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# A Comparative Study of e-Medicine Uptake in Uganda, Nigeria and Ethiopia

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**Abstract**. This study sought to examine the uptake of e-medicine in three Sub-Saharan Africa countries namely; Uganda, Ethiopia and Nigeria, with the aim of establishing the salient factors that influence sustainable e-medicine in Sub-Saharan Africa. A mixed research approach involving both qualitative and quantitative research methods was used. A sample of 416 Medical Officials, Information Technology staff, and Hospital Administrators was selected from all the three participating countries. Survey questionnaires and interviews guides were used to collect data. Data were sorted and analyzed using Structural Equation Modeling in order to test research hypotheses and develop the model. Findings show that social environmental factors determine the level of influence of institutional and technological environments on sustainable e-medicine uptake in all the three countries. The findings also reveal that countries with knowledge management practices are more likely to produce sustainable e-medicine outcomes, thereby improving e-Medicine uptake. For successful uptake of e-Medicine in Uganda, Ethiopia, Nigeria and other Sub-Saharan Africa countries, there is need to set up a networked e-Medicine sites across hospitals in different countries, generate local content, formulate national-level e-Medicine policies, train users, and encourage donor funding for e-Medicine projects.

**Keywords**: E-medicine, Telemedicine, Sub-Saharan Africa, E-medicine Sustainability, E-medicine Adoption, E-medicine Transfer, Developing countries

## 1. INTRODUCTION

E-medicine, also referred to as telemedicine is healthcare delivery where general practitioners remotely observe patients using Information Technologies such as computers, mobile phones, and the internet among others. E-medicine, just as with all Information Technologies, was developed and piloted in developed countries. However, due to its numerous benefits, it has previously been applied efficaciously to report pressing medical complications in SSA [1-2]. Although these initial achievements have been promising, however, these are comparatively small as well as isolated projects. Many researchers have emphasized the notion of telemedicine in terms of reduction of cost [3] and improvement of patient monitoring and management but have not explored the issues of sustainability of the isolated telemedicine

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initiatives in resource poor nations such as those in Sub-Saharan Africa. Although, some research has been conducted in the last decade on telemedicine in sub-Saharan Africa (SSA), almost no study has been conducted to compare how different countries in SSA have tried to implement the technology. This is perhaps because SSA region is still much overlooked in mainstream information systems research. Consequently, efforts to design and implement sustainable e-medicine technology in this area are minimal. There are currently no clear research-based guides for African policy makers on telemedicine. This has typically resulted in these policy makers basing decisions on what they know of the "Western" context of IT. In other words, the attitude is that of "let's get this or that technology just because it is the latest technology and it is widespread in the U.S.A and/or Europe." This, therefore, leads to poor judgments in the acquisition and sustainability of such technologies. The study therefore sought to examine the uptake of e-medicine in three African countries.

## 2. FACTORS AFFECTING E-MEDICINE UPTAKE IN SSA

A critical determinant of e-medicine transferal in SSA is e-medicine implementation factors [4-8]. Existing evidences identifies several implementation factors for IT generally, including project champions, user training, and support from the top management [9-10]. The section provides a quick review of evidence on the aspects that affect the uptake of e-medicine in SSA.

### *2.1.National IT Policies*

The primary critical determinant of e-medicine transfer included nationwide IT policy. Government policies are considered highly instrumental in diffusion of computing in a society [11]. This is very imperative within the context of SSA where governments control majority of the IT infrastructures [12-13] and support diverse policies that impact the use as well as acquisition of the infrastructures by private institutions. For instance, some of the SSA countries categorize CPUs as a luxury item and so charge precisely extraordinary custom duties when they are imported. Contrariwise, a country like Cameroon allows processors to be imported duty-free in a bid for the purpose of encouraging such imports [14]. With policies that encourage computer investments as well as ownership, it is anticipated that IT will be more eagerly transferred to all segments of the population.

*2.2. IT knowledge and skills*

Conventionally, failure in introducing an information system magnificently is correlated with how an implementation of system occurred. For instance, investigating training of users in the context of SSA, [1] debates for the essential role that human capacity development or IT training can play during the structuring of sustainable IT transfer to SSA. They additionally discussed that although the progress of IT infrastructure is an essential necessity for effecting sustainable SSA development, the manifestation of extensive infrastructure is incapable to yield economic development without the trained human capital to influence this conversion.

*2.3 IT Infrastructure in SSA*

The third critical determinant of e-medicine transfer is the IT infrastructure. As noted, e-medicine is healthcare delivery where physicians remotely examine patients using IT. To allow the practice of e-medicine, a nation desires a compacted IT infrastructure [15; 7]. In the ancient times, telecommunications infrastructure has typically been measured in terms of tele-density i.e. the number of land telephone lines per capita [16]. Nevertheless, with the elevating spread of wireless telecommunications, a broader outlook needs to be taken in classifying IT infrastructures.

*2.4 Culture and Beliefs*

Culture, the fourth critical element of e-medicine transfer in SSA, is a multifaceted notion typically evaluated in terms of manifold of magnitudes. Although the researchers have not been able to identify any studies of the influence of cultural factors explicitly pertaining to e-medicine, there has been substantial research probing the cultural proportions of IT transfer all together. The *beliefs and values* that individuals have ingrained in themselves by their cultural context significantly affects their perspective as well as thinking, and hence their attitude to consuming technology [17-20]. In [20] the culture, construct is distributed into two sub constructs. First, culture-specific beliefs as well as values signify particular beliefs or values that an individual might hold for the influence of his/her cultural background. The second culture sub construct is *technology culturation,* which signifies an individual's exposure to a comparatively technology-intense culture. In the milieu of studies of IT diffusion in the developing countries, this specifies an extent to which a resident of a developing country has been exposed to more technically modernized cultures [21; 7].

### *2.5 Degree of Donor Involvement*

Most telemedicine projects are developed and supported by donor nations from developed countries. The involvement of foreign donors is a particularly important consideration that is worthy of scrutiny, mainly because their participation can influence the outcome of a technology transfer venture, in both positive and negative ways. Lacking successful technology transfers, healthcare in SSA in its present state is heavily dependent on external assistance. Various international nongovernmental aid organizations occasionally intervene to ease the crisis. For example, *Médecins sans Frontières* (MSF, "Doctors without Borders"), a recent Nobel laureate organization, has supplied resources and efforts to alleviate these crises. However, MSF cannot be omnipresent. Whenever the crisis or conflict deepens, MSF is forced to evacuate the region, as they had to do in the July 2000 political crisis in Sierra Leone. In their absence, the status quo returns, once again marginalizing the population.

The above literature yielded into 4 hypotheses for this study listed as follows:

**H1:** Social environment in SSA determines the level of influence of institutional and technological environments on sustainable e-medicine outcomes

**H2**: Countries in SSA with strong institutional and technological environment (Internet, cable infrastructure, telephone, databanks) are more likely to implement policies that will lead to sustainable e-medicine outcomes.

**H3:** Degree of donor involvement in SSA determines the level influence of Technology transfer and knowledge management practices on sustainable e-medicine outcomes.

**H4**: SSA countries that have knowledge management practices are more likely to produce sustainable e-medicine outcomes.

## 3. THEORETICAL MODELS USED

In this section, the theoretical underpinning and theoretical model used in the study is described.

*3.1 The Arab Policy and Information Technology (APIT)*

In the “Arab Policy and Information Technology (APIT)” and “Arab Culture and Information Technology (ACIT) study”, Checchi & colleagues [7] and Straub & collogues [22] investigated culture as well as ICT policies at the national level, addressing ITT/ICT outcomes which were borrowed for this study. Policies work together with ICT infrastructure at the national level. Culture-specific beliefs, transfer implementation factors, and technology culturation function at the cultural level. Thus, for improved understanding of telemedicine transfer outcomes integrating national infrastructure as well as cultural models, we implemented the APIT/ACIT model of IT transfer as our principal theoretical underpinning to elucidate sustainability in addition to transfer of technology within resource-poor settings.

*3.2 Arab Policy and IT (APIT) and Arab Culture and IT (ACIT)*

The APIT/ACIT investigation performed in the region of information technology transfer to the Arab world is founded on policies in addition to culture [7; 22]. Checchi & colleagues [7] address three questions: (1) “How do national Information Technology (IT) policies and Technology Infrastructure (TI) affect Information Technology Transfer (ITT)?” (2) “Which transfer implementation factors affect ITT?” (3) “What role do culture and technological culturation play in ITT?” [23; 7; 22]. All of them reviewed the relevant evidence to identify experiences with IT, and specified that comparatively limited studies empirically tested cross-cultural impact on the implementation as well as diffusion of innovative IT. Conversely, limited studies [24; 1] conclude that culture has a noticeable impact on ITT. It is also eminent in [7] that other studies of national ICT infrastructures in addition to policies influenced IT transfer.

## 4. DESCRIPTION OF THE RESEARCH DESIGN

Both quantitative and qualitative research designs were adopted. The target population comprised of medical personnel, hospital administrators, nurses, IT personnel and patients, divided into non-overlapping subpopulations. A simple cluster sample of subpopulations (clusters) was obtained. Within each selected cluster, each subject was sampled. In total, 131 respondents came from Ethiopia (Bethel teaching hospital), 150 from Nigeria (Pan-African Telemedicine Centre of the University of Ibadan teaching hospital and Lagos hospital) and 135 from Uganda (Nsambya and Mulago hospital). Validity and reliability were done on the research instruments before being administered to respondents. Data were sorted and analyzed using Structural Equation Modeling in order to test research hypothesis.

## 5. INTERPRETATION OF RESULTS FROM THE STRUCTURAL EQUATION MODEL

The fit test statistics for the first model are: CFI (0.95) and RMSEA (0.76), with a 90% confidence interval of 0.075 and 0.103; the standardized room mean square residual was 0.066 and the Chi-square and log of likelihood that test the null hypothesis that all parameters equal to zero were significant at 1% level. These results imply good model fit.

The SEM model has two parts: the measurement model and the structural model. The measurement model, co-variances and variances have the same meaning as explained above in the Confirmatory Factor Analysis (CFA) results. For each country, results of the regression model/structural model are presented first and then followed by the results of the measurement model.

**Table 1:** Results of Structural Equation Model for Ethiopia

| Observable and Latent Variables | Estimate | Std.err | Z-value | P(>\|z\|) | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Measurement Model** | | | | | | |
| **Regression Model** | | | | | | |
| **e-Medicine Sustainability Outcome** | | | | | | |
| **Technical Environment** | -0.089 | 0.124 | -0.714 | 0.475 | -0.049 | -0.049 |
| **Knowledge Management Practices** | 1.053 | 0.193 | 5.469 | 0.000 | 0.749 | 0.749 |
| **Technical Environment** | | | | | | |
| **Institutional Environment** | 0.121 | 0.045 | 2.656 | 0.008 | 0.282 | 0.282 |
| **Social Environment** | 0.147 | 0.066 | 2.241 | 0.025 | 0.240 | 0.240 |
| **Institutional Environment** | | | | | | |
| **Social Environment** | 0.556 | 0.134 | 4.161 | 0.000 | 0.388 | 0.388 |
| **Knowledge Management Practices** | | | | | | |
| **Technology Transfer Project Environment** | -0.071 | 0.064 | -1.109 | 0.267 | -0.102 | -0.102 |
| **Donor Involvement** | 0.196 | 0.078 | 2.510 | 0.012 | 0.255 | 0.255 |
| **Technology Transfer Project Environment** | | | | | | |
| **Donor Involvement** | 0.135 | 0.102 | 1.327 | 0.185 | 0.123 | 0.123 |

The analysis of data pertaining to Ethiopia (Table 1), above shows, there was a positive dependency between e-Medicine sustainable outcomes and knowledge management practices (p-value<0.01). There is a negative but not significant relationship between technical environment and e-medicine sustainable outcomes. The results also reveal a positive relationship between technical environment and institutional environment and social environment that was statistically significant though the relationship of social environment was not significant.

The SEM results also revealed a negative non-significant relationship between knowledge management practices and technology transfer environment of P-Value<0.01 = -0.071. Knowledge management practices showed a positive dependence on donor involvement (0.196) which was statistically significant.  In Ethiopia, the SEM results also revealed a positive non-significant relationship between donor involvement and technology transfer project environment which was positively dependent on donor involvement, but not statistically significant. The study also reports that the measurement model revealed that all factors loaded in the same direction and were significant at P-Value<0.01.

**Table 2:** Results of Structural Equation Model for Uganda

| Observable and Latent Variables | Estimate | Std.err | Z-value | P(>\|z\|) | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regression Model** | | | | | | |
| **e-Medicine Sustainability Outcome** | | | | | | |
| **Technological  Environment** | -0.019 | 0.185 | -0.101 | 0.919 | -0.009 | -0.009 |
| **Knowledge Management Practices** | 0.540 | 0.076 | 7.070 | 0.000 | 0.579 | 0.579 |
| **Techninological Environment** | | | | | | |
| **Institutional Environment** | 0.111 | 0.055 | 2.000 | 0.045 | 0.272 | 0.272 |
| **Social Environment** | 0.490 | 0.200 | 2.456 | 0.014 | 0.529 | 0.529 |
| **Institutional Environment** | | | | | | |
| **Social Environment** | 0.900 | 0.306 | 2.937 | 0.003 | 0.397 | 0.397 |
| **Knowledge Management Practices** | | | | | | |
| **Technology Transfer Project Environment** | 0.761 | 0.110 | 6.900 | 0.000 | 0.603 | 0.603 |
| **Donor Involvement** | -0.065 | 0.174 | -0.376 | 0.707 | -0.032 | -0.032 |
| **Technology transfer project environment** | | | | | | |
| **Donor involvement** | 0.610 | 0.170 | 3.595 | 0.000 | 0.372 | 0.372 |

Equally, the Uganda analysis (Table 2) above, reveals that there was a positive dependency between e-medicine sustainable outcomes and knowledge management practices (p-value<0.01). There is a negative but not significant relationship between technological environment and e-medicine sustainable outcomes. The results also revealed a positive relationship between technological environment, social environment and institutional environment though the relationship was not significant. The results also indicated a positive significant relationship between institutional environment and social environment.

The SEM also revealed a positive significant dependence between Knowledge management practices and technology transfer environment of which was also statistically significant and negative non-significant relationship between knowledge management and donor involvement. In Uganda technology transfer project environment had positively statistically significant relationship with donor involvement (0.610). The study also reports that the measurement model revealed that all factors loaded in the same direction were significant at P-Value<0.01.

**Table 3:** Results of Structural Equation Model for Nigeria

| Observable and Latent Variables | Estimate | Std.err | Z-value | P(>\|z\|) | Std.lv | Std.all |
|---|---|---|---|---|---|---|
| **Regression Model** | | | | | | |
| **E-medicine Sustainability outcomes** | | | | | | |
| **Technological environment** | -0.104 | 0.087 | -1.199 | 0.230 | -0.070 | -0.070 |
| **Knowledge management practices** | 0.908 | 0.114 | 7.942 | 0.000 | 0.830 | 0.830 |
| **Technical environment** | | | | | | |
| **Institutional environment** | 0.122 | 0.048 | 2.567 | 0.010 | 0.222 | 0.222 |
| **Social environment** | 0.172 | 0.058 | 2.951 | 0.003 | 0.259 | 0.259 |
| **Institutional environment** | | | | | | |
| **Social environment** | 0.244 | 0.103 | 2.378 | 0.017 | 0.202 | 0.202 |
| **Knowledge management practices** | | | | | | |
| **Technology transfer project environment** | 0.026 | 0.139 | 0.190 | 0.849 | 0.020 | 0.020 |
| **Donor involvement** | 0.108 | 0.093 | 1.158 | 0.247 | 0.119 | 0.119 |
| **Technology transfer project environment** | | | | | | |
| **Donor involvement** | 0.336 | 0.065 | 5.156 | 0.000 | 0.487 | 0.487 |

In Nigeria (Table 3) above, results indicate that there was a positive dependency between e-medicine sustainable outcomes and knowledge management practices (p-value<0.01). There is a negative but not statistically significant relationship between technical environment and e-medicine sustainable outcomes. The results also revealed a positive dependency between technological environment social environment and institutional environment which was statistically significant.  A positive statistically significant relationship also was evident between institutional environment and social environment

The SEM results also revealed a positive statistically non-significant relationship between Knowledge management practices and technology transfer environment and donor involvement. In Nigeria technology transfer project environment was positively dependent on donor involvement (0.610) and statistically significant. The study also indicates that the measurement model revealed that all factors loaded in the same direction were significant at P-Value<0.01. Results of hypothesis testing for e-medicine uptake in respective country sites are given in table 4, 5 and 6:

**Table 4:** Hypotheses Testing In Ethiopia

| H | Hypothesis | Result |
|---|---|---|
| **H1** | **H1:** Social environment in SSA determines the level of influence of institutional and technological environments on sustainable e-medicine outcomes. | Strongly supported |
| **H2** | **H2**: Countries in SSA with strong institutional and technological environment (Internet, cable infrastructure, telephone, databanks) are more likely to implement policies that will lead to sustainable e-medicine outcomes. | Partially supported (only supported on institutional levels) |
| **H3** | **H3:** Degree of donor involvement in SSA determines the level influence of Technology transfer and knowledge management practices on sustainable e-medicine outcomes. | Partially supported ( Only on technological) |
| **H4** | **H4**: SSA countries that have knowledge management practices are more likely to produce sustainable e-medicine outcomes. | Strongly supported |

In Ethiopia Hypothesis **H1** about social environment determining the level of influence on institutional and technological environment on sustainable e-medicine outcomes was strongly supported as per results of the structural equation modeling that shows a positive significant relation of (0.147 at P<0.01). This means that that e-medicine projects that are supported by more robust health care systems are likely to produce more time interventions and expert advice.

Hypothesis **H2** was partially supported at the institutional level showing a positive significant relationship as per the SEM results. Technological environment was not supported and therefore for long-term sustainability of wired and wireless infrastructure was not significant.

Hypothesis **H3** was also partially supported indicating a strong dependency on technology transfer of project environment but knowledge management was not supported, as earlier discussed in the literature.

Hypothesis **H4** was strongly supported with a positive significant relationship revealing that countries with knowledge management practices will produce sustainable e-medicine outcomes.

**Table 5:** Hypothesis Testing In Uganda

| H | Hypothesis | Result |
|---|---|---|
| **H1** | **H1:** Social environment in SSA determines the level of influence of institutional and technological environments on sustainable e-medicine outcomes. | Strongly supported |
| **H2** | **H2**: Countries in SSA with strong institutional and technological environment (Internet, cable infrastructure, telephone, databanks) are more likely to implement policies that will lead to sustainable e-medicine outcomes. | Partially supported (only supported on institutional levels) |
| **H3** | **H3:** Degree of donor involvement in SSA determines the level influence of technology transfer and knowledge management practices on sustainable e-medicine outcomes. | Partially supported ( Only on technological) |
| **H4** | **H4**: SSA countries that have Knowledge management practices are more likely to produce sustainable E-medicine outcomes. | Strongly supported |

In Uganda Hypothesis **H1** of social environment determines the level of influence on institutional and technological environment on sustainable e-medicine outcomes was strongly supported as per results of the Structural equation modeling that shows a positive significant relation of 0.490 at P<0.01. This means that we can report on one side that e-medicine projects

that are supported by more robust healthcare systems are likely to produce more time interventions and expert advice. The study therefore hypothesizes that social environment influences institutional and technological environments on sustainable e-medicine outcomes.
Hypothesis **H2** was partially supported at the institutional level, which had a positive significant relationship as per the SEM results. Technological environment was not supported; therefore for long-term sustainability, wired and wireless infrastructure was not significant.
Hypothesis **H3** was also partially supported, indicating a strong dependency of technology transfer of project environment but knowledge management was not supported, as earlier discussed in the literature. The two items had a negative relationship though not statistically significant.

Hypothesis **H4** in Nigeria was strongly supported with a positive significant relationship revealing that countries with knowledge management practices will produce sustainable e-medicine outcomes.

**Table 6:** Hypothesis Testing In Nigeria

| H | Hypothesis | Result |
|---|---|---|
| **H1** | **H1:** Social environment in SSA determines the level of influence of institutional and technological environments on sustainable e-medicine outcomes. | Strongly supported |
| **H2** | **H2**: Countries in SSA with strong institutional and technological environment (Internet, cable infrastructure, telephone, databanks) are more likely to implement policies that will lead to sustainable e-medicine outcomes. | Partially supported (only supported on institutional levels) |
| **H3** | **H3:** Degree of donor involvement in SSA determines the level influence of technology transfer and knowledge management practices on sustainable e-medicine outcomes. | Not supported |
| **H4** | **H4**: SSA countries that have knowledge management practices are more likely to produce sustainable E-medicine outcomes. | Strongly supported |

In Nigeria, hypothesis **H1** that social environment determines the level of influence on institutional and technological environment on sustainable e-medicine outcomes was strongly supported as per results of the structural equation modeling that shows a positive significant relationship of 0.0170 at $P<0.01$. This means that we can report on one side that e-medicine projects that are supported by more robust healthcare systems are likely to produce more time interventions and expert advice. The study therefore concludes that social environment influences institutional and technological environments on sustainable e-medicine outcomes.
Hypothesis **H2** was partially supported at the institutional level, which had a positive significant relationship as per the SEM results. Technological environment was not supported and therefore for long-term sustainability wired and wireless infrastructure was not significant.
Hypothesis **H3** there was a positive non-significant relationship between knowledge

management practices and donor involvement. Therefore, the study shows an indifferent relationship, though all of the constructs individually influence e-medicine sustainability. Hypothesis **H4** was strongly supported, in Nigeria with a positive significant relationship revealing that countries with knowledge management practices will produce sustainable e-medicine outcomes.

### *5.1 A Combined Structural Equation Model for Uganda, Ethiopia and Nigeria*

Table 7 shows the combined structural model of e-medicine uptake in Uganda, Ethiopia and Nigeria:

**Table 7:** Lavaan (0.4-8) Converged Normality after 60 Interactions

| **Number of Observations** | | | | **415** |
|---|---|---|---|---|
| **Estimator** | | | | ML |
| **Minimum Function Chi-Square** | | | | 2876.788 |
| **Degrees of freedom** | | | | 678 |
| **P-value** | | | | 0 |
| **Chi-square test baseline model** | | | | |
| **Degrees of freedom** | | | | 741 |
| **P-value** | | | | 0 |
| **Full model Vs. Baseline Model** | | | | |
| **Comparative Fit Index (CFI)** | | | | 0.798 |
| **Tucker-Lewis Index (TLI)** | | | | 0.779 |
| **Log likelihood and Information Criteria:** | | | | |
| | | | | |
| **Log likelihood user Model (H0)** | | | - | 25229.93 |
| **Log likelihood unrestricted Model (H1)** | | | - | 23791.53 |
| **Number of free parameters** | | | | 102 |
| **Akaike (AIC)** | | | | 50663.85 |
| **Bayesian (BIC)** | | | | 51074.74 |
| **Sample-size adjusted Bayesian (BIC)** | | | | 50751.06 |
| **Root Mean Square Approximation:** | | | | |
| **RMSEA** | | | | 0.088 |
| **90 Percent Confidence Interval** | | | 0 | 85 0.000 |
| **P-value** | RMSEA < | 0.05 | | 0 |
| **Standardized Root Mean Square Residual:** | | | | |
| | | | | |
| **SRMR** | | | | 0.091 |
| **Parameter Estimates** | | | | |

| | |
|---|---|
| **Information** | Expected |
| **Standard Errors** | Standard |

When the data was combined to test for the overall model for all countries, the results of the structural equation model is as follows. The fit test statistics for the first model are: CFI (0.80); RMSEA (0.85) with a 90% confidence interval of 0.05 and 0.088; the standardized root mean square residual was 0.091 and the Chi-square and log of likelihood that test the null hypothesis that all parameters are equal to zero were significant at 1% level of significance which implied good model fit. The SEM model has two parts: the measurement model and the structural model. The measurement model, co-variances and variances have the same meaning, as explained above in the confirmatory factor analysis (CFA) results per country.

Overall, the analysis on combined results showed a positive dependency between e-medicine sustainable outcomes and knowledge management practices (p-value<0.01). There was a negative but statistically significant relationship between technical environment and e-medicine sustainable outcomes. This can be explained by the differences in technology adoption by different countries. The results also revealed a positive dependency among technological environment social environment and institutional environment which was statistically significant. A positive statistically significant relationship also was evident between institutional environment and social environment

The SEM results also revealed a positive statistically non-significant relationship between knowledge management practices and technology transfer environment and negative relationship between donor involvement but not statistically significant. Overall, technology transfer project environment was positively dependent on donor involvement (0.0.439) and statistically significant. The study also shows that the measurement model factors loaded in the same direction and were significant at P-Value<0.01. The study also shows that the measurement model revealed that all factors loaded in the same direction are significant at P-Value<0.01.

From the above analysis and results, we conclude that all factors in the model were significant in predicting e-medicine outcomes as per the relationships that were identified in the study, both direct and indirect. The interviews for this study support the quantitative results with many stakeholders indicating lack of training and awareness as key. This is confirmed by the results in the knowledge management practices that are positively related and significant in all countries.

## 6. DISCUSSION OF FINDINGS

In this study, we hypothesized that countries in SSA with strong institutional and technological environments **(H2)** were more likely to implement policies that will lead to sustainable e-medicine outcomes and that the degree of donor involvement would determine the level of influence of technology transfer and knowledge management practices on sustainable e-medicine outcomes in SSA **(H3).** The study however indicated a limited degree of influence of the constructs to the e-medicine outcome. The institutional environment has for instance has been a major issue as far as SSA is concerned. In the early 1970s through the early 1990s, dictatorial SSA governments deliberately hindered penetration of computers and the Internet. This move was typically due to self-interested political reasons with the goal of limiting citizens' access to information that could weaken their dictatorial regimes. Such regimes have generally slowed down the transfer of ICT to their countries.

While some countries in Africa are changing course and importing computers duty-free [14], there has been a failure to effectively come up with policies that will encourage the transformation of these technologies into the Information Age. National ICT policies in SSA tend to be very general in nature and do not necessarily have specific bearings on telemedicine transfer to the region.

## 7. CONCLUSION AND RECOMMENDATIONS

The study suggests abandoning singular, one-site (typically one organization) e-medicine projects in favor of a network of sites and establishment of databases across different country sites by governments in local and referral hospitals to generate local, self-sufficient learning processes together with working mechanisms for the supply of suitably formatted experiences of information acquired across sites in the custom of vertical as well as horizontal flow of information. This can be achieved with appropriate national level policies and directed government support for e-Medicine projects. A lack of computer skills on the part of healthcare personnel and limited understanding of the role of ICTs were also cited as pitfalls in this study.

Therefore, for sustainability, government should invest in training of health professionals in a more coordinated and planned effort that is essential to implement the applications of telemedicine, so as to solve the health personal and medical shortage. Synchronization among governmental bodies within the telecommunication and healthcare sectors, in educational institutions, NGOs and private hospitals should be considered. Moreover, local participation, as well as support of external donor agencies is significant in funding projects concerning telemedicine.

## 8. REFERENCES


1. Aynu B, Okoli C, Mbarika V. IT training in Sub-Saharan Africa: A moderator of IT transfer for sustainable development. *Proceedings of the 4th Annual Global Information Technology Management*. 2003.
2. Maher D, Smeeth L, Sekajugo J. Health transition in Africa: practical policy proposals for primary care. *Bulletin of the World Health Organization*. 2010 Dec; 88(12):943-8.
3. Kimaro H, Nhampossa J. The challenges of sustainability of health information systems in developing countries: comparative case studies of Mozambique and Tanzania. *Journal of Health Informatics in Developing Countries*. 2007 Dec 18; 1(1).
4. Isabalija SR, Mayoka KG, Rwashana AS, Mbarika VW. Factors affecting adoption, implementation and sustainability of telemedicine information systems in Uganda. *Journal of Health Informatics in Developing Countries*. 2011 Dec 9; 5(2).
5. Oak M. A review on barriers to implementing health informatics in developing countries. Journal of Health Informatics in developing countries. 2007 Dec 18;1(1).
6. Kifle M, Mbarika V, Payton F. Testing integrative technology (telemedicine) acceptance models among ethiopian physicians. InProceedings of the 2005 Southeast Decision Sciences Institute (DSI) Conference 2005.
7. Checchi, R. M., G. R. Sevcik, K. D. Loch & D. Straub, An instrumentation process for measuring ICT Policies and culture, *Proceedings of International Conference on Information Technology, Communications, and Development* (2002). Kathmandu, Nepal, December 1-3, 2002.
8. King JL, Gurbaxani V, Kraemer KL, McFarlan FW, Raman KS, Yap CS. Institutional factors in information technology innovation. *Information systems research*. 1994 Jun; 5(2):139-69.
9. Kwon TH, Zmud RW. Unifying the fragmented models of information systems implementation. InCritical issues in information systems research 1987 Apr 1. John Wiley & Sons, Inc. pp. 227-251
10. Rogers, E. M, Diffusion *of innovations*. New York: Free Press; 1995.

11. Gurbaxani V, Kraemer KL, King JL, Jarman S, Dedrick J, Raman KS, Yap CS. Government as the driving force toward the information society: National computer policy in Singapore. *The Information Society*. 1990 Jun 1;7(2):155-85.
12. Mbarika VW, Mbarika I. Africa calling [African wireless connection]. IEEE Spectrum. 2006 May;43(5):56-60.
13. ITU, Telemedicine and developing countries. Document 2/116, *International Telecommunications Union, Geneva; 2000.*
14. Balancing Act, C*ameroon slashes import duty on computers*. Panafrican News Agency. http://www.balancingact-africa.com/news/back/balancing-act48a.html (as of July 2006).
15. Kifle M, Mbarika VW, Datta P. Interplay of cost and adoption of tele-medicine in Sub-Saharan Africa: The case of tele-cardiology in Ethiopia. *Information Systems Frontiers*. 2006 Jul 1;8(3):211-23.
16. Mbarika, V., *Africa's Least Developed Countries' Teledensity Problems and Strategies (2001)*. Yaoundé, Cameroon: ME & AGWECAMS Publishers.
17. Leidner DE, Kayworth T. Review: a review of culture in information systems research: toward a theory of information technology culture conflict. MIS quarterly. 2006 Jun 1; 30(2):357-99.
18. Bertolotti, D. S., *Culture and technology*. Bowling Green, Ohio: Bowling Green State University Popular Press; 1984.
19. Hofstede, G., *Culture's consequences: International differences in work-related values*. Beverly Hills: Sage; 1980.
20. Straub, D. W., K. D. Loch, R. Evaristo, E. Karahanna & M. Srite, Toward a theory based definition of culture. *Journal of Global Information Management*; 2002, (10:1), pp. 13-23.
21. Tan, J., M. Kifle, V. Mbarika, and C. Okoli, *E-medicine diffusion: E-medicine in Developed and Developing Countries***.** Chapter 8 in E-health Paradigm Shift: Perspectives, Domains and Challenges; 2005.
22. Straub DW, Loch KD, Hill CE. Transfer of information technology to the Arab world: a test of cultural influence modeling. Advanced topics in global information management. 2003 Jan 1; 2:141-72.

23. Loch, K., D. W. Straub & S. Kamel, Use of the Internet: A Study of Individuals and Organizations in the Arab World. *Proceedings of Global Information Technology Management Conference;* 2000, 2000.Global Information Technology Management Association.

24. Raman KS, Yap CS. From a resource rich country to an information rich society: An evaluation of information technology policies in Malaysia. *Information Technology for Development*. 1996 Sep 1; 7(3):109-31.