then followed by the section that provides a basic background on telemedicine in Ethiopia, which is then followed by the literature review section. After that we present our proposed research and hypotheses. The last section is the conclusion and insights.

BACKGROUND ON ETHIOPIA

Ethiopia is one of the countries in East Africa, with a land area of approximately 1.1 million square kilometers, with an estimated population of 80 million, more than 80% of which live in rural areas. The country is subdivided into 9 national regional states and 2 administrative states. As in the case of many low income countries, the health care system of Ethiopia has numerous problems. According to the Health and Health related indicator published by the Ministry of Health (MoH) in 2003, the health care system is able to provide basic services to only 61% of the population. There are only 119 hospitals of which 83 are under the ministry and 36 owned by private investors. Physician-to-population ratio is one of the lowest in the world 1:25,958 (i.e., only one physician per almost 26,000 people!). Since most physicians are stationed in the urban areas, ratios across the country show a large variation. For example in one of the regional states-Harari, physician to population ratio is 1:3,179 whereas in Somali regional state the ratio is wider 1:72,764 (MoH, 2003). Moreover, more than 60% of specialists are working in the capital city Addis Ababa.

Referring the slow rate of production of physicians by universities and colleges of Ethiopia, Berhanu (2008) stated that the three prestigious medical schools at Addis Ababa, Gondar, and Jimma universities since their establishment (1964, 1978 and 1984, respectively) till 2006 graduated about 3,728 medical doctors in 42 years. Given the current scenario of physician production, it would take Ethiopia many years to improve the existing poor physician-to-population ratio. Therefore, exploring the potential of emerging technologies such as telemedicine and outlining strategies regarding the introduction and wise use of the technology will play a vital role in improving health care services.

BACKGROUND ON TELEMEDICINE IN EHTHIOPIA

Telemedicine appears to be a cost effective intervention to fill the gap created by lack of qualified experts in different fields of medicine in rural and remote areas and even in urban areas in Ethiopia. It would enable medical personnel in the underserved areas to get specialist support from hospitals in cities. By doing so, telemedicine can address two of the problems facing the health care system of the country: inadequate access and uneven resource distribution (Fikereyohannes et al., 2003; Negash, 2004). This is particularly important in rural areas that lack access to proper health care services and are unable to employ medical personnel. It would also be important in the cities as a means to get access to advanced health care systems and specialist support from physicians living abroad.

Efforts to introduce Telemedicine in Ethiopia started around June 1997 (Fikreyohannes et. al, 2004). In November 2005 a joint Telemedicine program was launched by Ethiopian and Indian government (Ethio-Indian Telemedicine Program) and as a result Telemedicine Centers were established at the Faculty of Medicine Teaching Hospital (Black Lion Hospital) Addis Ababa University and Nekemte Hospital, 300 km south west of Addis Ababa, Ethiopia (Asfaw, 2009). This joint

Telemedicine program links four sites (run by three institutions) across two countries: Black Lion Hospital, Care Hospital, Nekemte Hospital, and Hydrabad Hospital in India. Black Lion and Nekemte Hospitals have similar Telemedicine settings. Fairly adequate hardware, software, and communication devices are in place in order to carry out exchange of medical information among three cited health care institutions.

The Telemedicine center at Black Lion Hospital plays a vital role in the joint 4-center project. For example, the medical record/history of a patient is captured and stored in Digital Imaging and Communication in Medicine (DICOM) format and sent to the senior physician based in India, who studies the case and provides diagnosis and treatment during live Tele-consultation session with the doctor at the patient end. Such consultation sessions are conducted on a weekly basis as per the agreement reached at both ends. Virtually identical hardware and software technologies are available and similar Telemedicine processes are carried out at Nekemete Hospital.

Cases for Tele consultation from Black Lion and Nekemete Hopital are selected by clinical departments and delivered to the respective Telemedicine centers a few days prior to the live consultation session. However, only 63 Tele-consultations and continuing medical education sessions were conducted between Black Lion Hospital and Care Hospital between December 2006 and December 2008 (Asfaw, 2009). This shows a low level of usage of the system. Currently, the Telemedicine center at Black Lion Hospital is providing technical support in matters pertaining to Telemedicine at a national level and has already been involved in the Telemedicine committee composed of teams drawn from MOH and Ethiopian Information Communication Technology Development Agency (EICTDA). The center is also expected to be a part of the envisaged Pan African e-network which would connect Indian Institutions to 53 African countries through satellite and fiber optics links and which would provide Tele education and Telemedicine services (Asfaw, 2009).

LITERATURE REVIEW

There are various views and concerns regarding adoption and use of computer based system, magnified by risks involved in the implementation of computer based systems (Davis, et al, 1989) and Venkatesh (2000). Furthermore, Computer systems cannot improve organizational performance if they are not used properly. Various views are also observed surrounding the potential benefits of Telemedicine or ICT in low income countries. The views range from strong optimism, viewing telemedicine or ICT as a solution to health care service access problems (Edworthy, 2001), to pessimistic, viewing ICT as a tool favoring the privileged segments within a society and not reaching the economically and socially disadvantaged, thus leading to a widening of the socioeconomic gap within developing countries (World Summit, 2005).

Recognizing the potential benefits of Telemedicine, there are several initiatives to introduce Telemedicine in health care delivery system in some Low income Countries in Africa. These include Mozambique, Senegal, Uganda, and Kenya (Asfaw, 2009). A brief description of Telemedicine projects in Sub-Saharan African Countries is presented in Table 1.

	Mozambique	**Senegal**	**Health Net**	**Project SHARE**
Project start date	1998	Uncertain	Uncertain	Mid-1980s
Initiated by	ITU	SONATEL-Telecommunication operator in Senegal	SATELLIFE	International Satellite Organization and the International Institute of Communications
Health facilities involved	Central Hospital Bira and Maputo Hospital	Lille teaching Hospitals and other health units in Senegal	Health facilities in 20 African countries	St. John's (Canada) and medical facilities in two East African cities, Kampala (Uganda) and Nairobi (Kenya).
Telemedicine Link	Terrestrial and satellite communication system	-	Low Earth Orbit (LEO) satellite	A satellite link
Telemedicine Services	Tele radiology	Videoconferencing In-service training of health professionals	Email services with patients image data capabilities to over 10,000 health professionals	Audio-conference link between St. John's, Kampala, and Nairobi
Communication Technology	Store and Forward	Video link and store forward	Store and forward	

Table 1. Telemedicine Projects in African countries.
Source: Extracted from Asfaw, 2009

The various fledgling projects across sub-Saharan Africa lack formal studies related to the use of information technologies. In Ethiopia, to date, very few studies have been conducted regarding the potential application of Telemedicine. An attempt has been made to review the scope and content of four studies. The first study was by Mengistu et al. (2004) which aimed to identify critical success factors for telemedicine in Ethiopia, focusing on physical infrastructure and processes required to set up successful Telemedicine system in Ethiopia. The second study was by Fikreyohannes et al. (2004) which surveyed efforts underway and potentials for the application of telemedicine in Ethiopia. The third study was by Mengistu et al. (2006) which provides brief account on the application of telemedicine for exchange of ophthalmology and Eye Care medical information in Ethiopia. The forth study was a Master's thesis prepared by Asfaw (2009) which focused on the assessment and overall program effectiveness of the telemedicine unit of faculty of medicine, Addis Ababa University in order to make recommendations for future implementation of similar Telemedicine projects.

This work in progress proposes formal studies to gain some understanding of issues that remain unaddressed by prior studies. Even a robust and sophisticated state of the art telemedicine system would be meaningless if it is fails to be adopted and used by communities of medical practice. Therefore, this study will investigate the psychosocial and technological determinants of technology acceptance and use and assess the extent to which medical and health professionals have adopted and used the telemedicine systems in the study area, and recommend how the technology could be promoted, accepted, and used by the community of medical practice in Ethiopia and other developing countries. We also seek to shed some light on various internal and external factors impacting the use of telemedicine by physicians and health professionals in the area under study.

To this end our application of the Unified Theory of Acceptance and Use of Technology (UTAUT) model is expected to provide broader explanation regarding the acceptance of emerging technologies such as telemedicine in low income countries. Emphasis will be made on assessing as to how determinants such as performance expectancy, social influence, facilitating conditions, and moderating factors like voluntariness impacted Telemedicine service adoption and use in the study area.

The objective in this study is to assess the extent to which health workers in the facilities covered by the Ethio-Indian Telemedicine program have adopted and used the Telemedicine technology to provide health care services. We also seek to gain some insight on the level to which health professionals in the study area consider Telemedicine as an important tool for delivery of health care services. The study will also assess whether the Telemedicine facilities found in the study area are easily accessible by the health professionals.

PROPOSED RESEARCH AND THEORETICAL FRAMEWORK

The theoretical foundation of this working paper is based on literatures of two core constructs, Community of Practice, referring to Medical or Health Professionals and Acceptance and Use of Technology, which deals with psychosocial, behavioral, and technical factors impacting the use of technology. Community of practice is regarded as groups of people informally bound together by shared expertise and passion for joint tasks (Wegner and Snyder, 2000). In this study, community of practice refers to medical and health professionals forming a linkage to promote the provision of health care services and health education. People in the community of practice share their experiences and knowledge in free flowing, creative ways that foster new approaches to problems (Wegner and Snyder, 2000).

Over the years studies have been conducted regarding people's intention and use of technologies. To explain the level of acceptance and use of Telemedicine by physicians and health workers an attempt has been made to have closer look at various Technology Acceptance assessment Models developed by scholars (Musa et al., 2005). Effort has been made to look into core constructs used in Technology Acceptance Model (TAM) developed by Davis in 1989 and the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. in 2003 with a bid to identify the one that best suits to the subject under study.

TAM is specifically meant to explain computer usage behavior founded on a theoretical basis for specifying the causal linkages between two key beliefs: perceived usefulness and perceived ease of use, and users' attitudes, intentions and actual computer adoption behavior (Davis, 1989). The goal of TAM is to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations; while at the same time being both parsimonious and theoretically justified (Davis ,1989). According to Davis (1989) a key purpose of TAM is to provide a basis for tracing the impact of external factors on internal beliefs, attitudes, and intentions. TAM posits that two particular beliefs, perceived use/ usefulness and perceived ease of use, are of primary relevance for computer acceptance behaviors.

Attempts has also been made to go through constructs used in the UTAUT model (please see Figure 1). While the model appears complex, it addresses important issues including the bearings of social influence and facilitating conditions on behavioral intention and use behavior. The founders state that there is strong empirical support for UTAUT, which posits three direct determinants of intention to use (performance expectancy, effort expectancy, and social influence) and two direct determinants of usage behavior (intention and facilitating conditions). Significant moderating influence of experience,

voluntariness, gender, and age were confirmed as integral features of UTAUT. For this study the UTAUT model is selected because it addresses broader issues, such as facilitating conditions, and clearly depicts the bearing of moderating factors on behavioral intention and use. A relevant research from which we will borrow to ground our approach is application of case study research methodology (Yin, 2003). Structured questionnaire and interview guide will be used to gather facts from respondents. Moreover, relevant documents and log books used to track Tele-consultation sessions will be reviewed. Items and measures developed and validated by Venkatesh et al. (2003) for performance expectancy, effort expectancy, organizational facilitating conditions, and social influence will be used for this study. Questionnaire content will be extracted from items designed to measure the constructs and relationships contained in the UTAUT research model. Items will be measured using a five-point Likert-type scale for all questions, with 1 = strongly disagree and 5 = strongly agree.

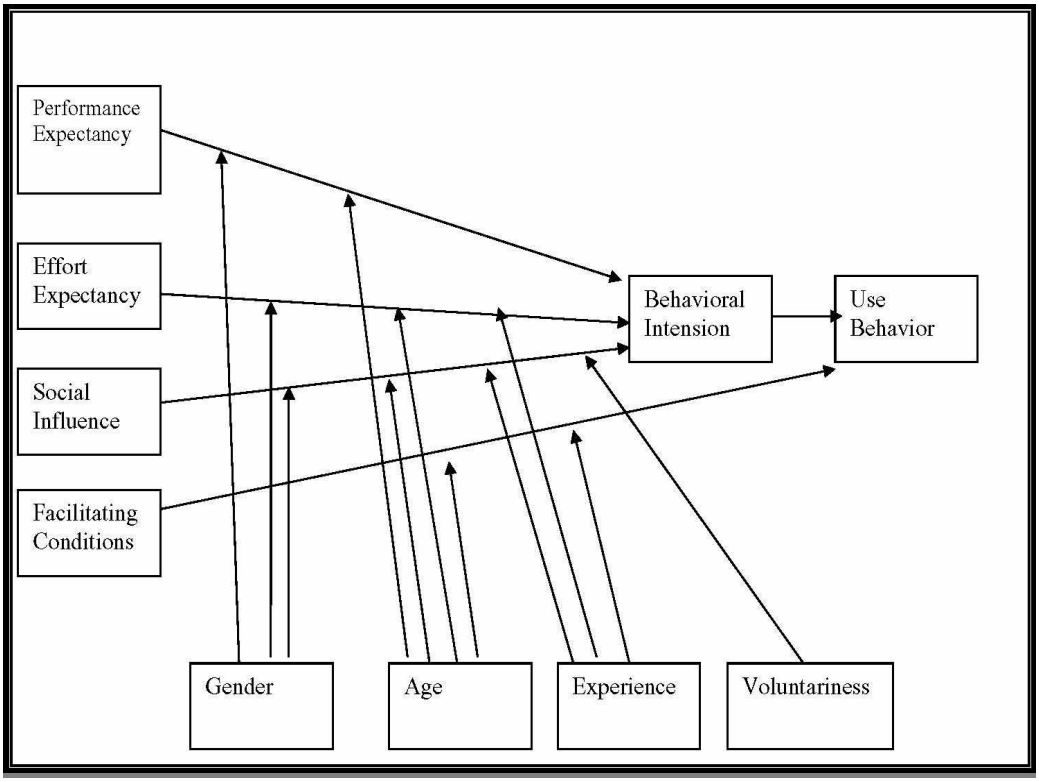

Figure 1. UTAUT Model

Source: Venkatesh et al., 2003

Contextualization of the UTAUT Variables

Performance Expectancy

Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance (Venkatesh, et al, 2003). In the context of Telemedicine, performance expectancy refers to the extent to which physicians and health professionals believe that Telemedicine improves health care service delivery and enhance their performance and collaboration bridging geographical boundaries and barriers. Regarding the link between

performance expectancy on behavioral intention, Venkatesh et al. (2003) have hypothesized that the influence of performance expectancy on behavioral intention will be moderated by gender and age. In this study an attempt has been made to treat the bearing of moderating factors separately and three hypotheses are extracted from the hypothesis cited as H1 in the original UTAUT model as follows:

H1a: Performance expectancy positively influences behavioral intention of Telemedicine users (Venkatesh et al, 2003).

H1b: Gender moderates the influence of performance expectancy on behavioral intention of Telemedicine users (Venkatesh et al, 2003).

H1c: Age moderates the influence of performance expectancy on behavioral intention of Telemedicine users (Venkatesh et al, 2003).

Effort Expectancy

Effort expectancy is defined as the degree of ease associated with the use of the system (Venkatesh, et al, 2003). In this study effort expectancy refers to the degree to which the Telemedicine system is user friendly and can easily be understood, accessed, and used by physicians without the need of long training and orientations. Extracted from the original UTAUT model, the link between effort expectancy and behavioral intention is hypnotized as follows:

H2a: Effort expectancy positively influences behavioral intention of Telemedicine users (Venkatesh et al, 2003).

H2b: Gender moderates the influence of effort expectancy on behavioral intention of Telemedicine users (Venkatesh et al., 2003).

H2c: Age moderates the influence of effort expectancy on behavioral intention of Telemedicine users (Venkatesh et al., 2003).

H2d: Experience of users moderates the influence of effort expectancy on behavioral intention of Telemedicine use (Venkatesh et al., 2003).

Social Influence

Social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new system (Venkatesh, et al, 2003). In this context, Colleagues within the community of medical practice and health profession may have impact on their behavioral intention to use the technology. The link between social influence and behavioral intention of Telemedicine users is hypothesized as follows:

H3a: Social influence will have positive or negative bearings on behavioral intentions of Telemedicine users (Venkatesh et al, 2003).

H3b: Gender moderates the bearing of social influence on behavioral intention of Telemedicine users **(Venkatesh et al, 2003).**

H3c: Age moderates the influence of social influence on behavioral intention of Telemedicine users (Venkatesh et al, 2003).

H3d: Experience of users moderates the influence of social influence on behavioral intention of Telemedicine use (Venkatesh et al, 2003).

H3e: Voluntariness of users moderates the bearing of social influence on behavioral intention of Telemedicine use (Venkatesh et al, 2003).

Facilitating Conditions

Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system (Venkatesh, et al., 2003). In this context facilitating conditions refer to the presence of hardware, software, and communication system to promote the use of Telemedicine. The influence of facilitating condition on behavioral intention and use behavior is hypothesized as follows:

H4a: Facilitating conditions will not have influence on behavioral intention of Telemedicine users (Venkatesh et al., 2003).

H4b: Age of users moderates the influence of facilitating conditions on usage of Telemedicine (Venkatesh et al., 2003).

H4c: Experience of users moderates the influence of facilitating conditions on usage of Telemedicine (Venkatesh et al., 2003).

Behavioral Intention

According to (Venkatesh, et al., 2003) behavioral intention will have a significant positive influence on technology usage.

H5*:* Behavioral intention of physicians and health professionals will have a positive influence on usage of Telemedicine (Venkatesh et al., 2003).

Study Population and Sampling

The study population will constitute mainly senior and junior physicians working at Black Lion and Nekemet Hospital**.** There were a total of 249 physicians in the five department of the Black Lion Hospital and 105 health workers in Nekempt hospital (Asfaw, 2009). In the UTAUT model there are 35 refined and validated measurement items, out of which 22 items corresponding to the core constructs of UTAUT used in this study are selected (please refer Appendix 1). For the purpose of this study 6 responses per item are believed to provide the required level of data set predicting 70% response rate. Therefore, 172 [(22x6 = 132+ (132x 0.3)] questionnaires will be used to conduct the survey. Besides, using structured interview guide the opinion of physicians and technical personnel at CARE Hospital, Hyderabad, India who engaged in the Ethio-Indian Joint telemedicine program and closely working with physicians based at Black Lion and Nekemet hospital will be gathered. Web chatting software like Skype and Yahoo messenger will be used to make online discussion with respondents.

The survey questionnaire will be distributed to potential respondents randomly. Department secretaries and messengers working at Black Lion Hopital and Nekemet Hospital will be used as a Hub through which physicians working in departments like, Internal Medicine, Surgery, Radiology, Pediatrics, Gynecology and Obstetrics can be reached. Quantitative and qualitative analysis will be carried out on the collected data and results will be presented using tables and figures. Descriptive statistics and SPSS statistical package will be used to analyze the collected data. Miles and Hubermans framework will be used for qualitative data analysis.

CONCLUSION AND INSIGHTS

The results from this working paper will provide an in sight explaining and predicting physicians' level of adoption and use of Telemedicine technology. It will also provide a foundation on future research on telemedicine in Sub-Saharan Africa. The

study will have three major contributions. Firstly, policy makers would use the finding in an endeavor to expand telemedicine in order to augment conventional health care service provision system to enable more people gain access to healthcare. Secondly, the study pinpoints the potential of Telemedicine in bringing together community of medical practice and enhancing collaborations and service provision. Thirdly, the study will provide the opportunity to further validate the UTAUT model in Telemedicine domain areas in the context of low income developing countries.

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Appendix 1. Constructs and Measurement Items

Source: Adapted from Venkatesh et al., 2003

Constructs	Measurement Items
Behavioral intention to use Telemedicine	1. I intend to use Telemedicine in the next 6 months. 2. I predict I would use Telemedicine in the next 6 months. 3. I plan to use Telemedicine in the next 6 months.
Performance Expectancy	1. I would find Telemedicine useful in my job. 2. Using Telemedicine enables me to accomplish tasks more quickly. 3. Using Telemedicine increases my productivity. 4. If I use Telemedicine I will increase my chances of getting a raise.
Effort Expectancy	1. My interaction with Telemedicine would be clear and understandable. 2. It would be easy for me to become skillful at using Telemedicine. 3. I would find Telemedicine easy to use. 4. Learning to operate Telemedicine is easy for me.
Social Influence	1. People who influence my behavior think that I should use Telemedicine. 2. People who are important to me think I should use Telemedicine. 3. The senior management of this business has been helpful in the use of Telemedicine. 4. In general, the organization has supported the use of Telemedicine
Facilitating conditions	1. I have the resource necessary to use Telemedicine. 2. I have the knowledge necessary to use Telemedicine 3. The system is not compatible with other network technologies that I use. 4. A specific person or group is available for assistance for system difficulties.
Voluntariness of use	1. Although it might be helpful, using a Telemedicine is certainly not compulsory in my job. 2. My boss does not require me to use Telemedicine. 3. My superiors expect me to use Telemedicine