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Abstract:

Ethiopia has one of the lowest ratios of health professionals to population in the world. The few medical specialists who are available work mainly in the capital city and in a few regional cities. The use of telemedicine in public health facilities can mitigate the shortage of medical personnel. We conducted a survey of selected public health facilities located in Addis Ababa, Ethiopia. The study could be modified and extended to other countries in Sub-Saharan Africa. In this study, we adapted Bakry's e-government assessment model, STOPE (Strategy, Technology, Organizational, People, and Environment) to assess telemedicine readiness. Validity and reliability tests were conducted using the Smart PLS software package. The survey data was analyzed using SPSS version 16, and descriptive and analytical statistical reports were generated. The color-coded feature of the McConnell International analysis tool was used to display the results. All factors in STOPE indicated amber color, which implies the need for substantial improvements at the health facilities in order to adopt Telemedicine. The STOPE model results from this study show that the degree of readiness for telemedicine implementation varies from a weak rating for Technology readiness to strong rating for Organization readiness.

Keywords: e-health readiness, telemedicine, tele-health, public health facilities, Ethiopia, Sub-Saharan Africa, STOPE, SPSS, McConnell International analysis tool

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I. INTRODUCTION

Ethiopia is located in the northeastern part of Africa, also known as the Horn of Africa. The country has a total area of about 1.1 million square kilometers and a population of 77.1 million. The annual population growth rate is 2.6 percent, with a high fertility rate of 5.4 children per woman. The current life expectancy is only fifty-five years. The literacy rate is 36 percent, compared with an average of 62 percent for Sub-Saharan African countries and 64 percent for the group of nations classified as "low-income" countries [FMOH, 2005a, 2005b].

In Ethiopia, the ratio of health professionals to population is very low and considered among the lowest in the world. The national and regional figures for doctor-to-population ratio have gotten worse, and health staff is unevenly distributed, with most healthcare professionals clustered in major urban such as Addis Ababa and Dire Dawa [FMOH, 2005c]. Due to the shortage of healthcare providers such as nurses and general practitioners (GP), patients often suffer from limited or nonexistent access to specialized care services. In a 2007 ranking by the World Health Organization (WHO), Ethiopia ranked 180 of 190 countries surveyed. The WHO survey indicated that Ethiopia had 46,666 total healthcare personnel, yielding a physician to population ratio of 1:42,706 [Photius, 2013].

The healthcare infrastructure consists of about 14,000 health facilities, which includes 143 hospitals, 690 health centers, and 1,662 health stations. Typically the differentiation of the various service levels is made by population size. Addis Ababa is the capital city of Ethiopia; it has a population of 3.059 million. The health infrastructure includes 608 health facilities, of which thirty are hospitals with 927 beds, twenty-nine are health centers with 180 beds, 130 are health stations, and 382 are private clinics.

The growth of ICTs (Information and Communication Technologies) provides opportunities to improve human development and confront social, economic, and health disparities [OECD, 2008]. Despite the heralded news that ICT will provide low-cost, fast solutions to improving the healthcare services of world populations, the grim reality is that we cannot easily close the gap and erase the inequities caused by the digital divide [UNDP, 2004].

Telemedicine initiatives represent an attempt to address some of these pressures; they have a real potential to improve accessibility and quality of healthcare services [Kifle, Mbarika, and Payton, 2006]. Many definitions of telemedicine emphasize the distance aspect, as well as the use of the Internet to solve problems related to the accessibility and quality of healthcare services.

This study is informed by literature on telemedicine, e-readiness assessment models, and the McConnell International analysis tool. One of our contributions is the extension of these to the context of Sub-Saharan Africa. Given that constructs such as "Strategy" are considered to be the major factors in achieving a successful e-government adoption [Reffat, 2003; Fletcher, 1999], another motivation for this study is to investigate the criticality of these constructs for a successful e-health or telemedicine implementation. We also compare results of our study with those done elsewhere in order to check for agreements.

Telemedicine is the use of electronic information and telecommunications technologies to support long-distance clinical healthcare, patient and professional health-related education, public health, and health administration [OAT, 2003]. It enables people in one geographical area to have access to trained medical specialists in another geographical location [Klein, 2004].

Telemedicine is not used directly by patients but primarily by doctors, nurses, and other care providers who need additional input from specialists to improve the service that they deliver. To transport a prescribed treatment regimen in telemedicine, healthcare providers might use real-time or store-and-forward methods of delivery.

Real-time (synchronous) e-health or telemedicine includes videoconferencing between provider and patient, and consultations between providers. Store-and-forward (asynchronous) telemedicine involves capturing medical information electronically and forwarding this to a health professional for review [Stamm, 1998].

Preparation of tissue and capturing of microscopic images at the remote site and the viewing and reporting of these images on a computer screen at a specialist's site can be achieved by means of dynamic telemedicine. This type of telemedicine uses a remote control of robotic microscope, allowing the remote pathologist or other telemedicine specialists to select the field of viewing and magnifications or by the so-called static image or store-and-forward

telemedicine. Communication technologies have the potential to help mitigate some of the challenges in providing healthcare in remote regions [Wright, 1998].

In the last decade, pilot studies have shown the potential benefits of telemedicine for patients and healthcare providers. Despite high hopes, however, telemedicine has been slow to come into routine use in Sub-Saharan Africa [Kifle et al., 2006]. Given the prevailing resource constraints, readiness for adopting the technology needs to be assessed in order to justify the viability of the investment and the potential benefits of using the system. In line with this concern, we assessed the extent to which public health facilities in Addis Ababa are ready to adopt a telemedicine system in order to supplement the conventional healthcare provision system. The study addresses two broad questions. First: *Are public health facilities in Addis Ababa ready to adopt telemedicine?* Second: *What opportunities and impeding factors prevail for telemedicine adoption?*

The general objective of the study was to assess the technological, environmental, organizational, strategic, and people readiness to adopt telemedicine in public health facilities in Addis Ababa and to come up with viable recommendations for successful implementation and effective use of the telemedicine system.

The remaining part of the study is structured as follows. First, we present the theoretical framework in which a brief description of each component of the research model and hypotheses are indicated. The second part discusses the methodology used in the study, including the model validation process, data collection, data analysis, and report generation techniques used. Subsequently, we present the main results of the study. The fourth part presents discussions and reflections on the research results. In the fifth and final section, we present some concluding remarks.

II. THEORETICAL FRAMEWORK

According to Bridges [2013] “an e-ready society is one that has the necessary physical infrastructure (adequate bandwidth, reliability, and affordable prices); integrated current ICTs throughout businesses (e-commerce, local ICT sector), communities (local content, ICTs used in everyday life, ICTs taught in schools), and the government (e-government); strong telecommunications competition; independent regulation with a commitment to universal access; and no limits on trade or foreign investment” [Bridges, 2013; Vaezi and Bimar, 2009].

Various e-readiness assessment models are currently available. However, each has its own strengths and limitations and may yield varying outcomes under different contexts. Therefore, while selecting a model, the objectives and goals of the assessment and the environment under which the assessment will be carried out need to be considered [Vaezi and Bimar, 2009]. This study employs the STOPE model, an acronym that stands for Strategy, Technology, Organization, People, and Environment. This e-readiness assessment model was developed by Bakry to explore transition to e-government [2004]. Since then, similarities between readiness for e-government and e-health readiness have been recognized in other studies. For example, Al-Osaimi, Alheraish, and Bakry [2006] reported that the STOPE model constructs, such as technology resources, management system, and government, as well as individual commitment in championing technology infrastructure, are essential for e-readiness in general. Moreover, Molla and Licker [2005] borrowed from Bakry and proposed a model for e-readiness in developing countries based on perceived organizational e-readiness and perceived environmental e-readiness. Constructs such as “Strategy” are considered to be the major factors in achieving a successful e-government adoption [Reffat, 2003; Fletcher, 1999], as it is for e-health or telemedicine.

The government in Ethiopia is the predominant healthcare provider. The health institutions considered in this study are all government-owned. As the major healthcare service providers, government-owned healthcare institutions are supposed to provide appropriate healthcare services. This is consistent with the United Nations position that attainable standard of health is one of the fundamental rights of every human being [UN Commission on Human Rights, 2003]. Currently, telemedicine is regarded as part of e-health, an umbrella term that describes the combined use of electronic communication and information technology in the health sector [Della Mea, 2001]. On the other hand, e-government is a technology solution meant to provide better delivery of government services to citizens and is thought to empower citizens through access to information [World Bank, 2005]. Considering the relations and similarities between e-government and e-health measurement items and constructs and the context of the study (the Ethiopian healthcare system), we believe that the STOPE model is an ideal framework for assessing e-health readiness in Ethiopia.

Although this study used STOPE as a framework, it has also employed McConnell’s e-readiness assessment techniques. McConnell International measured Jordan’s e-readiness by establishing the status and progress of five interrelated attributes: Connectivity, e-Leadership, Information Security, Human Capital, and e-Business Climate. The appeal in using the McConnell assessment tool is the ability to present the readiness for each domain in a color-

coded format. The study showed that the connectivity category in Jordan's e-readiness assessment was red-amber, pointing to a need for improvement in connectivity before telemedicine adoption. The amber color of the Technology readiness also implies the need for improvement. On the other hand, the e-Leadership category assessment resulted in amber-blue, implying a suitable condition to adopt telemedicine. As will be shown again later, the "Strategy" category in this study was also amber, which implies the need for improvement before telemedicine adoption. The information security domain construct showed red-amber results, which implies the need for numerous improvements.

On the other hand, the human capital readiness from the McConnell International e-readiness assessment was found to be amber, which again implies improvement needed in the human capital in both capacity and quantity. Finally, the Jordan's e-readiness assessment of the e-Business Climate domain indicated red results, which indicates that substantial improvement was needed to support adoption of e-technology.

Figure 1 presents major components and the perceived interrelationships in the STOPE model to be tested empirically. Brief contextualized descriptions of each construct are also presented in the figure, followed by more detailed discussions.

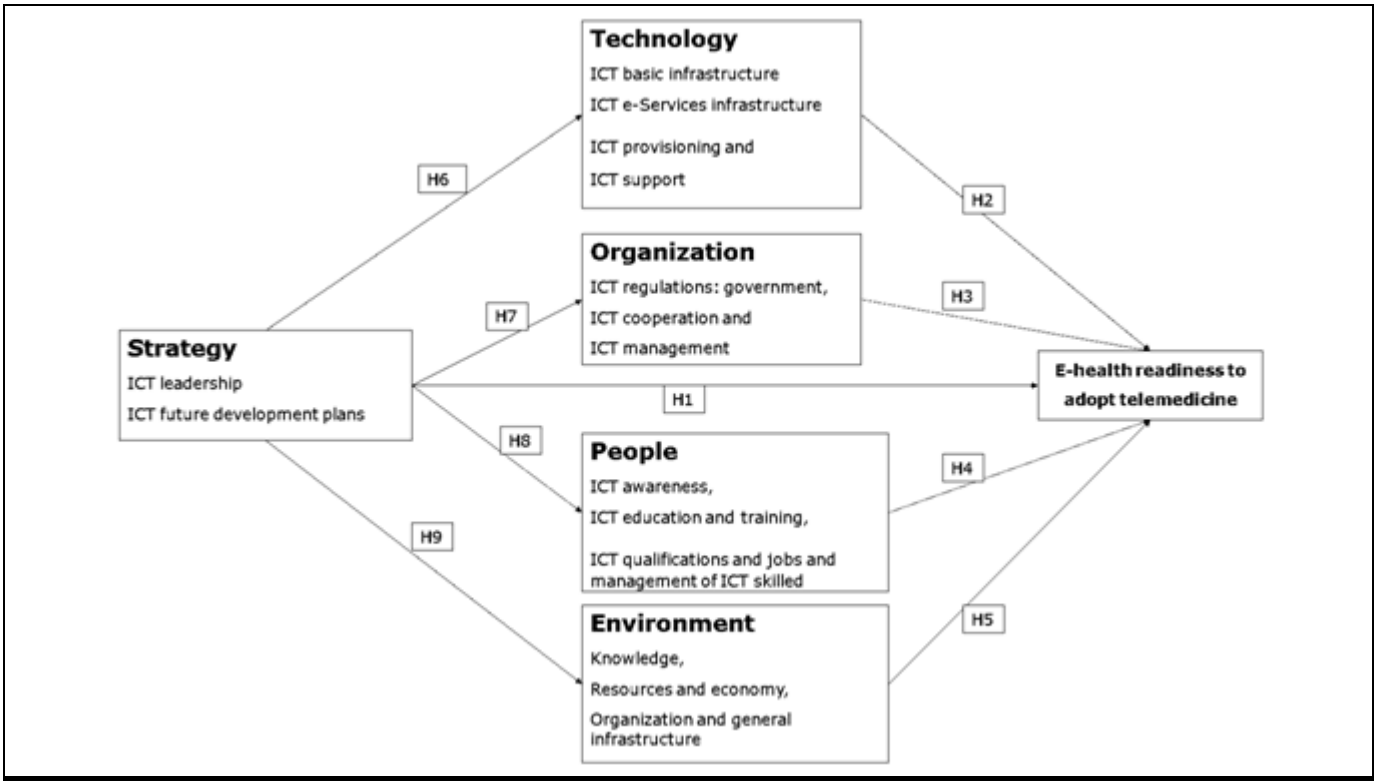

Figure 1. Theoretical Framework of the Study Using STOPE

Strategy Readiness

The "Strategy" construct integrates the factors concerned with "future directions, commitments and plans toward ICT development and utilization for telemedicine adoption." Two sub-domains are associated with this domain: "leadership" and "future development plans." The leadership sub-domain integrates the vision and support of government toward telemedicine implementation and utilization. The ICT development and plan contains the supporting variable that supplement the fulfillment of the category model preparedness toward telemedicine adoption since strategy for e-government is a major factor in reaching a successful e-government adoption [Reffat, 2003; Fletcher, 1999]. From "Strategy" and its sub-domains, we develop the following hypothesis:

Hypothesis 1 (H_1): *Strategy is related to e-health readiness in adoption of telemedicine.*

Technology Readiness

The "Technology" domain integrates the factors concerned with the "current state of issues dealing with ICT facilities." The four sub-domains associated with technology are: "ICT basic information infrastructure," "ICT e-services infrastructure," "ICT provisioning," and "ICT support." We used several factors to measure the "Technology" domain and its sub-domains. The factors are availability of network connection, technical support, policies and

regulations, trained staff, physical access to technology, and availability of technological infrastructure (i.e., e-health equipment) needed to implement the program, e.g., telephone lines and Internet connection, hardware, software, and computers) [Jennet, Jackson, Healy, Ho, Kazanjian, Woolard, Haydt, and Bates, 2003]. For telemedicine e-readiness, the technology must be appropriate, able to address the needs of the organization or community, affordable, and easily integrated with the existing healthcare system [Vaezi and Bimar, 2009]. Research on Sub-Saharan Africa suggests that sustainable adoption of technology is conditioned on meeting some precursors [Musa, Meso, and Mbarika, 2005]. We will test for technology readiness based on the following hypothesis.

Hypothesis 2 (H_2): *Technological readiness level is related to telemedicine adoption.*

Organization or Management Readiness

The "Organization" domain integrates the factors related to ICT regulations and management. Three sub-domains are associated with this domain: "ICT government regulations," "ICT cooperation among organizations," and "ICT management."

Some factors that impact e-readiness for adoption of telemedicine have to do with the structure of the organization: the complexity of an organization's structure and the conflicting roles of key actors (such as physicians and managers), practitioners' unfamiliarity with the technology, and ineffective management, as well as organizational culture and medical norms. These factors can enhance or limit the diffusion of e-health in organizations [Robinson, Savage, and Campbell, 2003]. The success of e-health (e.g., telemedicine) in healthcare organizations also depends on physician acceptance and organizational readiness factors. These include the commitment of telemedicine managers and logistic support from the organization (financing, technical resources, and human resources) [Whitten and Adams, 2003]. This is an important factor for decision makers because it reflects potential service volume, thereby determining the extent to which innovations can be translated into reality.

According to a study conducted by Tachinardi [1998], when technological innovations are not accepted or implemented properly, the failure may be traced to a poor fit between the nature of the innovation and the vested interests, resources, and expectations of its major gatekeepers. Senior management commitment may be important for successful implementation. Involvement of personnel is important for change process. Therefore, we offer the following hypothesis.

Hypothesis 3 (H_3): *Organizational readiness level is related to telemedicine adoption.*

The Physician or Individual Readiness

The "People" domain integrates the factors associated with the "current state of issues concerned with ICT users and skills." The domain has four sub-domains: "ICT awareness," "ICT education and training," "ICT qualifications and jobs," and "management of ICT skills."

Health informatics training programs at the national level will ensure that health-care professionals have an in-depth understanding of the role of ICTs in health and that qualified personnel are available to manage and operate e-health services. Research suggests that the lack of healthcare professional readiness is a significant barrier for e-health technology in developing countries [Kifle et al., 2006]. Thus, it is important to provide appropriate training for physicians on how to use the technology prior to deployment or adoption. Socio-cultural factors can affect a physician's readiness to adopt e-health technologies. The following hypothesis captures the relationship.

Hypothesis 4 (H_4): *People readiness is related to telemedicine adoption.*

Environment Readiness

The "Environment" domain integrates the factors associated with the "current state of the basic non-ICT issues surrounding and affecting the current state of ICT" [Croteau, Vieru, Kifle, and Mbarika, 2005]. The domain has four sub-domains: "knowledge," "resources and the economy," "organization" including general regulations, cooperation, and management, and the basic "non-ICT infrastructure." The external environment readiness is the government commitment, top management support, and supporting industries [Croteau et al., 2005]. Large infrastructure start-up costs, high operational costs, and inappropriate utilization, however, could offset potential cost savings. Without sharing telecommunication systems with other users, healthcare facilities may find that their costs per consultation are prohibitively high [Al-Qirim, 2004]. The relevance of environmental readiness to telemedicine adoption is conveyed in the next hypothesis.

Hypothesis 5 (H_5): *Environmental readiness level is related to telemedicine adoption.*

Relations Between STOPE Components

The study argues that all five factors—Strategy, Technology, Organization (management), People, and Environment—are affected by e-government strategy, since this strategy comprises a number of aspects that cause major changes in these factors. A study by [Azab, Kamel, and Dafoulas, 2009] revealed that e-Strategy has a positive impact on Technology and People readiness to adopt technology. This observation leads to the following four hypotheses:

Hypothesis 6 (H_6): *E-Strategy affects technology readiness.*

Hypothesis 7 (H_7): *E-Strategy level of readiness is positively related to the organization readiness.*

Hypothesis 8 (H_8): *E-Strategy level of readiness is positively related to individual/physician readiness.*

Hypothesis 9 (H_9): *E-Strategy is positively related to external environment readiness.*

For this study, the McConnell International analysis tool was used because it has five scale measurements and it is congruent with the STOPE model. The McConnell e-readiness assessment tool measures the Connectivity, e-Leadership, Information Security, Human Capital, and e-Business Climate of a country based on global standards. As mentioned earlier, the appeal in using the McConnell International assessment tool is the ability to present the readiness for each domain in a color-coded format.

III. METHODOLOGY

The study was conducted in Addis Ababa, the capital city of Ethiopia. At the time of data collection, the city had thirty-four public health facilities, twenty-four health centers, and ten hospitals. Health facility-based cross-sectional survey and key informant interviews were used to capture quantitative and qualitative data respectively. Every attempt was made to cross-validate the quantitative analysis with the facts obtained through the interview.

Medical directors, administrators, healthcare professionals, and IT experts working in these public health facilities were the study subjects. The inclusion criteria in the study are that the health facility should be government-owned. All health facilities that have not conformed to these requirements were excluded from the study.

Out of the thirty-four public health facilities in Addis Ababa, fifteen facilities (six hospitals and nine health centers) were selected through a simple random sampling technique. This concluded the first round of sampling. The second round of sampling was conducted by making a preliminary survey aimed at identifying the number of medical directors, administrators, healthcare professionals, and IT experts working in each of the fifteen health facilities selected for the study. This yielded thirty study participants at this level across the fifteen health facilities. In their respective health facilities, these participants are involved in strategy-formulation and organization-related tasks.

Self-administered questionnaires and structured interview guides were used to gather quantitative and qualitative data respectively. The design of the survey questionnaire was based on the constructs in the STOPE model. It includes 5-scale Likert scale questions, yes or no questions, and some multiple-choice questions. Two types of questionnaires were developed in the study: one for medical directors and administrators and another for healthcare professionals and IT experts. The questionnaire for medical directors and administrators included socio-demographic characteristics of respondents; ICT infrastructure availability; and organizational, strategic, and environmental readiness questions. The survey questionnaire for healthcare professionals and IT experts included socio-demographic characteristics of respondents, ICT infrastructure availability, and Technology, People/Individual, and Environment readiness questions. Before the actual survey, the survey questionnaires were pretested. To this end, four health facilities were selected: the police force hospital in the center of Addis Ababa and three health centers located in an Arada sub-city (one of the ten sub-city administrative units in Addis Ababa). A total of thirty-four survey questionnaires were distributed, and fifteen usable questionnaires were returned. Preliminary analysis was conducted to check the validity and reliability of the survey instrument and the measurement model. Two data collectors were hired for distributing and collecting completed questionnaires. Data encoding, cleansing, and analysis were made using SPSS v16.

Frequency tables and crosstabs were used for the descriptive analysis. Associations among variables were seen using correlation coefficients and one-way ANOVA. For multivariate analysis, the necessary adjustment was done for the possible confounding factors to identify the predicting variables. Hence, internal comparison between the variables was done taking the mean values of each of the variables on STOPE and combining the results with the McConnell International's analysis model.

McConnell International's method for analyzing the 5-level Likert scale questions was used. Correlation coefficients were used to test the hypotheses against the domain areas (Strategy, Technology, Organization, People, and

Environment) and to determine whether the participants were ready to adopt telemedicine technology in the health facility. Finally, tables and graphs were employed for data presentation.

Key informant interviews were also conducted with designated officials from the Federal Ministry of Health and the Addis Ababa City Administration Health Bureau. The interview was open-ended to adequately capture the readiness level of each domain factor from each catchment area. The interviews were conducted by the principal investigator. Responses to the interview were manually recorded. Yin [2009] presents four case-study data analysis strategies. Among these, Yin [2009] presented at the forefront, "relying on theoretical propositions that led to the case study would have shaped the data collection plan and therefore would have given priority to the relevant analytic strategy" (p. 130). In line with this suggestion, the responses from the interview were summarized and categorized into the five major STOPE constructs (Strategy, Technology, Organization, People, and Environment) and used to cross-validate and supplement the outcome of the quantitative analysis. Whenever the qualitative data did not quite agree with the survey result, we offered a possible explanation.

IV. MODEL VALIDATION

The Smart PLS (Partial Least Square) 2.0 software package was used to assess the validity of the measurement and structural model used in this study (see Figure 1). The Structural Equation Modeling (SEM) approach was used in this study at the frontend to perform validity and reliability tests, although SEM is a comprehensive analysis tool that helps to answer a set of interrelated research questions [Gefen, Staub, and Boudreau, 2000]. A major objective of this study is to assess the readiness of health facilities in Addis Ababa using the STOPE model drawn from e-government analysis and McConnell International e-readiness assessment model. The validation process focused on two components of SEM: the measurement and the structural model.

Assessment of the Measurement Model

The research model consists of six latent variables and seventy-four Indicators or manifest variables. Following the guidelines by Urbach and Ahlemann [2010], the measurement model used in this study is categorized as reflective. Table 1 shows the latent and corresponding manifest variables. Descriptions of all the manifest variables are provided in Table 10–Table 14.

Table 1: Latent and Corresponding Manifest Variables

Constructs	# of Manifest Variables	Variable Names and Range
Strategy (STRXXX)	15	STR701-STR715
Technology (TCHXXX)	14	TCH401-TCH414
Environment (ENVXXX)	16	ENV501-ENV516
Organization (ORGXXX)	12	ORG601-ORG612
People (PPLXXX)	13	PPL301-PPL313
e-Readiness (NFRXXX)	4	NFR202-NFR205
Total	74	

The first sketch of the path model and the measurement model in the PLS model editor window appeared complex. However, we noted that PLS supports complex models having many constructs and manifest variables [Urbach and Ahlemann, 2010]. The exploratory factor analysis performed indicated that some variables had high loading above 0.600, and some factors' loadings were found to be below the suggested threshold of 0.400, and, therefore, eliminated from the model [Urbach and Ahlemann, 2010; Churchill, 1979]. Table 2 shows refined factors and corresponding loading coefficients.

Table 2: Refined Factors and Loading Coefficients

Construct	Manifest Variables	Loadings	Remark
Strategy	STR702	0.843	
	STR703	0.747	
	STR704	0.880	
	STR705	0.712	
	STR711	0.543	
Environment	ENV502	0.892	
	ENV514	0.949	
e-Readiness	NFR204	0.997	
Organization	ORG601	0.616	
	ORG603	0.821	
	ORG604	0.771	
	ORG605	0.763	

Table 2: Refined Factors and Loading Coefficients – Continued			
	ORG608	0.601	
	ORG609	0.755	
People	PPL310	0.679	
	PPL312	0.962	
Technology	TCH411	1.000	

As indicated in Table 2, all items loaded with a high coefficient on latent variables. Cross loadings were observed to ensure discriminant validity. Figure 2 shows the refined measurement and structural model of the study.

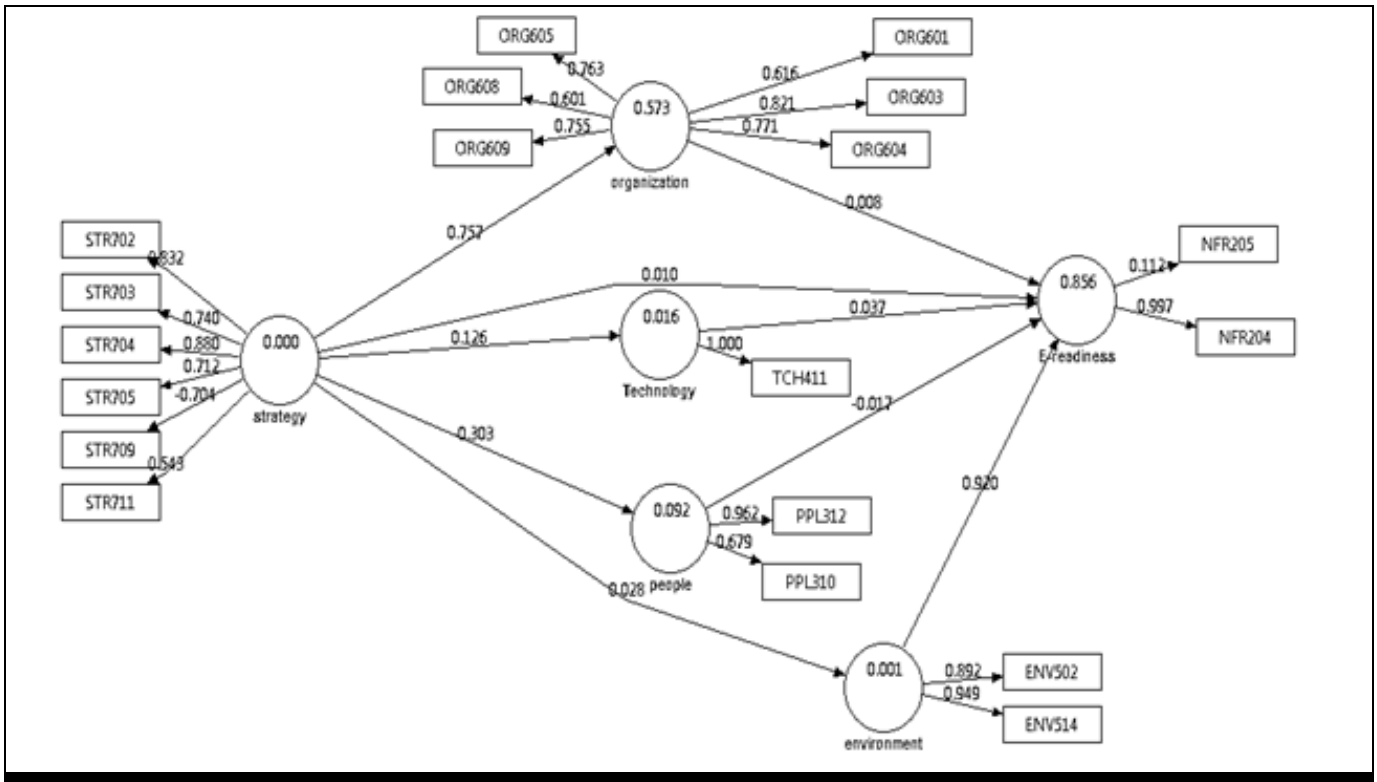

Figure 2. Structural Model with Refined Measurements

A composite reliability (CR) test was performed to ensure the internal consistency of the latent variables. Values above 0.700 are recommended to be desirable for exploratory research [Nunnally and Bernstein, 1994; Urbach and Ahlemann, 2010]. Table 3 shows the analysis results. Furthermore, the Average Variance Extracted (AVE) was used to test for convergent validity of threshold values greater than 0.500. Except for e-Readiness, all factors revealed composite reliability (CR) values above 0.600; all factors had AVE values above 0.500.

Table 3: Results Showing Average Variance Extracted		
Construct	CR Values	AVE
Technology	1.00	1.00
Environment	0.917	0.847
Organization	0.868	0.527
People	0.814	0.693
Strategy	0.770	0.552
e-Readiness	0.553	0.552

Assessment of the Structural Model

The first essential criteria for the assessment of the PLS structural equation model has to do with each endogenous latent variable's coefficient of determination, R^2 [Urbach and Ahlemann, 2010]. R^2 measures the relationship of a latent variable's explained variance to its total variance. The structural equation model results are summarized in Table 4. In general, R^2 values greater than 0.670 are considered to be significant. Values around 0.333 are perceived as average, while 0.190 or lower are considered weak [Urbach and Ahlemann, 2010].

Table 4: Coefficient of Determination Results	
Constructs	R^2
e-Readiness	0.856
Technology	0.098
Environment	0.115
Organization	0.659
People	0.232

The other criteria for the assessment of the structural model are the evaluation of the path coefficient's algebraic sign, magnitude, and significance. A path coefficient magnitude indicates the strength of the relationship between two latent variables [Urbach and Ahlemann, 2010]. The path coefficient results are shown in Table 5 below.

Table 5: Path Coefficients				
	e-Readiness	Technology	Environment	Organization
e-Readiness				
Technology	0.155861			
Environment	0.613594			
Organization	0.231243			
People	-0.101080			
Strategy	0.255476	0.767992	1.090956	0.644970

V. RESULTS

Demographic Characteristics of Respondents

The socio-demographic characteristics of the respondents are summarized in Table 6. There were a total of 120 respondents, the majority of whom were male and hospital-based. About 88 percent of the respondents were between twenty-four and forty-three years old. There were eighty-nine (83.4 percent) health professionals and twenty-one (16.6 percent) non-health professionals (from Management and IT fields of specialization).

Table 6: Socio-demographic Characteristics of Respondents from Addis Ababa		
N = 120		
	Frequency	Percentage
Sex		
Male	75	62.50%
Female	45	37.50%
No. of respondents from facilities		
Hospitals	77	64.16%
Health centers	43	35.84%
Age distribution of respondents		
24–27	24	20%
28–31	28	23.30%
32–35	18	15.10%
36–39	16	13.40%
40–43	20	16.70%
44–47	9	7.50%
48–51	3	2.50%
≥52	2	1.70%

Availability and Knowledge of ICT in the Health Facilities

The availability of computer and network services in the health institution is supposed to be an indicator for measuring the level of technology readiness. Table 7 summarizes information pertaining to the levels of computer availability, use, and computer training services provided to health workers. Accordingly, the facts presented indicate that of the ninety-four respondents, eighty-eight (93.6 percent) confirmed that computers are available in their respective health facilities.

Table 7: Computer Service Availability and Usage			
Computer Availability and Usage			
	Yes	No	Total
Have computer	88 (93.6%)	6 (6.4%)	94
Use computer	22 (24.4%)	68 (75.6%)	90
Need computer	58 (68.2%)	27 (31.8%)	85
Get computer training	60 (63.8%)	34 (36.2%)	94
Use computer out of the health facility	58 (61.7%)	36 (38.3%)	94
Use Internet	53 (57.6%)	39 (42.4%)	92

Further inquiries were made to ensure the presence of network or Internet services. The survey revealed that twenty (21.7 percent) of the total respondents (N = 94) indicated that Internet is available in their health facility, but that the speed and quality of the Internet was poor. As indicated in Figure 3, among those who had Internet access, only fourteen (70 percent) had broadband Internet in their health facility.

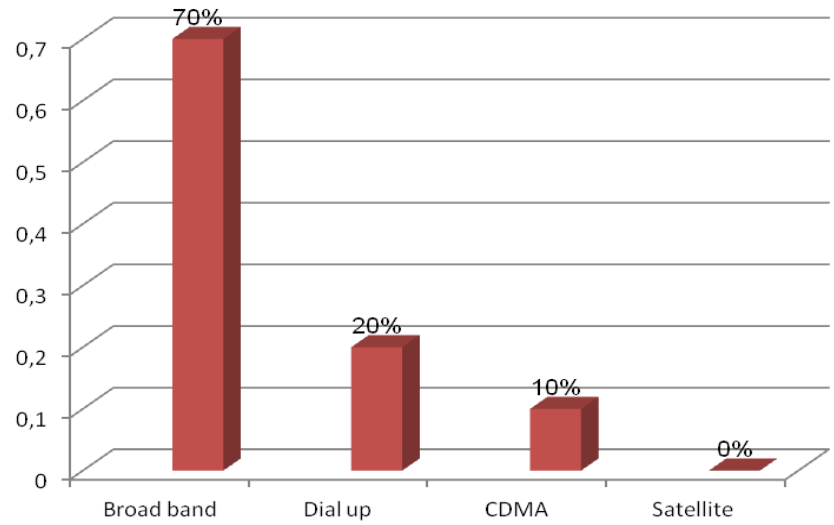

Figure 3. Type of Internet Services Available in the Study Area

Responses to the question pertaining to the cost of Internet connection are summarized in Table 8. Only twenty-nine (35.8 percent) of the eighty-one health professionals who responded indicated that the cost of Internet connection is fair for the intended purpose.

Table 8: Summary of Responses on the Cost of Internet Connection		
Price of Internet Connection		
	Frequency	Percent %
Too costly	27	33.3
Does not encourage longer time	15	18.5
Does not encourage many users at a time	10	12.3
Fair/Satisfactory	29	35.8
Total	81	100

With regard to the health facilities' use of ICTs to refer patients to other health facilities, forty-seven (39.8 percent) of health professionals indicated that they use ICTs for referrals. However, a significant proportion fifty-three (44.9 percent) of the respondents indicated that the use of ICT for referral services has not been planned in their respective health facilities (see Table 9).

Table 9: Use of ICT for Patient Referral Services		
ICT for Referral		
	Frequency	Percent %
Yes	41	34.7
Planned	6	5.1
Planning stage	18	15.3
Have not planned	53	44.9
Total	118	100

While the analysis made so far focused on ICT infrastructure availability and level of use, research suggests that comprehensive and rigorous studies can be conducted to explore the level of readiness of various factors based on relevant models (e.g., Khalid et al., 2007). In line with this, the next section presents the analysis made based on the STOPE model and the McConnell analysis method. In the McConnell procedure, scores are averaged. As shown in Figure 4, depending on the average score, the responses are represented with traffic light colors: red, amber-red, amber, amber-blue, and blue lights to visually indicate their e-readiness in each of the categories in the STOPE model.

Traffic Light	Red	Red-Amber	Amber	Amber-Blue	Blue
Mean of Domain					
	[0, 0.8)	[0.8, 1.6)	[1.6, 2.4)	[2.4, 3.2)	[3.2, 4)

Blue: Majority of conditions are suitable for e-Health
Amber-blue: Many conditions are suitable for e-Health
Amber: Improvement is needed to support e-Health
Red-amber: Numerous improvements are needed to support e-Health
Red: Substantial improvement is needed to support e-Health

Figure 4. McConnell International Tools of Traffic Light Colors

Of the fourteen strategic readiness (STR) variables coded and described in Table 10, there were four which showed amber-blue color. These were presence of ICT funding, policy for use of telemedicine, commitment for telemedicine, and plan to improve telemedicine. Amber-blue conveys that these conditions are suitable to support e-health/telemedicine adoption and implementation. On the other hand, measures such as clear ICT vision, institutional policy to promote telemedicine, user's involvement in telemedicine project, plan for telemedicine education, telemedicine implementation plan, and presence of responsible body for telemedicine planning were amber, indicating that some levels of improvements are needed in these areas before adoption of telemedicine technologies can be feasible. The rest of the strategy variables showed red-amber light, which indicates that numerous significant improvements are needed at the health facility levels to support the adoption of e-health or telemedicine.

Table 10: Strategic Readiness of Health Facilities in Addis Ababa

Strategy Construct Measures	Sample Size	Mean of Each Factor
Clear ICT vision	26	2.27
ICT funding	26	2.69
Policy for use of telemedicine (TM)	26	2.44
Commitment to TM	26	2.64
Institutional policy to promote TM	26	2.08
Plan for TM education	26	2.12
Plan for TM budget	26	1.92
Plan for TM initiatives evaluation	26	1.44
ICT Infrastructure development plan	26	1.96
TM training for care providers	26	2.2
Plan to improve TM environment	26	2.56
TM implementation plan	26	2.32
Responsible body for TM planning	26	2.28
AVERAGE STR = 2.274		Amber

Although the survey result revealed the need for improvements in the strategy category before meaningful implementation of e-health technologies, the telemedicine focal person at the Federal Ministry of Health (FMOH) stated that a Health Sector Development Plan (HSDP IV) document indicates that the Ethiopian government has a plan to adopt e-health. A national e-health policy is being formulated in collaboration with the Ethiopian Information Technology Development Agency (EICTDA). Since real-time telemedicine connectivity is very costly, the FMOH has adapted a strategy of store-and-forward telemedicine in their HSDP IV document. The store-and-forward telemedicine can be implemented at a relatively lower cost. Given the success stories from those who have adopted store-and-forward telemedicine, this method may be appropriate for Ethiopia at the current time. Since we have a shortage of healthcare specialists and a high turnover of professionals, telemedicine would partly solve the problem of access and improve quality of care.

Responses to organizational readiness measures in this study suggest that Ethiopia needs significant improvements before sustainable telemedicine can be implemented. These factors are summarized in Table 11. For example, measures such as organization's *level of transparency for telemedicine (TM) adoption* revealed the lowest result (or need for most improvement), although measures such as availability *of bandwidth size* showed a similar result. Based on the overall results, we can conclude that the organizational readiness domain of the STOPE model requires numerous improvements in order to pave the way for telemedicine/e-health adoption at the health facility level. The measures in Table 11, such as *TM compliance with the legal framework, TM for improving involvement in the healthcare, IT department's acceptance of TM, Institutional policy for TM use,* and *Reliability of organization's network,* were amber, again pointing to the need for improvement. The measure on organization network, however, indicates a slightly fair level of readiness of organization for telemedicine adoption, since it is amber-blue (at 2.92).

In answering questions related to organizational readiness to adopt telemedicine, those interviewed by officials at the Addis Ababa City Health Bureau and the FMOH cited many impediments. Within the health institutions, the main barrier cited is high turnover of health professionals. Resource constraints are also major impeding factors in healthcare organizations, according to the FMOH focal person for telemedicine. The respondent suggested that a possible solution to resource constraints may be to cross-train professionals and even lower-level employees.

Table 11: Organizational Readiness of Health Facilities in Addis Ababa

Organization Construct Measures	Sample	Mean of the Factors
Telemedicine compliance with the legal framework	26	2.65
Patients data privacy	26	2.35
TM for improving involvement in the healthcare	26	2.77
IT department's acceptance of TM	26	2.73
Institutional policy for TM use	26	2.54
Transparency in TM adoption	26	1.46
Adequate bandwidth for up and downlink	26	1.54
Reliability of organization's network	26	2.92
AVERAGE = 2.366		Amber

Many respondents suggested that all stakeholders should collaborate in telemedicine initiatives. They also mentioned that the current healthcare services were not satisfactory due to lack of access and quality of care. The problems cited include lengthy travel, long waiting times, shortages of diagnostic materials such as CT scans, and lack of specialists at each healthcare facility, to name but a few. Stakeholders' expectations of telemedicine adoption are illustrated by their perceived needs, dissatisfaction with the current situation, and willingness to change (core readiness). Since very few stakeholders are aware of the potential benefit of telemedicine, a public awareness campaign is needed to inform clinical and other professionals in the healthcare system.

Of the *People* construct measures summarized in Table 12, measures such as *Experience in using IT for education,* exhibited red-amber color. This implies significant need for improvements through training and development so that physicians would appreciate the role of telemedicine for continuing medical education and practice. On the other hand, measures such as *TM (telemedicine) rectifies care providers shortage*, *Involvement of care providers in TM* initiatives, *Policy makers level of TM awareness*, *Ability to use telemedicine technology*, and *Ability of ICT use for patient care* all indicate readiness for telemedicine technology adoption. The remaining variables in Table 12 signal the need for substantial improvements.

Table 12: Strategic Readiness of Health Facilities in Addis Ababa

People Construct Measures	Sample size	Mean of the Factors
TM rectifies care providers shortage	94	2.9
Level of TM awareness	94	1.77
Intention to enhance TM awareness	94	1.76
Quality of ICT training	94	1.64
Use of ICT for healthcare education	94	1.52
Experience in using IT for education	94	1.86
Involvement of care providers in TM	94	2.46
Use of ICT for decision making	94	1.6
Policy makers level of TM awareness	94	2.48
Availability of TM training	94	2.29
Ability to use telemedicine technology	94	2.96
Ability of ICT use for patient care	94	2.95
AVERAGE PPL= 2.18		Amber

During the interview, the focal person at FMOH stated that the individuals at the care-provision level need some expertise to adopt telemedicine. At the individual level, the physicians lack adequate familiarity with e-health technologies. They generally have not seen shortages of healthcare providers addressed using telemedicine. Funding is one of the major challenges to adopting telemedicine at the healthcare facilities level. The study identified knowledge gap, getting licensed, uncertainty regarding the sustainability of the service, and technology reliability concerns as key barriers. If the recommendations and insights offered by the healthcare professionals in this study are implemented, telemedicine could play a significant role toward a more effective use of the relatively limited resources that are currently available.

Table 13 summarizes the variables addressed under the construct *Technology* domain of the STOPE model. Measures such as *Internet connectivity speed*, *Adequacy of Internet connectivity for TM (telemedicine)*, *Use of Internet for health information exchange*, *Availability of hardware and software*, *Availability of adequate bandwidth*, and *Affordability of communication services* revealed red-amber results. This suggests that numerous significant improvements are needed for effective implementation and use of telemedicine.

Table 13: Technological Readiness for Telemedicine Adoption

Technology Construct Measures	Sample	Mean of the Factors
Internet connectivity speed	94	1.37
Adequacy of Internet connectivity for TM	94	1.41
Use of Internet for health information exchange	94	1.48
Availability of hardware and software	94	1.45
Affordability of hardware and software	94	1.85
Availability of adequate bandwidth	94	1.2
Affordability of communication services	94	1.51
Availability of technical personnel	94	2.06
Ease of getting technical support	94	1.8
Availability of technical support	94	1.97
AVERAGE TCH = 1.61		Amber

The survey results were cross-validated with the interview responses. The respondent or key informant interviewee suggested that lack of familiarity with technology or technophobia and low ICT infrastructural coverage nationally were some of the impeding factors to adopting e-health technologies needed for the implementation of telemedicine. In addition to these, limited bandwidth, slow dial-up connectivity, lack of quick maintenance services, and inadequate electricity coupled with frequent power outages conspire to make adoption of telemedicine/e-health harder. Some respondents stated that, in order to alleviate these problems, policy makers and other stakeholders need to change their attitudes toward telemedicine adoption. Therefore, in addition to mitigating the problems cited here, refresher and basic training on telemedicine and preventive maintenance expert(s) at each health facility are required. Additionally, timely consultation, discussion with FMOH, and integrated supportive supervision could provide viable solutions.

In Table 14, we present key variables related to the Environmental readiness construct of health facilities. For instance, measures such as *Use of ICT for referral, Presence of consumers' privacy laws, Availability of ICT-based referral system*, *Extent of belief in TM, Effort to cover TM costs,* and *Capacity of backbone telecom infrastructure to support TM* were blue-amber. This suggests that the healthcare facilities already have many suitable conditions to support the adoption of telemedicine. However, the existing overall situation in Ethiopia points to numerous needed improvements before meaningful telemedicine or e-health can be implemented. Furthermore, the variable that measured the capacity of health facilities to cover telemedicine-related expenses was red amber, implying the need for numerous improvements prior to adopting telemedicine. Other factors in Environmental Readiness appeared amber, suggesting the need for enhancing existing facilities in order to support telemedicine applications.

Table 14: Environmental Readiness of Health Facilities for Telemedicine Adoption		
Environment Construct Measures	Sample Size	Mean of the Factors
Use of ICT for referral	120	2.09
Presence of consumers' privacy laws	120	2.92
Availability of ICT-based referral system	120	2.99
Availability of IT local support	120	2.26
Budget availability	120	1.96
Extent of belief in TM	120	2.67
Effort to cover TM costs	120	2.63
Capacity of backbone telecom infrastructure to support TM	120	2.42
Reliability of telecom infrastructure	120	2.36
TM training expense coverage	120	1.5
AVERAGE ENV = 2.254		Amber

Information gathered through interviews from the Addis Ababa City Administration Health Bureau and from the FMOH confirmed that the Environmental domain needed improvement before adopting telemedicine. The FMOH telemedicine focal person stated that a national advisory committee had already been established to adopt e-health systems. The stakeholders on the national advisory committee were drawn from EICTDA, the Ethiopian Telecommunication Authority, public health, private companies, and the Clinton Foundation. They offered training and created awareness on how to adopt store-and-forward types of telemedicine. They also stated that the application of e-health may be accepted by the community when treatment is affordable and patients/customers are satisfied with the service. As specified earlier, the FMOH has a plan to adopt store-and-forward telemedicine for services such as radiology, dermatology, ophthalmology, cardiology, and pediatrics.

The summary of results of the five domain categories of the research model is presented in Table 15. Cross-referencing with the McConnell International tool was made. According to the McConnell International tool, all the categories of domain model average between 1.6 and 2.4, or amber color. This suggests that healthcare facilities in Addis Ababa need various improvements to adopt telemedicine. However, it does not mean that all the factors of the domain yielded the lowest possible score. Some factors revealed that institutional readiness to adopt e-health and telemedicine had already been achieved, while some factors show that numerous improvements are needed before telemedicine adoption.

Table 15: Summary of Analysis Results in the Domain Categories of the Research Model Adoption			
No.	Domain Category	Average	Result
1	Strategy	2.27	Amber
2	Technology	1.61	Amber
3	Organization	2.37	Amber
4	People	2.18	Amber
5	Environment	2.25	Amber

Further analyses were made to examine the correlations among the components of the STOPE model and the nine hypotheses stated earlier in the theoretical framework section. An analysis was made of the association between the Strategy components of the model with the remaining constructs of the model: Technology, Organization, People, and Environment. We had suspected that the readiness level of one component impacts the readiness of other components (see Table 16). More specifically, we hypothesized that the Strategy readiness level impacts the rest of the model constructs, except the Environmental domain.

From the results presented in Table 16, we can conclude that, based on the STOPE model, telemedicine adoption is affected by the readiness level. Therefore, the hypotheses formulated earlier, H1, H2, H3, H4, and H5, are significant at the 0.05 significance level. Furthermore, Hypotheses H6, H7, and H8 are supported as significant at the 0.01 level. This implies that the readiness of domains such as People, Technology, and Organization are dependent on the readiness of Strategy. However, we did not find convincing evidence regarding the impact of Environment on Strategy and vice versa.

Table 17 depicts e-health readiness as conveyed by the main factors in the model. It could be concluded that e-health implementation readiness is significantly affected by the readiness level of the STOPE model at the 0.05 significance level. Therefore, the inter-domain readiness of each category of the model affects the level of telemedicine adoption. Thus, hypotheses H_6, H_7, H_8, and H_9 are supported at the 0.05 level.

Table 16: Correlations Coefficient and Level of Significance						
Readiness Score						
STOPE Category	People	Technology	Environment	Organization	Strategy	e-Health
People readiness score	1	.484**	.194*	-.280**	-.280**	.260**
		0	0.034	0.002	0.002	0.004
Technology readiness score	.484**	1	0.027*	-.300**	-.300**	.274**
	0		0.025	0.001	0.001	0.002
Environment readiness score	.194*	0.127*	1	0.098**	0.152	.182*
	0.034	0.025		0.000	0.098	0.047
Organization readiness score	-.280**	-.300**	0.098**	1	.569**	-0.171*
	0.002	0.001	0.000		0	0.023
Strategy readiness score	-.280**	-.300**	0.152	.569**	1	-0.151*
	0.002	0.001	0.098	0		0.039
e-Health readiness score	.260**	.274**	.182*	-0.171*	-0.151*	1
	0.004	0.002	0.047	0.023	0.039	
** Correlation is significant at the 0.01 level (2-tailed).						
* Correlation is significant at the 0.05 level (2-tailed).						

As we saw from the correlation coefficients in Table 16 and the analysis of variance in Table 17, similar results are observed regarding the effect on Environmental readiness. Therefore, we conclude that there is no evidence that the Environmental readiness is affected by the Strategy readiness.

Table 17: Analysis of Variance ANOVA on STOPE					
e-Health Readiness Against the Factors	Sum of Squares	Df	Mean Square	F	Sig.
People	Between groups	102.569	1	102.569	15.689
	Within groups	771.431	118	6.538	
Strategy	Between groups	36.697	1	36.697	4.316
	Within groups	1003.23	118	8.502	
	Total	1039.93	119		
Technology	Between groups	26.408	1	26.408	9.184
	Within groups	339.292	118	2.875	
Environment	Between groups	15.023	1	15.023	3.896
	Within groups	454.977	118	3.856	
Organization	Between groups	16.31	1	16.31	5.105
	Within groups	376.99	118	3.195	

From Table 16 we conclude that e-health adoption readiness is significantly affected by the readiness level of the STOPE model at the 0.05 significance level. Therefore, the inter-domain readiness of each category of the model affects the level of telemedicine adoption. Thus, the hypotheses H_6, H_7, H_8, and H_9 are significant at the 0.05 level.

With regard to Environmental readiness, Table 18 shows similar results as observed in the correlation coefficients in Table 16, and the analysis of variance in Table 17.

Table 18: The Effect of e-Strategy Against the Rest of Domain Categories of the Research Model with ANOVA					
Strategy Readiness Against the Rest Category Model	Sum of Squares	Df	Mean Square	F	Sig.
People	Between groups	572.634	12	47.719	10.287
	Within groups	496.358	107	4.639	
Technology	Between groups	73.441	12	6.12	2.209
	Within groups	296.484	107	2.771	
Environment	Between groups	53.809	12	4.484	1.153
	Within groups	416.191	107	3.89	
Organization	Between groups	330.896	12	27.575	47.281
	Within groups	62.404	107	0.583	

VI. DISCUSSION

This study used survey questionnaires to assess major factors that may facilitate or hinder e-health adoption in health facilities in Addis Ababa, Ethiopia. We considered key issues such as ICT infrastructure, physician familiarity with technology, leadership, affordability, and availability of ICT, regulation of government and organizations, and the external environment such as telecommunications and other supporting groups or functions. This and similar studies on readiness are expected to provide key readiness indicators for telemedicine adoption and for implementing new work processes and systems. As expected, telemedicine readiness requires a significant investment because various backbone and support technologies and facilitating systems are prerequisites for their successful implementation and use. In addition to these factors, behavioral and psychological issues can potentially affect the adoption and implementation process of ICT. These issues either positively or negatively impact technology adoptions and effective utilization [Musa et al., 2005].

Our results also suggest a pertinent finding—Strategy readiness affects the readiness of all other domains of the research model except Environmental readiness. Furthermore, the study points to interrelationships among the components of the model and indicates how the components reinforce each other. Since this study indicated that the Technology readiness score is the lowest of all the domains of the research model, it is considered to be the critical domain next to Strategy readiness that requires improvement priority. The findings of this study are comparable with similar studies conducted elsewhere, for example, the e-readiness assessment made in Jordan by McConnell International [2002].

VII. CONCLUSION

This study assessed e-health readiness of public health facilities in Addis Ababa, Ethiopia. It covers most internal factors affecting adoption of telemedicine/e-health. The e-Readiness assessment model [Bakry, 2004] has five domains: Strategy, Technology, Organization, People, and Environment. A number of factors were addressed under each domain. The study examined the level of readiness of each of the five domains impacting the adoption of telemedicine technologies and the relationships between them. It revealed that almost all domains involved in the model need improvement to support adoption of e-health or telemedicine at health facilities in Ethiopia. The results from the study supported the research hypotheses that all the five-category domains affect e-health readiness. As pointed out earlier, the Strategy domain affects the rest of the domains in the study model, except Environment.

We indicated that the selected public health facilities in Addis Ababa have an amber readiness level, which suggests that significant improvements are needed before telemedicine could be adopted at healthcare facilities.

While the telemedicine readiness levels of the selected health facilities indicate amber readiness level, across all the five domains of the research model, there are significant variations in the degree of readiness. For instance, the Technology readiness score was 1.61 (the worst score from the five domains). Drilling down the Technology readiness domain revealed the need for improvement in the area of technological readiness. The required improvements are of various forms (e.g., infrastructure availability, support services, and type and simplicity of e-health equipment).

Another example is the Organization readiness, which has a score of 2.37; this is the highest average score among the five domains. This implies that the selected health facilities have better Organization readiness and commitment toward adopting e-health technologies as compared to the other domains in the research model. Thus, even though improvements are required in the area of Organization readiness, more significant improvements are required in the other domains of the research model.

Based on the findings of this study, we recommend that the Ethiopian Government Ministry of Health and the Addis Ababa Regional Health Bureau should pursue improvements in the areas pointed out for telemedicine adoption across all public health facilities. The rationale for e-health or telemedicine adoption should be widely diffused among health professionals so that healthcare facilities can collaborate with each other via the store-and-forward type of telemedicine. This would be a major step toward a comprehensive adoption of telemedicine.

Ethiopia needs varying levels of improvements of the e-readiness indicators. We call for further studies focusing on behavioral, psychological, and social aspects to provide a clearer picture of telemedicine readiness and to enhance the usability of the systems once it is put in place.

In spite of the fact that the setting or context, as well as the scales used in the current study, are different from others conducted elsewhere, our results are fairly similar. The study design, application of analysis tools and results obtained could be cited as added strengths of the current study. Other Sub-Saharan African countries may benefit from this work, and it may be used to inform their own telemedicine adoption studies.

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APPENDIX A: INTRODUCTION AND CONSENT FORM

Dear Sir/Madam:

My Name is Amare Ayalew. I am a postgraduate student of Addis Ababa University in health informatics program. I want to study the research thesis project on readiness of health facility to adopt telemedicine in Addis Ababa health facilities.

As you know, we suffer from a shortage of medical specialists to treat various diseases. Given the severe shortage of medical specialists, evaluation of telemedicine as a possible solution in healthcare delivery seems reasonable. Therefore, I want to study the telemedicine readiness of our health facilities. I am soliciting your response to questions related to technological infrastructure of your facility, strategies, the environmental factor, impeding and facilitating telemedicine readiness for the adoption of telemedicine.

Your name, address, and other personal information should not be written on this questionnaire. Your responses to this questionnaire will be used for this research purpose only. It will not be used for other research, even if it is somewhat related to other kinds of research. You can stop at any time during the interview or complete self-administered questionnaire. While your cooperation in answering every question will help us understand important questions with regards to telemedicine readiness, you are not obligated to answer every question.

It will take about **40 minutes** to complete the questionnaire.

If you are willing and able to provide me the numbers, please indicate your consent below.

Yes, I am willing to participate in this study _____

No, I am not willing to participate in this study _____

If you are willing to participate in this study, Please provide the number of health professionals required in the space available for your health facility in the following table.

Thank you!

Health Facility	Specialists	Medical Doctors	Health Officers	Nurses	Laboratory Technicians	Data Experts
St Paul Hospital						
St Peter Hospital						
Yekatit 12 Hospital						
Menelik II Hospital						
Gandi hospital						
Zewditu Memorial Hospital						
Bole Health Center						
Kazanchis Health Center						
Meshwalekia Health Center						
Gulele Health Center						
Kotebe Health Center						
Entoto No1 Health Center						
Arada Health Center						
Kebena health center						
Lideta Health Center						
Nifas silk health center						

QUESTIONNARIE

Section I—Demographic Characteristics

DMC101—What is the respondent's age?

A) 20–25 B) 26–35 C) 36–45 D) 46–55 E) Above 55

DMC102—Sex: A) Male 2) Female

DMC103—What is your profession in the health facility?

A) Physician B) Administrator C) Medical Director D) Manager E) Other, Please specify _____

DMC104—Year of service by the profession at this facility _____

Section II—ICT Infrastructure

201. Do you have a computer in your facility? 1. Yes 2. No 3. Don't know

202. If yes in Q201, do you use it? 1. Yes 2. No

203. If yes in Q201, do you need a computer for your job? 1. Yes 2. No

204. Do you have computer training? 1. Yes 2. No

205. Do you use a computer out of the health facility? 1. Yes 2. No

206. Do you use Internet service? 1. Yes 2. No

207. If yes in Q206, how frequently?

1. daily 2. Weekly 3. Monthly 4. Less than once a month 5. Sometimes

208. Is the health facility ready to adopt telemedicine? 1. Yes 2. No 3. Don't know

Section III—Strategy Readiness

STR701—The organization has a clear articulated mission, vision, or both about ICT.

1. Strongly agree 2. Agree 3. Uncertain 4. Disagree 5. Strongly disagree

STR702—The government provides plan/fund or any other support of ICT/e-health in your facility.

1. Strongly agree 2. Agree 3. Uncertain 4. Disagree 5. Strongly disagree

STR703—Government policies of health are in place to promote and manage the use of telemedicine in the facility.

1. Strongly agree 2. Agree 3. Uncertain 4. Disagree 5. Strongly disagree

STR704—Your organization has a direction, commitment, and plan toward ICT for telemedicine development and utilization

1. Strongly agree 2. Agree 3. Uncertain 4. Disagree 5. Strongly disagree

STR705—Institutional policies are in place to promote and manage the use of telemedicine in your facility.

1. Strongly agree 2. Agree 3. Uncertain 4. Disagree 5. Strongly disagree

STR706—Do you think all the user groups among staff and other stakeholders in your organization have been involved in planning for the new telemedicine project?

1. Yes 2. No 3. Don't know

STR707—There is a plan that is needed and accessible by human resources for ICT awareness, education, and ICT training to prepare readiness to adopt telemedicine.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

STR708—In planning for the new telemedicine project, the implementation plan includes proper budgeting and identification of resources.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

STR709—In planning for the new telemedicine project, there is an appropriate plan for evaluation of telemedicine initiative, including an option for external evaluation.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

STR710—Your healthcare facility has a future development plan for basic ICT and information infrastructure, e-service infrastructure, and ICT support to adopt telemedicine technology.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

STR711—Do you agree that to implement telemedicine there should be training for health providers?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

STR712—There is a strategic resource plan and basic infrastructure service for the surrounding environment.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

STR713—In planning for the new telemedicine project, there is an appropriate plan for implementation of telemedicine initiatives.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

STR714—In planning for the new telemedicine project, an individual or a group has taken responsibility for planning in order to get top management support.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

STR715—In order to strengthen the capacity of ICT knowledge, the healthcare provider will be willing and committed to accept additional responsibilities.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

Section IV—Technology Readiness

TCH401—Your facility has Internet access. 1. Yes 2. No 3. Don't know

TCH402—If you answered "yes" in TCH401, indicate the type of Internet.

1. Dial up 2. Broadband 3. Satelite 4. CDMA

TCH403—Speed of connections is appropriate ICT/Internet for the proposed use that operates in your facility.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

TCH404—Quality of connections is appropriate for the proposed use at your healthcare facility.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

TCH405—The cost of Internet connection is _____.

1. Very high *2. Do not encourage to use long time* *3. Do not encourage many users at a time* *4. Sufficient*

TCH406—The facility has a website. 1. Yes 2. No 3. Don't know

TCH407—Do you agree that your healthcare facility uses Internet for information exchange with another similar facility?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

TCH408—Hardware and software required for the proposed project are readily available at your facility.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

TCH409—Hardware and software required for the proposed project are readily affordable by your facility.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

TCH410—In your health facility, the required ICT (telephone/internet/bandwidth) is easily available to adopt telemedicine.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

TCH411—In your healthcare facility, the required ICT (telephone/internet/bandwidth) is easily affordable to adopt telemedicine technology for the institutions involved.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

TCH412—Availability of operations and maintenance persons will be a problem if telemedicine or e-health technology is adopted

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

TCH413—Service/support is available within a reasonable time frame for the proposed use.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

TCH414—Adequate local support is available to address most of the problems related to proposed use.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

Section V—Organization Readiness

ORG601—What is your level of agreement with the legal framework of IT for telemedicine?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ORG602—Telemedicine software keeps patient data from being abused.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ORG603—Do you agree that telemedicine encourages individuals and investors to participate in demand and supply of healthcare services?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ORG604—The health facility IT department should accept e-health technology.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ORG605—Institutional policies are in place to promote and manage the use of telemedicine in the facility.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ORG606—Your organization's vision of planning of adoption telemedicine is widely communicated throughout the facility.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ORG607—Your facility has high bandwidth connectivity to the Internet to speed up downloading and attaching files.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ORG608—To your knowledge, the cost of ICT maintenance is _____.

1. Low *2. Enough* *3. High* *4. Very high* *5. Don't know*

ORG609—The network connection in the health sector are reliable and affordable, in addition to providing technical assistance for the healthcare provider

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ORG610—To your knowledge, does information exchange between your facility and other health facilities exist?

1. Yes *2. Will be planning soon* *3. Already in planning stage* *4. No plan* *5. Don't know*

ORG611—To improve e-health, to what extent is communication needed between industry leader and health facility?

1. None *2. Low* *3. Good* *4. Very good* *5. Don't know*

ORG612—Do you think that there is a strategic plan for ICT support at your health facility?

1. No *2. Planned* *3. Implementing stage* *4. Implemented*

Section VI—People Readiness

PPL301—Do you think that telemedicine can solve the shortage of healthcare providers?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL3102—Awareness of ICT and Internet's role in telemedicine in the organization exists among the planners.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL303—Policy makers identify and prioritize to create awareness about ICT.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL304—What quality level do you think the training and education for ICT has at your facility?

1. No ICT training 2. Poor 3. Good 4. Very good 5. Don't know

PPL305—Institutional access to ICT/Internet training: Programs are in place to train the users for proposed project.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL306—Use of ICT/Internet to enhance education of care providers: Programs exist for continuous education.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL307—Use of ICT/Internet to enhance education of care providers ICT/Internet is readily used in continuous education.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL308—Involvement of healthcare providers in telemedicine projects: There is a plan in place to involve healthcare providers in the planning and implementation of new telemedicine interventions.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL309—The capacity of ICT is adequate to make business decisions in your organization.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL310—Do you believe that policy makers, government officials, and healthcare providers prefer telemedicine to alleviate the shortage of healthcare providers?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL311—Do you agree that there will be telemedicine training for healthcare providers?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL312—Comfort with technology: There is general comfort in using ICT/Internet among users of the proposed telemedicine/e-health project.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

PPL313—There is general comfort among staff institution in using ICT/Internet for the purpose of customer and patient for care and education.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

Section VII—Enviroment Readiness

ENV501—Do you agree with a paper-based referring system?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV502—Currently ICT is used for referrals between this institution and other healthcare institutions.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV503—We believe there are effective laws to protect consumer privacy.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV504—A referral system is available between this institution and other healthcare institutions to provide patient care in certain specialties.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

5ENV505—We feel that there is efficient and affordable support from the local IT industry to support our move to the Internet.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV506—The health facility has Internet service? 1. Yes 2. No 3. Don't know

ENV507—If you answered yes in ENV506, the health facility has an adequate budget to pay for Internet access.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV508—Do you believe in science- and technology-sponsored telemedicine technology?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV509—Do you agree that there have been organizational efforts to cover the cost of telemedicine technology?

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV510—The technology infrastructure of commercial and financial institutions is capable of supporting telemedicine.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV511—The telecommunication infrastructure is reliable and efficient.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV512—The health facility covers training expenses of telemedicine.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV513—The relevant material is available in language(s) easily understood by all the staff and other users of information.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV514—The health facility healthcare provider has been influenced by culture to accept telemedicine technology.

1. Strongly agree *2. Agree* *3. Uncertain* *4. Disagree* *5. Strongly disagree*

ENV515—Educational institutions can contribute to the quality of ICT for the society.

1. No *2. Poor* *3. Something is better than nothing* *4. High* *5. Don't know*

ENV516—We believe that quality of ICT training is _____.

1. No ICT *2. Poor* *3. Something is better than nothing* *4. High* *5. Don't know*

********** THE END —— Thank You **********

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