Determinants of Electronic Health in Developing Countries

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Abstract
Limitations of paper-based records are influencing a transition across the globe towards Electronic Health Records (EHRs) and in general electronic health (eHealth). However, despite the well documented benefits of eHealth, adoption particularly in developing countries remains a great challenge. Lessons learned from widespread implementation efforts can be used to encourage and inform the use of eHealth. This study evaluates the most current literature to establish the extent to which electronic health has been adopted in developing countries. The study has shown various determinants of electronic health adoption which will help countries particularly the developing ones come up with necessary interventions to accelerate the adoption. As part of future work, more studies need to be done, firstly to confirm the effect of the mentioned determinants in this paper in each developing country, secondly to find out other determinants of eHealth adoption and thirdly to show how developing countries' cooperation on eHealth strategies can affect the journey towards eHealth adoption by these countries.

Keywords: electronic health, eHealth, ICT adoption, developing country

1. Introduction

Health is one of the most important sectors in any country's economy. A country that has poor health systems and policies is bound to experience poor economic growth as productivity of citizens might be greatly affected when they fall sick or die from curable cases. According to the World Health Organization (WHO), increasing life expectancy at birth by 10% will increase the economic growth rate by 0.35% a year (World Health Organization, 2001). Despite the important role played by health sector, serious problems continue to be experienced. These countries experience the problem of lack of qualified doctors due to brain drain and scarcity in medical training facilities, lack of enough money to equip health institutions with modern technologies, poor health policies that fail to address short and long term needs, low budgetary allocation to the health sector among others. In general, there is a major problem of access to healthcare services by majority of citizens in developing countries, low quality of healthcare services due to scarcity of highly trained clinicians and high cost of healthcare services unaffordable to majority of citizens, problems that can be alleviated through embracing eHealth in developing countries (Currie & Finnegan, 2009; Ojo *et al.*, 2007).

Recording of patient information in many hospitals in developing countries has been on papers. Miller *et al* (2005) identifies limitations of these paper-based records as including illegibility, ambiguity, incomplete data, poor availability and data fragmentation. Laerum (2003) argues that recording of patient information on papers impede the continuity and quality of care for patients. As argued by Currie and Finnegan (2009), these are the problems that eHealth through electronic medical records seeks to address. In particular, Chaudry *et al* (2006) says that electronic medical records applications can prompt for completeness; provide better ordering for searching and retrieval, and permit validity checks for data quality, research, and especially decision support.

Various definitions of the term 'eHealth' have been put forward. For the purposes of this paper, eHealth is considered to be the application of Information and Communication Technologies (ICT) across the whole range of functions that affect healthcare, from diagnosis to follow-up (Denise, 2003). EHealth covers the development and use of a wide range of ICT systems for healthcare such as electronic health records, telemedicine, health information systems, mobile devices, e-learning tools, and decision support systems (Gerber *et al*., 2010). The value of eHealth is in its ability to help lower costs in health sector while delivering better care within a citizen centered approach (Currie & Finnegan, 2009). Additionally, eHealth through the use of Personal Health Records (PHR) is a key factor in empowering patients and will help them to play an increasingly central and active role in their own healthcare (Markle, 2004).

In attempts to lower the costs, improve the quality and expand the access to health services many developing countries' governments put much hope in electronic health records (Nyella & Mndeme, 2010) and ICT-based Health Information Systems (HIS) (Mosse & Sahay, 2005). The migration to electronic medical records is necessitated by limitations in paper based records that include temporal, spatial, and monetary constraints associated with continued paper-based record accumulation and compression over time. Additionally, paper-based systems have limited functionality; many people cannot easily view the same record at the same time (Hwang *et al*., 2009). Having electronic medical records can support medical professionals in their decision-making and also improve operating efficiency, thus improving medical care quality (Ayers *et al*., 2009). Other systems such as decision support systems have been shown to reduce medical errors in applications such as drug order entry (Bates *et al.*, 2001). Research on eHealth in developing countries has shown that eHealth can be one solution to provide better access to healthcare facilities for patients and healthcare professionals, improve collaboration between different governmental bodies, and increase care quality (Cecchini & Scott, 2003; Khalifehsoltani & Gerami, 2010; Mostafa *et al.*, 2010). According to a survey carried out by the World Health Organization (WHO), eHealth tools, among them Electronic Health Record (EHR) systems, are seen as extremely useful for 70% of the non-OECD countries (World Health Organization, 2006).

Despite the well documented reports on the benefits of electronic health, adoption remains low in developing countries (Omary *et al.,* 2010; Kathryn, 2011; Juma *et al*., 2012). These developed countries continue to face health threats characterized by HIV/AIDS pandemic, wide spread incidences of infectious diseases, high levels of infant mortality, low levels of life expectancy and now rising cases of lifestyle diseases such as diabetes and cancer (World Health Organization, 2013).

This study evaluates the most current literature to establish the extent to which electronic health has been adopted in developing countries. Secondly, review of the literature on electronic health is analyzed to help discover the determinants of successful eHealth implementation, with a focus on primary healthcare practices. The rest of the paper is organized as follows: in section two the paper presents the state of eHealth adoption in developed countries before delving into eHealth landscape in developing countries in section three. A discussion is then presented on determinants of eHealth based on studies that have been carried out in developing countries in section four. A conclusion is finally presented on the way forward in section five.

2. Adoption of EHealth in Developed Countries

Hospitals in developed countries continue to implement electronic medical records to lower costs and to improve quality of care. In United States of America for instance, $1.2 billion grant was unveiled to facilitate adoption of electronic health records in all hospitals by 2014 (Stacy & Ulku, 2012). With the adoption of electronic medical records, patient information will be electronically captured in any care delivery setting. This is aimed at increasing Health Information Exchanges (HIEs) and eventually maintaining a Nationwide Health Information Network (NHIN), which aims to provide a secure and interoperable health information infrastructure that allows stakeholders, such as physicians, hospitals, payers, state and regional HIEs, federal agencies, and other networks, to exchange health information electronically (Cline, 2012).

Closely related to electronic medical records are Personal Health Records (PHR) that have emerged as a way of enabling patients control the access to their health information while empowering them make appropriate health-related decisions. Using PHRs, patients are able to maintain, update and communicate their personal health information in the way they prefer thereby taking control of their health and in general lifestyles in greater way. Large technology vendors like Microsoft and Google have already released their PHR products. However, the uptake of these PHR remains low in developed countries with little research having been conducted to explain this low adoption trend (Helmer, Lipprandt, Frenken, Eichelberg & Hein, 2011).

Transforming the health sector with enabling technologies is a major priority of the European Union member states. European Commission Council for health information, stated that "eHealth is today's tool for substantial productivity gains, while providing tomorrow's instrument for restructured, citizen-centered health care systems and, at the same time, respecting the diversity of Europe's multi-cultural, multi-lingual health care traditions. There are many examples of successful e-Health developments including health information networks, electronic health records, telemedicine services, wearable and portable monitoring systems, and health portals" (European Union, 2005).

One notable observation in Europe is that each country has its own distinctive approach in the journey towards enabling technologies in healthcare. France is developing the concept of *digital hospitals* via telemedicine technologies (Currie & Finnegan, 2009). Germany is working on an Electronic Health Card (EHC) which will allow the physicians to check the administrative data of the patient and to write prescriptions on EHC. The EHC will also have voluntary medical functions like the emergency data record and later an electronic patient record that can be checked anywhere using appropriate card readers (Sunyaev *et al*., 2009). Denmark leads the way in European eHealth and patient-controlled health records (Cruickshack *et al*., 2012). It boasts a universal Electronic Health Record system and a national PHR service available to any Danish citizen to allow them control who accesses their medical information and how it is accessed. Launched in 2003, the country's government-run PHR portal is *Sundhed.dk*, a website where, a citizen can view treatments and diagnoses from his/her own hospital patient record, book appointments with his GP, renew prescription drugs, monitor own drug compliance, survey shortest waiting lists for operations and quality ratings of hospitals, register as organ donor, and get access to local disease management systems in out-patient clinics (Makori, Musoke & Gilbert, 2013).

Data security and privacy in eHealth remain very important issues. Policies to protect the citizen patients' data are at the core of eHealth in Europe. Most laws have been written in accordance with European Union Telecommunications Privacy (1997/66/EC) and Data Protection (1995/46/EC) Directives respectively (Berg, 2004; Blobel, 2004). In USA, there also exists various laws and standards regulating how patient data and in general medical information should be handled. For instance, Health Insurance Portability and Accountability Act, (HIPAA 1996) was passed in USA to curtail the encroachment on the health information of workers by information technologies to the detriment of patient confidentiality. HIPAA was

designed to provide the mechanisms of investigating and punishing improper disclosure of health information held by third parties such as insurance companies taking care of patients' medical bills. Existence of these laws may help in dispelling fears concerning security, privacy and confidentiality of medical information as regards electronic health.

ICT training among clinicians is cited as a key determinant of electronic health (Ochieng & Hosoi, 2005; Martins & Oliveira, 2008; Terry *et al.*, 2009; Marques *et al.,* 2011). According to Ochieng and Hosoi (2005) on a study that sought to establish the factors influencing diffusion of electronic medical records in Japan, ICT skills are required to foster positive attitudes about electronic medical records which translate to greater adoption of electronic medical records. Therefore developed countries in an effort to raise ICT skills amongst clinicians have incorporated ICT training in health courses offered at various academic levels. New courses such as medical informatics, bioinformatics, computational biology, and health informatics have been started. Sood *et al* (2008) notes that developed countries are using cutting edge technologies like 3D simulations, virtual reality and robotics to train clinicians and that ICT is included in the curriculum of medical courses. Availability of ICT skills amongst clinicians is likely to lead to the acceptance and actual use of eHealth in primary healthcare. This is because, clinicians with ICT skills are able to appreciate the possible benefits of ICT in execution and improvement of the various processes they are engaged in.

Hospital Information Systems (HIS) have been introduced in most developed countries in European (Currie & Finnegan, 2009). These systems allow for seamless flow of administrative as well as clinical data between various hospital departments such as outpatients, accounts office, wards, pharmacy, laboratories, and theatres among others depending on the units within a hospital. Health portals are gaining acceptance especially in dissemination of health information and structuring of web content. For instance in Malta, a national eHealth Portal is in place for provision of various health services and information related to the promotion of healthy lifestyles and the application of the European Health Insurance Card (EHIC). Other enabling technologies in various stages of adoption across European Countries include Cloud Computing, Computer Physician Order Entry, Picture Archiving and Communications Systems (PACS), Telemedicine, and Health Portals (Currie & Finnegan, 2009). While Netherlands, Denmark, Sweden, UK and Germany are ahead in the implementation of these emerging technologies lesser developing countries in Europe such as Romania are less well advanced. However, these laggards have the advantage of being able to quickly learn and adapt the 'lessons learned' from first mover countries (Drees, 2006).

The Internet, and in particular broadband, provides a foundation upon which various eHealth applications are built. Applications and services such as telemedicine, data transfer, and access to health information are usually internet dependent. In Europe, Sweden, Denmark, Netherlands, Finland, United Kingdom, Norway, Germany, Switzerland, Belgium, and France perform well with over 70% of households with broadband connection (OECD, 2013). This indicates these countries' readiness towards embracing internet-based eHealth solutions such as telemedicine, searching of health information online by patients and clinicians, and the adoption of PHR by patients.

3. Electronic Health in Developing Countries

Developing countries are now waking up to the realization that they have to embrace information and communication technologies to deal with the problem of access, quality and costs of healthcare. Ojo *et al* (2007) additionally argues that adoption of ICT in health sector across developing countries will accelerate knowledge diffusion and increase access to health information. This section investigates the studies that have been conducted on eHealth adoption in developing countries to show evidences of adoption.

Telemedicine and electronic learning (eLearning) are being practiced in several countries (Makori, Musoke & Gilbert, 2013). ELearning is important for allowing acquisition of medical knowledge by healthcare providers as well as patients. Telemedicine plays a key role in offering medical services remotely and is very important in situations where healthcare providers are scarce. Several Francophone African countries, such as Mali, Cote d'Ivoire, Senegal and Burkina-Faso, have implemented an online platform (RA FT) that allows for web-based seminars, training, discussions and sharing of best practices between healthcare professionals in each of the ten participating Francophone countries. Videoconferencing tools have been deployed in Tunisia for tele-diagnosing while in Botswana there is extensive eLearning for AIDS programmes by community health workers. In Rwanda efforts are on-going to connect the district hospitals with referral hospitals for the transfer of medical information. This is going to be very important especially in the area of teleradiology (Makori, Musoke & Gilbert, 2013). The problems that exist in the health sectors of many developing countries such as high mortality and morbidity rates, high population, and lack of enough medical staff can be addressed by telemedicine adoption (Orlando, 2007). However, it is worth noting that telemedicine adoption is still low in most developing countries due to lack of necessary infrastructure required (Omary *et al.*, 2010). Most importantly, telemedicine adoption calls for internet connectivity across the countries. By 2013, household internet penetration was 28% compared to 78% in the developed world (ITU, 2013). This indicates that, for developing countries to achieve high levels of eHealth adoption, internet penetration should be increased.

Hospital Information Systems (HIS) systems have enabled faster processing, storage and transfer of medical information between service providers in developing countries. An HIS prominently featuring in developing countries' eHealth landscape is the one shared by Southern African countries including Botswana, South Africa, Mozambique, Tanzania, Ethiopia and Malawi. In Ghana, adoption of Electronic Health Information Technology, (EHIT) has become an integral part of the national health care delivery system. Reliance on EHIT seems poised to grow in the years to come due to the myriad of advantages derived from the capture, storage, retrieval and analysis of large volumes of protected health data, and from multiple sources, which is spread over a long period of time. However, the challenge with this implementation is that concerns have been raised on its potential to erode the sanctity of physician- patient relationship (Norman, Alkins & Binka, 2011). It is also argued that information technology exposes the actions of both physicians and patients to the unwarranted oversight of others through the internet and the worldwide web both nationally and internationally.

Electronic medical record systems provide the basic infrastructure upon which other electronic health solutions can be laid. There exists evidence to show that electronic medical records are gaining ground in the health sector in developing countries. For instance, the OpenMRS developed by the Regienstrief Institute and Partners in Health, provides a user-friendly interface for electronically storing medical data and has been very successful in Kenya. The Mosoroit Medical Record System (MMRS), which was implemented at a primary care rural health center in Kenya, provides patient registration and patient visit records management with capability to handle information of over 60,000 patients (Sood *et al.*, 2008). Other electronic medical records that have succeeded in developing countries include the Lilongwe EMR used for a wide range of clinical problems in a pediatric department of the Central Hospital in Malawi; Partners in Health (PIH)-EMR, Peru; HIV-EMR system, Haiti; Careware, Uganda; PEPFAR project, Tanzania; National EMR, project Zambia (Sood *et al.*, 2008). However, these electronic medical records require addressing of confidentiality, privacy and security issues for maximum acceptability by clinicians. The clinicians must also understand their benefits and how they will impact on routines and business processes in hospitals, a

challenge that can be overcome by including ICT in the curriculum of medical courses offered in developing countries.

Use of ICT for public health promotion is also being experienced in developing countries. The Uganda Health Information Network (UHIN) uses personal digital assistants (PDAs) to provide early warning information about the spread of communicable diseases to citizens under the project AED-SATELLI FE. Praekelt Foundation's Project Masiluleke is another project that has successfully been used to offer free information about HIV testing locations via customers' mobile phones. In Uganda, SMS-based quizzes have been used to increase knowledge and understanding of HIV/AIDS. With the number of mobile broadband subscriptions more than doubling from 2011 to 2013 (from 472 million to 1.16 billion subscribers) in developing countries (ITU, 2013), there is huge potential for using mobile phones to search for health related information. Appropriate mobile applications can be developed to allow customized search for health information by patients whenever they fall sick or generally to seek information on various ways of staying healthy. Internet continues to play a key role in public health promotion. According to Griffiths *et al* (2006) one of the most common functions of internet is that it provides all sorts of health related information through use of different websites. This can be of great benefit to citizens in developing countries who are able to identify the latest information regarding illnesses, treatments, and best practices in medicine.

4. Discussion

Despite efforts to adopt eHealth in most developing nations, various challenges have been faced leading to low rates of adoption compared to developed countries. Based on eHealth landscape presented in section three and drawing on lessons from developed countries, this section presents a discussion on the determinants affecting eHealth adoption in developing countries.

EHealth infrastructure pertinently affects adoption of eHealth (Ouma & Herselman, 2008; Qureshi *et al.*, 2013). In a study conducted in Kenya, which focused on adoption of ICT in SMEs in the health sector, quality of ICT systems is noted as a significant factor in determining adoption of ICT (Muathe, Wawire & Ofafa, 2013). In their study focusing on establishing the infrastructural barriers to eHealth implementation in developing countries, Qureshi *et al* (2013) indicates that internet connectivity is vital for successful adoption of eHealth. In another study conducted in Kenya, it was revealed that doctors are willing to conduct e-searches in order to access and share health information with their colleagues in others parts of the world. However, insufficient ICT resources limit them in performing the searches (Gatero, 2010). In yet another study, it is indicated that cost of computers and lack of computers hinder adoption of eHealth amongst hospitals in the rural areas (Ouma & Herselman, 2008). According to a study conducted by Micevska Maja (2005), which focused on the complementarities that exist between information technologies and public health promotion based on two countries, Bangladesh and Lao, the stock of telecommunication infrastructure plays a key role in public health. Transmission of health information between health institutions, health institutions and patients, health institution and third parties such as insurance companies, patients and health institutions is negatively affected if telecommunication and internet penetration is low.

The low rate of internet penetration and low bandwidth are among the challenges to eHealth adoption in developing countries. Omary *et al* (2009) points out that due to poor ICT infrastructure and internet penetration in Tanzania, the majority of areas in the country cannot support internet deployment, which in turn, hampers eHealth adoption. Even in developing countries that have high internet penetration, bandwidth may still be a challenge, thereby limiting adoption of telemedicine and other internet based eHealth applications. As long as internet penetration remains low in developing countries, adoption of eHealth will

continue to lag behind compared to countries with high adoption rates such as Denmark (broadband connection per household in Denmark stands at 83.9% according to OECD (2013)). However, to fully realize the importance of internet for accessing healthcare information there are some issues that must be addressed, for example, poor internet skills on the part of healthcare professionals prevent them to understand the difference between biased and unbiased information, to differentiate evidence-based claims, and to interpret the information which is meant for health professionals (Qureshi *et al.*, 2013).

Although privacy, confidentiality and security concerns have not been much addressed in research, these concerns affect adoption of eHealth (Flaser *et al.*, 2005; Juma *et al.*, 2012; Omary *et al*., 2009). Users of eHealth want to be sure that their confidentiality is protected if eHealth is to be embraced by them. Privacy and security of electronic health data are of pertinent importance if eHealth is to gain confidence amongst healthcare stakeholders. Privacy is the claim of individuals to determine for themselves when, how, and to what extent information about them is communicated to others. On the other hand, security can be defined as the extent to which personal information can be stored and transmitted such that access to the information is limited to authorized parties. In a study that focused on Tanzania, ICTs are vulnerable to security and privacy breaches which negatively affect their adoption in health sector (Omary *et al*., 2009). Issues of privacy, confidentiality and security are not limited to developing countries alone. For instance, Yu (2012) links the lack of integration of medical records by various organizations to lack of clear legislation in regard to accountability, security, privacy and confidentiality in Australia.

Legislation and standards on eHealth are vital in any developing countries for successful eHealth adoption. However, sufficient standards for medical imaging, interoperability, software, transmission, infrastructure, architecture, medical informatics, and bioinformatics are yet to be formulated in developing countries (Omary *et al.*, 2009; Kathryn, 2011; Juma *et al*., 2012). Inadequate electronic legislation (eLegislation) and eHealth standards for instance have negatively affected eHealth adoption in Kenya which is also the case for Ghana (Kathryn, 2011). In Ghana, it appears that apart from a few clauses contained in the Electronic Communication Act, 2008 (Act 775) Section 4(2), limiting access to electronic personal information of the customers of the communications industry, there does not seem to be a dedicated and broad based national legislation on the primary and secondary uses of electronic personal information of the individual (Norman, Alkins & Binka, 2011). This provides a good example of the gap in the legal framework for the protection of privacy when it comes to patient data in the use of information technology and this may negatively affect the adoption of information technology in the health sector.

Funding of the health sector determines adoption of electronic health (Omary *et al.*, 2010; Abdullah, 2012). Due to low funding of health sector in Tanzania, Omary *et al* (2010) argues that it is difficult to allocate much money for acquisition of ICT resources needed in the health sector. Adoption of electronic health infrastructure is costly and this calls for increased funding in the health sectors for various developing countries. Findings show that increased funding in health sector is strongly correlated with adoption of eHealth even in the case of developed countries and this should also be the case for developing countries (Yu, 2012). It is worth noting that public funding is tied to individual institutions where the amount allocated to a given health institution is proportional to its size. Larger hospitals achieve easily economies of scale and mainly information and resources needed across the organization. Several studies show positive relationship between ICT adoption and organization size (Zhu *et al.,* 2003; Pan & Jang 2008) since they have more finances compared to smaller institutions.

The design and use choices for information technologies are influenced by an individual's characteristics such as age, knowledge, expectations, and assumptions concerning the purpose, context, importance, and role of a technology in a given context (Muathe, Wawire & Ofafa, 2013; Waithaka *et al*, 2013). Although Waithaka *et al* (2013) focused on establishing adoption of Inter-Organizational Information Systems (IOIS) in Kenyan Universities; their findings that users' ICT skills affect the adoption of IOIS can be extrapolated to cover health information technologies.

Omary *et al* (2010) attributes low adoption of eHealth among developing countries to lack of computer skills amongst the clinicians. In countries that have assimilated ICT training for clinicians, acceptance of eHealth and actual use is relatively high (Khan *et al*., 2012). Training boost awareness and confidence level as users are able to overcome technophobia while relating usage to expected benefits (Sahay & Walsham, 2006). Abraham *et al* (2011) add their voice by arguing that optimal use of IT towards the transformation of health care requires IT knowledge in the medical communities. The correlation between ICT skills and adoption of eHealth is also discussed by Juma *et al* (2012) who points out that inadequate ICT skills in the health sector in Kenya explains the low adoption of eHealth. Hogan & Palmer (2005) are of the opinion that those health care professionals who lack the ICT skills of processing the online health data end up spending too much time on the same. According to Malik *et al* (2008) sluggish internet use among doctors in Pakistan was due to unavailability of proper technology and lack of computer training. Without adequate ICT skills, user involvement in selection and development of ICTs becomes difficult and if it happens, it is only to rubberstamp the experts' decisions. This might lead to having eHealth technologies that are not widely accepted or used adequately.

Users' perceptions on technology can affect how a new technology is conceptualized and if it will be accepted and further used. On a study that involved exploring hopes and fears in the implementation of electronic health records in Bangladesh (Khan, Shalid, Hedstrom & Andersson, 2012), it was found that most actors are only afraid of use of ICT in health sector based on their perceptions about it. In the study for instance, some physicians thought that using an EHR would be more time consuming, which would negatively influence the time they could spend with patients. This indicates that for successful adoption of eHealth to be witnessed in developing countries various stakeholders must change their attitudes on eHealth. Patients must be ready to allow their information to be shared using ICTs, they should be able to use mobile devices to search health information and must develop trust towards electronic medical records. The clinicians must perceive ICTs positively by encouraging each other to use them in the provision of health services. Where there are challenges with technologies, they should seek to have those challenges addressed other than dismissing the whole concept of eHealth. Governments must also be in the forefront in raising awareness of ICTs in health sectors by organizing seminars or conferences that bring together academicians, clinicians, hospital administrators and other policy makers.

Voluntariness has been shown to determine the use of information technologies (Phichitchaisopa & Naenna, 2013). For instance, use of ICTs in Kenyan primary schools is expected to be mandatory for delivery of curriculum and this could lead to adoption. If use of technologies is mandatory, chances that the technology will be used are higher than when users are left to choose whether to use or not to. In institutions that have made use of technologies mandatory, employees are left with no option unless they decide to resign. This is not only a situation in developing countries but has also been witnessed in developed countries. An example is, in developed countries such as Denmark and Norway where high rates of ePrescribing were achieved by making e-prescribing mandatory for primary care providers by the governments. However, in a study

conducted by Muathe, Wawire & Ofafa (2013), on factors affecting ICT by SMEs in the Kenyan health sector, voluntariness was not a major factor towards adoption of ICT by SMEs in the health sector. More studies should therefore be done to concretely examine the effect of making use of ICTs mandatory in the health sector.

5. Conclusion

This paper has revealed the various determinants to eHealth adoption amongst developing countries which have been seen to have low adoption of health information networks, electronic health records, and health cards unlike their developed counterparts. These determinants can be summarized as follows: level of ICT infrastructure in a country, internet penetration, ICT skills amongst the stakeholders particularly the clinicians, users' perceptions on ICT, and voluntariness in the use of technology. In addition, it has been established that data security and privacy legislation and eHealth standards are key determinants to eHealth.

To address the problem of low adoption based on encountered determinants various recommendations can be proposed. Firstly, user engagement at all levels is essential in order to carry eHealth forward. This is particularly important to come up with various solutions that will raise awareness and ICT skills amongst the stakeholders in the health sector. This is consistent with Khoja *et al* (2007) who are of the view that all healthcare providers must be involved in planning, development and implementation of new eHealth interventions and their success. Secondly, necessary infrastructure required for eHealth must be set up. Further, emerging technologies in electronic health like PACS, telemedicine, cloud computing, and 4G mobile communications among others should be further explored to find out how they can be harnessed in developing countries. Thirdly, with increasing concerns regarding data security and privacy, especially with the advent of cloud computing, stringent measures need to be in place to ensure data security and integrity in developing countries. These stringent measures could include various legislation and ways of enforcing them.

At the global level, the key to a successful future for eHealth is cooperation at both national and international levels to improve the compatibility of eHealth solutions and to come up with international standards and laws. In addition, lessons from front-runners in electronic health such as Denmark should be contextualized within developing countries. In this way, the likelihood of avoiding mistakes and challenges that were encountered or made by early adopters goes down thereby increasing the rate of adoption by developing countries.

Research in electronic health appears to be fragmented and so far few longitudinal studies have been conducted to indicate progression towards eHealth in developing countries. Fragmentation in eHealth research needs to be overcome through broad ranging studies, which offer standardized concepts that enable data to be collected across multiple points in time. Studies involving several countries are also limited. Such studies could indicate areas of cultivating synergy by countries for instance in having interoperable systems. Therefore, as part of future work, more studies need to be done, firstly to confirm the effect of the mentioned determinants in this paper in each developing country, secondly to find out other determinants of eHealth adoption and thirdly to show how developing countries' cooperation on eHealth strategies can affect the journey towards eHealth adoption by these countries.

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