

7

Implementing Successful E-health Implementations within Developing Countries

Stella Ouma, Marlien E. Herselman and Van Greunen

The use of Information Communication Technologies (ICT) within healthcare can make significant changes in the daily operations of hospitals particularly in the developing world. A technology assessment of five hospitals based within Nyanza Province in Kenya was conducted to find out how hospitals are embracing the use of ICT. Both primary and secondary data were collected to be used in the study. A qualitative study was used through the application of a multiple case study to investigate five randomly selected hospitals. Structured interviews, open ended questionnaires and observations were used as methods to collect data from the various hospitals. In order to collect relevant data the participants were divided into three categories. Managers (n=5), hospital staff members (n=31) and patients (n=24). Therefore a total of (n=60), participated in the study. The findings revealed that just like in the majority of the developing nations, there are very few computers and e-health solutions that are currently used in the hospitals as a result of various challenges in Kenya. Consequently, this paper analyses the challenges and provide a way forward for developing nations when implementing e-health solutions.

1. Introduction

The developed countries have embraced the use of information communications technologies (ICT) within the hospitals and health clinics. A few examples of the use of ICT include computerisation of medical records, electronic scheduling for appointments, use of the Internet for the purposes of communication and the use of magnetic cards [Tomasi, Facchini and Maia, 2004:867].

In the case of developing countries, Ojo et al. [2007:3] state that the majority of African countries are grappling with major socioeconomic development challenges. Samake and Mbarika [2007] concur by stating that the challenges include wars, diseases and poverty, which affect the provision of medical care for both the rich and the poor.

As much as this is the case, Richardson [2006] argues that healthcare providers and governments have no choice but to meet healthcare demands for future citizens and the application of e-health is therefore fundamental.

Hence to overcome the challenges that Africa is facing, there is a need to improve information and communication exchange in the healthcare industry in order to accelerate knowledge diffusion and increase access to information [Ojo et al., 2007].

Of more concern are the rural areas within the developing countries. The authors in IOM [2001], state that the quality of healthcare is essential to all. The factors that are of significance in the provision of quality healthcare include timeliness, patient centeredness, efficiency, effectiveness, equity and safety. These factors however do not exist in the provision of healthcare in some of the rural communities. According to Chang, Bakken, Brown, Houston, Kreps, Kukafka, Safran and Stavri [2004:449] the rural inhabitants actually receive fewer healthcare services compared to the problems that they have. Hence, they can be referred to as undeserved populations. This is because rural hospitals are faced with many challenges that lead to a negative effect on the quality of service that is provided in the rural communities [Ruxwana, 2007:103]. Information Technology therefore, can dramatically revolutionise the delivery of healthcare thereby making it safer, more efficient and more effective [Thielst, 2007].

According to ABARD [2005:4], the use of ICT can enhance the quality of services in rural areas by providing a better and more cost-effective approach to service delivery. This can be done by implementing various e-health solutions within rural hospitals.

Based on these conclusions on the use of ICT, a technology assessment was conducted in the rural areas of Kenya, particularly in Nyanza Province to find out how the hospitals are using ICT to improve service delivery within the rural hospitals.

Nyanza province is one of the eight provinces in Kenya. The population comprises 2,291,069 females and 2,107,326 males with a total of 4,398,395 as per the 1999 population census [Nyanza Provincial Development Plan, 2007]. More over, the Province has a total of 35 hospitals, 20 sub district hospitals, 127 health centres and 240 dispensaries. In terms of human resource, it has 156 doctors and 2271 nurses [Ministry of Health, 2006].

According to the Central Bureau of Statistics, Kenya [2006], 65 per cent of the population in Nyanza province are living below the poverty line. The province also has the highest prevalence of human immunodeficiency virus [HIV] infection in the country. Therefore, there is a need to address the quality of services, increase efficiency and reduce costs in rural areas in order to improve healthcare services.

2. E-health Solutions

E-health can be described as any electronic exchange of health information within the healthcare industry by use of different stakeholders [Kwankam, 2004; Denise, 2003]. There are various e-health solutions that can be used in rural areas to improve the quality, efficiency and to reduce costs within the rural hospitals. Key among them includes electronic health records, hospital information systems, telemedicine and the internet.

2.1 Electronic health records (EHR)

Initially known as computer patient records [Katehakis and Tsinakis, 2006], the concept of electronic health records has revolutionised to what it is today from the 1960's [Hanson, 2006:105].

EHR can be relied on to act as a back up in cases of emergencies and when patients change locations unlike the case of paper based records given the fact that they are easily accessible [Blair, 2007; Novak,2005].

Essential functions of EHR include shared health records, support for external information requests, provision of security and message transfer of health records [Edwards, 2007].

The benefits of using EHR include improved quality of healthcare [Miller and West, 2007], reduced medical errors and reduced costs [America Academic of physicians, 2007], access to medical record information [Gans, Krlewski, Hammons and Dowd, 2005] and time savings [Thakkar and Davis, 2006].

2.2 Hospital Information Systems (HIS)

Clinical managers and health planners rely on information in order to make decisions regarding effective functioning of health facilities, allocate resources and also to make strategic policies [AbourZahr and Boerma, 2005]. Therefore, HIS consist of different softwares that are integrated in order to capture data in specific sections of the hospital [Garrido, Raymond, Jamieson, Liang and Wiesenthal [2004:21-22]], handle the workflow of daily medical services and also assist in managing financial, administrative and clinical data [Yang, Yeh and Wang, 2006:174]. The benefits of using HIS include improved quality, better communication, staff efficiency, reduced transcription costs and increased patient safety and increased revenues[Garrido et al., 2004].

2.3 Telemedicine

Telemedicine can be referred to as the provision of medical services from a distance [Wooton, Craig and Patterson, 2006:1]. This includes diagnosis, treatment and prevention of diseases

The types of telemedicine can be categorised as real-time or pre-recorded telemedicine. Information is sent and received by the participants almost immediately in the case of real time telemedicine while in the case of pre-recorded telemedicine, information is captured and then transmitted later for subsequent reply [Anthony et al., 2005:288-293].

Examples of pre-recorded telemedicine include tele-electrography, tele-obsterics and tele-radiology [Mea, 2006:43-45]. Examples of real time telemedicine include tele-consultation, tele-pathology and tele-dermatology [Wooton, Craig and Patterson 2006:52-60].

2.4 The Internet

The role of the Internet in healthcare cannot be ignored. The Internet provides a platform where various stakeholders of e-health are able to achieve various goals. Key among the solutions that the Internet provides in healthcare includes:

- **Business operations:** There are various types of e-business that are conducted by organisations and individuals online within the healthcare industry. These business models include business to business to consumer models [Olatokun and Ajiferuke, 2006], business to business and business to consumer models [European

Commission Enterprise Directorate General, 2004. Some examples of business models within the healthcare industry include virtual doctor visits, online medical suppliers and automated systems [Tan, 2005].

- **Research:** The Internet has provided a platform for conducting a lot of research in healthcare. This has led to the use of online experiments, randomised trials and surveys [Couper, 2007]. Additionally the numbers of publications on healthcare issues have increased tremendously [Curry, 2007]. **Professional medical education:** Medical learners can now share a lot of digital information from the various digital libraries on the Internet which have been reviewed by various researchers [Ruiz, Mintzer and Leipzig, 2006:209-210]. Additionally various professionals in medical fields can now access various web pages in order to take continuous medical education [Tan, 2005] hence improving current standards of healthcare by use of the availed technologies on the Internet [Dario et al., 2004].
- **Consumer Informatics:** Patients are using the Internet to get information, interact with their physicians and order pharmaceutical products online [Podichetty and Biscup, 2003]. Hence the patients are now taking charge of their health status by staying informed with issues regarding to their health [Lorence, 2006].

3. Research Motivation

Currently the selected rural areas are using the traditional ways to access health and those who are currently using ICT do not know the power that exist behind it, in improving healthcare services.

The study seeks to establish the current structures in place in terms of technologies, equipments and communication media available within the rural areas. More importantly it examines challenges that exist which may not favour the implementation of e-health solutions within the developing world.

The contribution of the paper will be to advice on should be done since majority of the hospitals in the developing do not know how to go about implementing e-health solution with the resources available. The main research question was to find out how ICT can be applied in rural hospitals to support E-health solutions in the developing world.

4. Background of the Hospitals

The background of the rural hospitals that were investigated are discussed below:

4.1 Background of the rural hospitals

These section looks at the background of all the selected hospitals. The hospitals include Homabay district hospitals, Nyamira district hospital, Bondo district hospital, Kisumu district hospital and Chulaimbo health centre.

4.1.1 Homabay district hospital

Homabay district hospital is located in Asego division in Homabay district. The hospital was established by the colonial government in Kenya in 1958. According to the district health records (2007/2008), the hospital is a level-IV service delivery hospital and

serves a total of 96,936 outpatients and 10,046 inpatients, a total of 106,982 patients a year. It is the most sought after hospital in the district in terms of use of resources and human resources for effective service delivery. This is confirmed by Homabay district health plan (2007/2008), which states that the utilisation rate of the hospital is 107 per cent. This shows that they serve more patients than the expected figure. In the human resources section, it has around 211 employees. The hospital serves the entire district since it is also a level-III referral hospital and has specialised staff (district health records, 2007/2008).

4.1.2 Nyamira district hospital

Nyamira district hospital is located in Nyamira division at Kebiringo trading centre. Opposite the hospitals are various kiosks and shops, with a busy road in between. Nyamira guest house is located next to the hospital. The hospital was established in 1979 as a government project. According to Nyamira district health records (2006) the hospital serves between 160 and 260 outpatients at the hospital every day with a total of 143,236 a year. The utilisation rate of the hospital, according to Nyamira district health plan (2007/2008), is 225 per cent, which is very high. Major diseases manifested by patients at this hospital are malaria, diseases of the respiratory system and pneumonia.

4.1.3 Bondo district hospital

Bondo district hospital was started by the colonial government as a dispensary and it operated as such until 1970 when the late Jaramogi Oginga Odinga raised funds for the construction of the wards. After the completion of the wards in 1972, the hospital was upgraded to a health centre, finally becoming a district hospital in 1998. Bondo district hospital is located in the Maranda division of Bondo. It serves around 44,837 patients per year and has a utilisation rate of 285 per cent (Bondo district health plan, 2007/2008) with only 94 professional staff members to deal with the workload. The major diseases that affect the patients are malaria, HIV and pulmonary TB (Bondo district health records, 2007).

4.1.4 Kisumu district hospital

The hospital was started in 1942 by the then Ministry of Social Services. The hospital is located in Winam division in Kisumu town along Ang'awa road opposite Kenyatta sports ground in Kisumu. The hospital serves a population of 142,400 patients with an utilisation rate of 164.1 per cent (Kisumu district health plan, 2007/2008) and around 337 staff members. The hospital is a level IV hospital and a third referral level within the district. The complaints that the patients in the hospital suffer from include malaria, HIV, pneumonia and pulmonary tuberculosis (Kisumu district health plan, 2007/2008).

4.1.5 Chulaimbo health centre

Chulaimbo health centre is located along the Kisumu-Busia road. The hospital was started on 20 January 1976 by the government with the idea of facilitating training for healthcare workers in proper rural health service delivery. The facility serves a

population of 75,678 people (projected from 1999 census). It is a first level referral health facility. The government of Kenya health facilities refer patients to Chulaimbo from Maseno division are Siriba dispensary and Chulaimbo including Ekwanda and Ipari health centres in Vihiga district and Nyahera Kisumu. Chulaimbo has become a hub for outpatients; attendance has risen from 32,952 patients (2004) to 46,464 in the year 2005 (Chulaimbo PRHTC work plan (2006/2007)). The utilisation rate is 684.5 per cent (Kisumu district health plan, 2007/2008).

5. Methodology

In this section, the study design, data collection instruments and participants have been discussed.

5.1 Study design

A qualitative study was used. This was done through a multiple case study approach. Through random sampling, five rural hospitals were identified to be used in this multiple case study. These hospitals include Bondo district hospital, Nyamira district hospital, Kisumu district hospital, Homabay district hospital and Chulaimabo health centre.

5.2 Data collection instruments

The data collection instruments used included observations, interviews and questionnaires.

5.3 Observations

This involves watching a particular phenomenon within a certain period in order to understand a particular outcome. Lategan and Lues [2006:21], state that observation refers to the physical act of keeping certain variables and making notes of what was observed. Therefore the participants were observed in this research including the technologies of ICT that is available in each of the selected hospitals.

5.3.1 Interviews (Semi structured)

Semi structured interviews were used to collect data from the selected hospitals. The interviews were used mainly to access collect data from the participants concerning the existing technologies in place. These interviewees therefore included various e-health stakeholders. These included management, doctors, nurses and patients at selected hospitals in Nyanza province in Kenya.

Additionally to confirm the reliability and validity of the collected information, all interviews were captured using a tape recorder and later transcribed to Microsoft Excel application for further analysis.

5.3.2 Questionnaires

The questionnaires focused on the background or history of ICT within the rural hospitals, the access level of ICT and the current condition of the ICT infrastructure in place that support e-health solutions in the various hospitals.

Open ended questionnaires were. The questionnaires were categorized into three. The first questionnaire was for managers, another set was for the staff and finally the last category of questionnaires was particularly for patients in order to collect relevant data and to back up the in.

The English language was used to conduct the interviews and also on the questionnaires as Nyanza province uses different languages.

5.4 Participants

Purposive sampling was used to select the managers, doctors, nurses and patients as a sample that is truly representative of the users of the total population, who use the hospitals. The participants were categorized into three namely managers, staff members and patients. The managers that were selected were the medical superintendents who are in charge of the hospital operations. The hospital staffs included doctors, nurses and clinical officers. A total of 12 participants took part from each hospital. An overall of 60 participants therefore took part in this study as shown in table 1, below.

Table 1: Expected participants in the study in the selected hospitals and data collection techniques that were used.

	Observations	Still Photos	Tape Recording	Interviews	Questionnaires
Bondo Hospital	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients
Kisii Hospital	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients
Maseno Hospital	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients
Kisumu Hospital	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients
Homabay Hospital	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients	1 Manager 6 Staff 5 Patients
Total	60 participants from 5 different hospitals				

6. Results

From the findings this section has been categorised into three parts. In the first part, we look into the existing technologies within the hospitals, the perception of the participants in regard to benefits of using ICT's is discussed in the second part and finally barriers to e-health implementations are discussed in the last section.

6.1 Available ICT technologies within the hospitals

The first sub question sought to investigate the current technologies in place which could be used to support e-health. The methods that were used to answer this question are:

- a. Questionnaires
- b. Interviews

A questionnaire was posed to managers, patients and staff members of the rural hospitals. Majority of the patients seemed not to be aware of any ICT technologies in place. However, the managers through the questionnaires were quick to point out the technologies in place and the managers contributions were backed up by the staff members through the interviews which were conducted.

Table 2: ICT infrastructure and e-health technologies in place within the hospitals

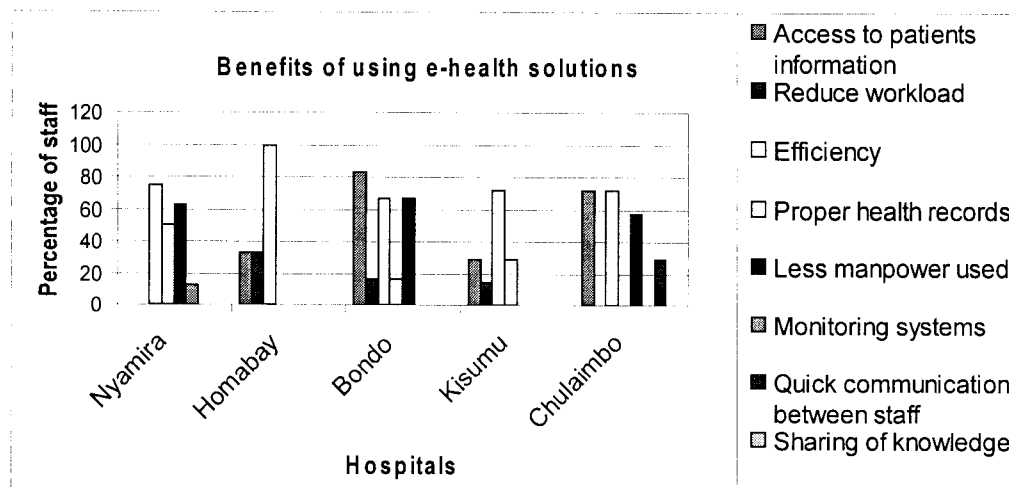
Participants	ICT infrastructures and e-health solutions
Respondent 1 (Homabay district hospital)	Has got ten computers, one photocopier and one printer. In addition it has an internet connection and telephone services are also available.
Respondent 2 (Bondo district Hospital)	Only administrators have got access to mobile phones. The other staff members do not have access to telephones. There is one computer and a printer at the records office. No internet connectivity is available.
Respondent 3 (Nyamira district hospital)	Has got six computers for use, two printers and a network that connects two computers. Additionally it has information systems operating in the billing department, at the pharmacy and at the chest office.
Respondent 4 (Chulaimbo health centre)	Only administrators have access to telephones. The rest of the staff members use their personal mobile phones for communication. In addition the hospital has got a computer and a printer for administrative work.
Respondent 5 (Kisumu district hospital)	Telephone services are available in addition to two computers, a fax machine, and a printer.

In summary, the few technologies in place among the hospitals included, computers, telephones, a network and an internet connection. In addition information systems are used within two hospitals. Homabay district hospitals have information systems at the pharmacy and at the billing department while the Nyamira hospital has information systems at the radiology office, in the pharmacy and at the billing department.

6.2 Benefits of using ICT technologies as depicted by the participants

Through the interviews conducted, the 60 participants were able to point out their understanding of how they would benefit if ICT technologies were to be implemented. The participants managed to point out the following benefits as shown in figure 1:

Figure 1: Participants perception on benefits of using e-health solutions



From the diagram above the participants identified the following benefits:

- Increased efficiency
- Access to patient's information
- Reduced workload
- Proper health records
- Available monitoring systems
- Quick communication between staff
- Sharing of knowledge

Additionally, the various staff members and the management totalling to 36, pointed out that the use of ICT within the hospitals would improve the quality of services in the hospital in addition to reducing costs.

6.3 Existing barriers to E-health implementation

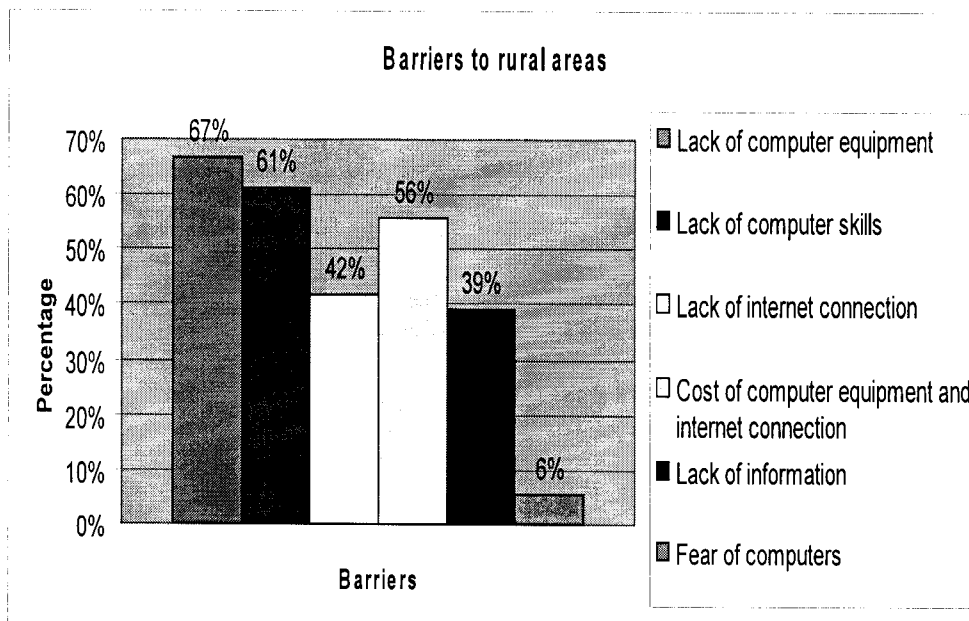
Through the questionnaires, we sought to find out why e-health benefits could not be realised within the hospitals. The managers and staffs (36) were given nine options from

which they would identify what they consider as barriers to e-health implementation within their respective hospitals. The options included the following.

- Option 1: Lack of computer equipment
- Option 2: Lack of computer skills
- Option 3: Lack of Internet connection
- Option 4: Out-dated and unreliable equipment
- Option 5: Lack of broadband connection
- Option 6: Working style not suited to the use of computers
- Option 7: Cost of computer equipment and Internet connection
- Option 8: Fear of computers
- Option 9: Lack of information

Figure 2 below shows the findings:

Figure 2: Participants perception on barriers that affect the use of ICT within the rural areas



As shown in figure two the barriers that the participants mainly selected included lack of computer equipment, lack of computer skills, cost of computer equipment and internet connection, lack of internet connection, lack of information and fear of computers respectively.

6.4 Findings from observations

Observations that were carried out ascertained that a lot of the processes within the hospitals are still done manually.

Patients have to buy their own files and prescription books. The files are then kept

at the records office after they are attended to. However when making the next visit, patients make a long queues as they wait to pick their files before they can be attended to. In some hospitals however, patients go home with their health records that are stored in form of books. In the process some of the patients loose the books.

It was also observed that some patients cannot be attended to since the procedures demand that they must come with books hence they are first sent to go and buy a patient's book where the patient's prescription will be recorded in addition to a file, despite insisting that they have no money.

Additionally, the matrons were manually drawing the worksheet that contains the duty schedule for the nurses. In addition outdated schedules are pinned on the wall in the wards. The pharmacy is using an information system to monitor the use of drugs.

In some hospitals patients have specific days on which they come to the hospital. For example, the hospital has days when referred patients come to the hospital or clinic days for mothers to bring the children to the hospital. This is done in order to share the resources available (i.e. the records office has few employees and so can only work with few patients at a time, the doctors are also few).

It was also confirmed that the only hospitals that use information systems in the pharmacy and at the billing points are the Nyamira and Homabay district hospitals. Apart from these, other operations are still conducted manually just like the other hospitals.

7. Discussions

From the findings, a lot of the functions within the hospital are manually done since there are very few ICT's in place, therefore a lot remains to be done. Additionally the use of ICT technologies in place currently are characterised by the following as a result of existing challenges:

- i. **Unavailability** - Currently these hospitals do not have enough technologies in place. Bondo district hospital and Chulaimbo hospital do not have telephone landlines in place as majority of staff use personal mobile phones. Each of these hospitals has only one computer. Only Homabay hospital has an internet connection in the matron's office. This is due to the availability of limited funds to put these technologies in place.
- ii. **Unreliability** - Additionally the telephones in place experience very frequent break downs forcing members of staff to move from point to point in order to communicate leading too a lot of time wasteges. This situation was most prevalent at Kisumu district hospital. Additionally, the internet service at Homabay district hospital was not functioning at the time of conducting the research. ICT's need to be put in place in such a way that it is reliable, to avoid making unnecessary errors and to promote efficiency.
- iii. **Inaccessibility** - Moreover majority of the staff members do not have access to the ICT technologies in place. Especially accessibility to the internet connectivity and accessibility to the available computers. This is due to the inadequacy in the number of the facilities in place.

- iv. **Lack of skills** – Majority of the staff members are not trained or equipped with basic computer operations skills. Therefore they may not be able to embrace the use of ICT technologies.

Unless these challenges are addressed, the hospitals will continue to implement e-health solutions that are not accessible, unavailable, unsustainable and unreliable as is the case currently from the research findings in Nyanza province, Kenya.

Moreover, these research findings support a similar research done in Eastern Cape Province, South Africa by Ruxwana(2007) and the findings show that they face similar challenges.

This calls for a way to deal with these challenges which have crippled implementations of ICT solutions within the developing nations.

Recommendations

From the findings, it is depicted that the developed countries are grappling with quite a number of challenges that are acting as barriers to the implementation of e-health solutions. Some of the major barriers include lack of computer infrastructure and lack of skills. Hence, it is imperative that e-health solutions are applied over a period of time to allow for a smooth integration and transition considering the fact that not all the challenges can be addressed at once by the developing nations but may be implemented in stages. By doing these, the governments within the developed nations will be able to plan and even measure the output even as the implementation process proceeds in the various stages. The proposed stages are as outlined in the following subsections.

- **Phase one (Initial stage)**

This stage requires various stakeholders in e-health to work together towards the implementation of e-health.

During this phase the governments and hospital administrators should be in the process of purchasing various ICT equipments, needed within the hospitals. This should include computers and its accessories and networking equipments. More importantly all the hospitals should have telephones to improve quality of service within the hospitals.

In addition to purchasing the ICT equipments, software development should begin at this stage. The government may work with various researchers to develop templates of open source softwares for use within the dispensaries, health centres, sub-district hospitals and the district hospitals, provincial hospitals and the national hospitals. This will act as a cheaper option compared to purchasing of on shelf software which requires licensing for a particular number of machines thereby limiting its use within the rural hospitals.

Moreover, the various staff members (doctors and nurses) should be trained during these phase in order to support e-health implementations.

- **Phase two (Deployment stage)**

Local area networks and wide area networks should be set up at this stage to facilitate the communication between various hospitals. In addition the various software templates for the health information systems that were developed should be customised to be used at the different hospitals. Telemedicine equipment should also be purchased at this stage. In addition, policies governing the use of e-health solutions should be set up. If possible there should be cross-sector linkages between various government ministries to support the implementation of e-health.

- **Phase three (Implementation stage)**

Since the hospitals shall have had ICT structures in place the use of health information systems, telemedicine and the Internet can then be implemented in each hospital to improve the quality of services provided to the patients.

- **Phase four (Evaluation stage)**

The use of various e-health solutions in place should be reviewed at this stage in order to determine the way forward for the hospitals. In accordance to the findings, changes should be made where possible. A way forward should also be proposed after analysis of the findings.

Note

The initial, deployment and implementation stage can overlap according to the time frame given based on the availability of resources at hand available within the various countries.

8. Conclusions

ICT's can improve the quality of services in rural hospitals, reduce costs and improve the efficiency. However, there are a few technologies that exist within the rural areas, these technologies are not sufficient for the implementation of e-health solutions. For e-health solutions to be implemented successfully, the key is to first deal with the barriers or challenges that exist within the developing nations.

Only when the challenges have been resolved, will the rural areas be able to enjoy the enormous benefits that e-health solutions provide. Therefore the challenges should be addressed in a step by step process in accordance to availability of resources at hand within the given periods in order to implement the use of e-health solutions within developed nations.

9. References

ABARD NEWS. 2005. *Why e-health?* e4, Nov. [Online]

Available at: http://66.102.9.104/search?q=cache:6_JXgS2sGMMJ:www.a-bard.org/Repository/ABARD%2520Newsletter%25204%2520-%2520November05.pdf+ABARD+News&hl=en&ct=clnk&cd=3

[Accessed: 17 May 2007].

- ABOUZAHAR, C & BOERMA, T. (2005). Health information systems: the foundations of public health. *Bull World Health Organ*, 83 (8), Geneva, Aug.
- AMERICA ACADEMY OF FAMILY PHYSICIANS. (2007). *Potential Benefits of EHR*, [Online]. Available at: <http://www.centerforhit.org/x1117.xml> [Accessed: 05/07/2007].
- ANTHONY, S. C., BENSIK, M., ARMFIELD, N., STILLMAN, J. & CAFFERY, L. 2005. Telemedicine and rural healthcare applications. *Journal of Postgraduate Medicine*, 51(4), Oct-Dec: 286-293
- BABBIE, E. (2005). *The basics of social research*. Thomson Wadsworth.
- BLAIR, R. (2007). Disaster-Proof Patients. *Health Management Technology*, 28(2), Feb.
- BONDO DISTRICT HEALTH RECORD (2006). Bondo district health plan, *Ministry of Health*. Republic of Kenya.
- BONDO DISTRICT DEVELOPMENT PLAN. 2002-2008. Effective management for sustainable economic growth and poverty reduction. Kenya: *Ministry of Finance and Planning*.
- BONDO DISTRICT HEALTH PLAN 2007/2008. *Ministry of Health*. Republic of Kenya.
- CENTRAL BUREAU OF STATISTICS, 2006. *Kenya facts and figure*. [Online] Available at: <http://www.cbs.go.ke/downloads/pdf/Kenyafacts2006.pdf?SQMSESSID=101561fb04e4511cde553e35a3da421e&SQMSESSID=5c6af6c69dda837b8417fcd03e7045b0> [Accessed: 06-03-2007].
- CHANG, B, L., BAKKEN, S., BROWN, S., S., HOUSTON, T., K., KREPS, G., L., KUKAFKA, R., SAFRAN, C. and STAVRI, P., Z. (2004). Bridging the digital divide: Reaching vulnerable populations. *Journal of the American Medical Informatics Association*, 11(6), pp: 448-457, Nov / Dec 2004.
- CHULAIMBO HEALTH PLAN 2002-2007. *Ministry of Health*. Republic of Kenya
- COOMBES, H. (2001). *Research using IT*. Basingstoke: Palgrave, 2001.
- COUPER, M. P. (2007). Issues of representation in e-health research (with a focus on web surveys). *American Journal of Preventive Medicine*, 32(5S).
- CURRY, S. J. (2007). E-health research and healthcare delivery: Beyond intervention effectiveness. *American Journal of Preventive Medicine*, 32(5).
- DARIO, C., DUNBAR, A., FELICIANI, F., GARCIA-BARBERO M., GIOVANNETTIL S., GRASCHEW, G., GÜELL, A., HORSCH, A., JENSSEN M., KLEINEBREIL, L., LATIFI, R., LLEO, M. M., MANCINI, P., MOHR, M. T. J., GARCÍA, P. O. , PEDERSEN, S. , PÉREZ-SASTRE, J. M. & REY, A. (2004). Opportunities and challenges of e-health and telemedicine via satellite. *Eur J Med Res Supplement. Proceedings of ESRIN-Symposium*, July 5, Frascati, Italy.
- DENISE, 2003. *The case for e-health*. [Online] Available at :http://www.eipa.nl/Publications/Summaries/03/2003_E_01.pdf [Accessed: 23-02-2007].

- EDWARDS, J. (2007). Electronic Health Records: Essential IT Functions and Supporting Infrastructure. *Gartner Publication*, G00145016, Jan.
- EUROPEAN COMMISSION, ENTERPRISE DIRECTORATE GENERAL. (2004). *Electronic Business in Health and Social Care Service Sector*. The quantitative picture Diffusion of ICT and e-business in 2003/04. [Online]
Available at: http://www.ebusinesswatch.org/resources/health_generic/SR10-I_Health.pdf
[Accessed: 05/06/2007]
- GANS, D., KRALEWSKI, J., HAMMONS, T. & DOWD, B. (2005). Medical Groups': Adoption of Electronic Health Records and Information Systems. *Health Affairs*, 24(5), Sep/Oct.
- GARRIDO, T., RAYMOND, B., JAMIESON, L., LIANG L. & WIESENTHAL, A. 2004. Making the business case for hospital information systems. *Journal of Healthcare Finance*, 31(2): 21–22.
- HANSON, C. W. 2006. *Healthcare informatics*. New York: McGraw Hill.
- HOMABAY DISTRICT HEALTH RECORD (2007/2008). Homabay district health plan Republic of Kenya: *Ministry of Health*.
- HOMABAY DISTRICT DEVELOPMENT PLAN 2007/2008. *Effective management for sustainable economic growth and poverty reduction*. Kenya: Ministry of Finance and Planning.
- HOMABAY DISTRICT HEALTH PLAN 2007/2008. Republic of Kenya: *Ministry of Health*.
- INSTITUTE OF MEDICINE (IOM), 2001. *Crossing the quality chasm: A new health system for the 21st century*. [Online] Available at: www.iom.edu
[Accessed on: 05/06/2007]
- KISUMU DISTRICT HEALTH RECORD (2007/2008). Kisumu district health plan. Republic of Kenya: *Ministry of Health*.
- KISUMU WEST DISTRICT DEVELOPMENT PLAN. 2002, 2008. *Effective management for sustainable economic growth and poverty reduction*. Kenya: *Ministry of Finance and Planning*.
- KISUMU DISTRICT HEALTH PLAN 2007/2008. Republic of Kenya: *Ministry of Health*.
- KURTINAIYTYTE, L. (2007). *E-health: The use of ICT in developing healthcare system*. Multiple case study of European countries: Denmark and Lithuania. Published dissertation in International Marketing, University of Halmstad.
- KWANKAM, S. Y. 2004. What E-Health can offer? *Bull World Health Organ*, 82(10), Oct.
- KRUGER, S. J. & WELMAN, J. C. (2001). *Research methodology*. Cape Town: Oxford University Press.
- LUES, L. & LATEGAN, L., L. (2006). *Research ABC*. Sun Press
- LEEDY, P.D. AND ORMROD, J.E. (2005). *Practical research: planning and design*. Columbus: Prentice hall.
- LORENCE D. (2006). Web-based consumer health information: Public access, digital division, and remainders. *Medscape General Medicine*, 8(2):e4.
- MEA, V. D. (2006). Pre-recorded telemedicine. In *Introduction to telemedicine*. 2nd ed. WOOTON, R., CRAIG, J. & PATTERSON, V. (Eds.). London: RSM Press.

- MILLER, R. H. & WEST, C. E. (2007). Market watch: The Value of Electronic Health Records In Community Health Center. *HealthAffairs*, 26(1). Jan. /Feb.
- MINISTRY OF HEALTH (KENYA). (2006). *Kenya health facilities by district, type and running agency as by 2005-2006*. [Online]
- Available at:<http://www.health.go.ke/Healthfacilities/Health%20facilities%20by%20District.xls>
- [Accessed on: 12/12/07]
- NOVAK, K. (2005). *Reducing costs through Electronic Health Records and Services*. Benefits and Compensation Digest. [online].
- Available at: www.ifebp.org
- [Accessed: 05/06/2007].
- NYAMIRA DISTRICT DEVELOPMENT PLAN 2002, 2008. *Effective management for sustainable economic growth and poverty reduction*. Kenya: Ministry of Finance and Planning.
- NYAMIRA DISTRICT HEALTH PLAN 2007/2008. Republic of Kenya: *Ministry of Health*.
- NYANZA PROVINCIAL DEVELOPMENT PLAN, 2007(KENYA). *Ministry of planning and development*.
- OLATOKUN, W. M. & AJIFERUKE I. (2006). *E-commerce challenges and policy considerations in Nigeria*. *Encyclopaedia of e-Commerce ,e-Government and Mobile Commerce*. Volume 1. London: Idea Group Reference.
- OLIVIER, M. S. (2004). *Information technology research: A practical guide for computer science and informatics*. Pretoria: Van Schaik
- OJO, O., OLUDAY, O., OLUGBARA, O., SUNDAY, M., ADIGUN, O. J., EMUOYIBOFARHE, O. & XULU, S. S. 2007. An architectural framework for rural e-healthcare information infrastructure with web service-enabled middleware support. In *Proceedings of HELI NA 2007, conference on scientific at a glance* , January 8–12, 2007. Bamako, Mali[Online].
- Available at: <http://www.sim.hcuge.ch/helina/6.pdf>
- [Accessed on: March 15th 2007].
- PODICHEITY, V. K. & BISCUP, R. S. (2003). E-Health, a new approach in healthcare practice. *Internet Journal of Allied Health Sciences and Practice*, 1(2).
- RICHARDSON, R. J. 2006. *The role of e-health*. [Online] Available at: http://www.medetel.lu/download/2006/parallel_sessions/abstract/0407/Richardson.doc?PHPSESSID=cc6aa23c71108db22338556e858f183e.
- Accessed: [05/03/2007].
- RUIZ, J. G., MINTZER, M. J. & LEIPZIG, R. M. (2006). The impact of e-learning in medical education. *Academic Medicine*, 81(3).
- RUXWANA, L. K. (2007). *Technology assessment of rural hospitals in the Eastern Cape province*. Dissertation in Information Technology, Tshwane University of Technology.
- SAMAKE, K. B. & MBARIKA, V. W. (2007). *HELINA 2007 scientific programme*. [Online]
- Available at:<http://www.sim.hcuge.ch/helina/22.pdf>
- [Accessed: 05/06/2007]

TAN, J. 2005. *E-Healthcare information systems; an introduction for students and professionals*. Jossey bass.

THAKKAR, M. & DAVIS, D. C. 2006. *Risks, Barriers, and Benefits of EHR Systems: A Comparative Study Based on Size of Hospital, Perspectives in Health Information Management*. [Online].

Available at:

http://library.ahima.org/xpedio/groups/public/documents/ahima/bok1_031769.pdf

[Accessed: 20/05/07].

THIELST, C. B. (2007). The New Frontier of Electronic, Personal, and Virtual Health Records. *Journal of Healthcare Management*, 52(2), Mar. /Apr.

THOMAS, A. B. 2004. *Research skills for management studies*. London: Routledge.

TOMASI, E., FACCHINI, L. A. & MALA, M. S. (2004). Health information technology in primary healthcare in developing countries. *Bulletin of the World Health Organization*, Nov. 82(11).

WOOTON, R., CRAIG J. & PATTERSON, V. (eds). (2006). *Introduction to telemedicine*. London: The Royal Society and Medicine Press.

WUTOH, R., BOREN, S. A., & BALAS, E. A. (2004). E-Learning: A Review of Internet-Based Continuing Medical Education. *Journal of Continuing Education in the Health Professions*, 24: 20-30.