E-health in Rural Areas: Case of Developing Countries

Stella Ouma, and M. E. Herselman

Abstract—The Application of e-health solutions has brought superb advancements in the health care industry. E-health solutions have already been embraced in the industrialized countries. In an effort to catch up with the growth, the developing countries have strived to revolutionize the healthcare industry by use of Information technology in different ways. Based on a technology assessment carried out in Kenya – one of the developing countries – and using multiple case studies in Nyanza Province, this work focuses on an investigation on how five rural hospitals are adapting to the technology shift. The issues examined include the ICT infrastructure and e-health technologies in place, the knowledge of participants in terms of benefits gained through the use of ICT and the challenges posing barriers to the use of ICT technologies in these hospitals. The results reveal that the ICT infrastructure in place is inadequate for e-health implementations as a result to various challenges that exist. Consequently, suggestions on how to tackle the various challenges have been addressed in this paper.

Keywords—Challenges, e-health, healthcare, information communication technology, rural areas.

I. INTRODUCTION

THE role of Information Communication Technologies (ICT) can no longer be ignored within the healthcare industry [1]. In fact, for the healthcare industry to maintain and improve both clinical and business operations, it has to depend on Information Technology (IT) [2].This is as a result of the capability of e-health initiatives ability to tackle challenges that exist within the healthcare industry [3].

Electronic health (e-health) describes the application of ICT across a whole range of functions that affect the healthcare industry when it comes to matters relating to health through the various solutions that exists [4]. E-health can also be described as any electronic exchange of health related data through an electronic connectivity for improving efficiency and effectiveness of health care delivery [5]. The solutions that are provided through e-health initiatives within hospitals include Hospital Information Systems (HIS), telemedicine services, Electronic health records and Internet services.

A. Hospital Information Systems

Information systems are usually designed to meet specific purposes [6]. The functions of a health information system are to monitor, inform and evaluate a health system and to make clinical and management decisions [7]. There are different types of health information system. An example is HIS.

HIS allows physicians or hospital administrators to make informed decisions since it allows daily workflow of medical services in all the departments within the hospital to be evaluated and monitored. Patient records are also updated and therefore made immediately available [6] - [8].

B. Telemedicine

The growth of the internet and deployment of personal computers has really facilitated the growth in telemedicine use [9]. Telemedicine can be used to offer medical consultation and diagnosis through e-health [10] – [11].

Categories of telemedicine that exist are real time and pre-recorded telemedicine. Real-time telemedicine allows participants to send and receive information almost instantly with insignificant delay while pre-recorded telemedicine (store and forward) is whereby information is encapsulated and then conveyed to the receiver for subsequent reply [12].

Telemedicine can provide learning opportunities to the doctors and nurses in the rural areas and also provide a platform for second opinions among professionals. Additionally, it can save patients and physicians time and money as they will not have to travel far distances to provide or receive hospital services. Moreover, it can allow underprivileged rural hospitals to share equipments and human resources within well equipped hospitals [12] and [13].

C. Electronic Health Records (EHR)

In most cases, people change their locations and do not move with the paper based medical records [14].

This wastes time and increase costs since more tests have to be repeated. Moreover, in case of emergencies patients do not usually have medical records at hand. A system that can serve patients without regarding the changes in patient's location and additionally, act as a backup during emergencies is beneficial [15].

Moreover by using such systems physicians are allowed to focus more on their patients instead of worrying about medical records [16]. Therefore physicians should take advantage of the upcoming technologies and make use of them. This is

World Academy of Science, Engineering and Technology
International Journal of Humanities and Social Sciences
Vol:2, No:4, 2008

because IT can dramatically revolutionize the delivery of healthcare making it safer, efficient and effective [17].

EHR enables patient information to be stored safely and retrieved when necessary thereby improving efficiency, reducing medical errors and improving access to patient's information [14], [17] and [18].

D. Internet

There were days when patients relied on physicians for all the information concerning their health. Those days are gone.

Nowadays patients are constantly on the look out for information regarding their health on the Internet hence by the time they arrive at the physician's offices; they already have an idea concerning the disease that is bothering them [19] and [20].

This transformation has not only affected the patients only but also other e-health stakeholders. Physicians are constantly on the look out for online information in regard to research and education [21]. Pharmaceuticals are selling their products online, hospitals are purchasing their products online and billing insurance companies using the Internet, hence the need for a drastic shift from the traditional way of conducting health affairs [22]. Therefore the use of the internet cannot be ignored within hospitals.

II. BACKGROUND

Much has been done in the industrialised countries when it comes to the implementation of e-health solutions. The computerisation of medical records in hospitals and health clinics, the use of internet for communication and information exchange, the development of magnetic cards for user identification, electronics scheduling systems for appointments, examinations and hospital admissions, and computerised protocols for diagnosis and treatment support just a few examples [23].

However, while the industrialised countries are at the forefront of e-health in its development in their countries, the developing countries are still in their early stages of development [24]. This is as a result of major socio economic development challenges facing most African countries. Some of these challenges include economic diversification, poverty, unemployment, diseases and sustainable use of natural resources. In addition, the healthcare industry in the developing countries has its own challenges therefore; the hospital administrators need to increase their operations, efficiency and effectiveness in healthcare delivery by strengthening the information basis of public health delivery [25].

The Rural Areas within the Developing World

The state of local communities in the rural areas can be categorised as inadequate, since the quality of medical care provided in rural areas has generally been perceived to be substandard to that of the urban settings [26]. Reason being that, the rural inhabitants are in general more likely than urban inhabitants to have lower education achievement, experience high unemployment, live in poverty and additionally are more likely to be ineligible for welfare benefits [27].

Additionally, when it comes to access to health care, the rural population has been viewed as vulnerable with respect to access to healthcare because of poorly developed and fragile health infrastructures, high prevalence rate for chronic illness and disability, socio economic hardships and physical barriers such as distance including lack of public transportation [28].

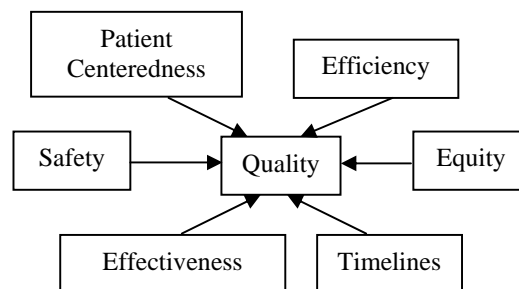There are six quality aims, which are essential [29] for all as shown in Fig. 1 below:

Fig. 1 Quality aims
Source: (Adapted from [29])

These quality aims can be provided by use of ICT which can offer new opportunities to facilitate change in rural areas such as work opportunities but more crucially a better and a more cost effective approach to deliver other services that can improve the value of life in rural areas [30].

Therefore there is an urgent need to introduce ICT in response to outstanding health and disease issues within the rural areas. This, in turn, raises infrastructural and educational issues. Therefore, local communities must be allowed to participate in the implementation of use of ICT to boost the development of primary healthcare in rural areas, including better quality of services and access to medical care for the poor [31].

A technology assessment was therefore carried out within the rural areas in Kenya as a developing country to investigate the current ICT infrastructure and e-health solutions provided, participants knowledge on benefits gained from ICT implementations and the challenges that exists towards ICT implementations within the hospital was sought.

III. METHOD

Study design

Qualitative study was applied by use of multiple case studies on five rural hospitals which were chosen through random sampling. The selected hospitals include Bondo district hospital, Nyamira district hospital, Chulaimbo health centre, Kisumu district hospital and Homabay district hospital based in Nyanza province of Kenya.

Participants

In order to carry out a technology assessment of the selected rural hospitals, various participants were selected to participate in the study. The participants were categorized into three categories:

    a.   Hospital managers
    b.   Hospital staff

World Academy of Science, Engineering and Technology
International Journal of Humanities and Social Sciences
Vol:2, No:4, 2008

c. Patients

These participants were selected through purposive sampling. The managers that were selected were the medical superintends who are in charge of the hospital operations. The hospital staffs included doctors, nurses and clinical officers. Patients comprised of young and old, male and female, literate and illiterate, working class and the jobless in order to have a fair representation of the community.

Data Collection

Various methods were used during the data collection period. These included interviews, observations and questionnaires.

Semi structured interviews were used and interviewees were selected based on the representation point of view and additionally in regard to their relevance to the conceptual questions. The interviewees included management, doctors, nurses and patients at selected hospitals. Additionally for reliability and validity of the information, all interviews were captured using a tape recorder and later transcribed to Microsoft Excel application.

Open ended questionnaires were used in the five selected hospitals in Nyanza province in Kenya. The questionnaires were categorised into three categories. The first questionnaire was for managers, another one for the staff and finally a questionnaire for patients in order to collect relevant data. 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.

TABLE I
QUESTIONNAIRE AND INTERVIEW PARTICIPANTS

Name of hospital	Number of managers	Number of staff	Number of patients	Total
Homabay District hospital	1	6	5	**12**
Bondo district hospital	1	7	4	**12**
Nyamira district hospital	1	6	5	**12**
Chulaimbo health centre	1	6	5	**12**
Kisumu district hospital	1	6	5	**12**
Total	**5**	**31**	**24**	**60**

Data Analysis

In this study, deductive strategies are used to present the results that were ascertained, through the interpretations that were made by the principal investigator and the project coordinator after collecting the data, organising the data, classifying the data and then figuring out the relationships that existed.

IV. RESULTS

A. ICT Infrastructure and E-Health Solutions in Place

From the interviews conducted participants (staff members) were able to point out the following:

Respondent one
"We have two computers for us in the pharmacy, the fist computer is used for monitoring for example like the anti retrovirals, we are able to know defaulters e.t.c and the other one for planning like when we want to order the drugs, we are able to know what has been used and what is remaining and again we have a monitor for a point of sale" (Nyamira district hospital).

Respondent two
"We use computers to collect revenues in the billing department, for the pharmacy we are in the process of developing a database to help us with the inventory, additionally there is another software for collecting data for HIV patients, the administration also use the computers for administrative issues"(Homabay district hospital).

The statements above and the ones from the other participants were backed up by the management who filled out the questionnaires and stated that the only technologies available are as shown on Table II.

TABLE II
ICT INFRASTRUCTURE AND E-HEALTH TECHNOLOGIES IN PLACE WITHIN THE HOSPITALS

Participants	ICT infrastructures and e-health solutions
Respondent 1 (Homabay district hospital)	Have ten computers, one photocopier and one printer. Also available is an internet connection and telephone services.
Respondent 2 (Bondo district Hospital)	Only administrators have access to phones. There is one computer and a printer at the records office. No internet connectivity is available.
Respondent 3 (Nyamira district hospital)	Have 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 x-ray office.
Respondent 4 (Chulaimbo health centre)	Only administrators have access to telephones. Other staff members use their personal mobile phones for communication. In addition the hospital has 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.

World Academy of Science, Engineering and Technology
International Journal of Humanities and Social Sciences
Vol:2, No:4, 2008

B. Benefits of Using ICT Technologies

Since the ICT technologies implemented within the rural areas are few and there are no e-health solutions, the participants thought that they would gain from the benefits below if a proper ICT infrastructure was to be put in place and e-health solutions implemented:

Respondent 1

"If the computers are linked together then one will not take a lot of time in the hospital walking from one office to the next, looking for general information. Additionally the staff will have knowledge on computers since they will be trained."

Respondent 2

"Reduce stationery costs, reduce medical errors and avail information easily hence save on transport costs if information is to be gotten from town for example from the pharmacies"

Respondent 3

"It improves money collection because of accountability, increases efficiency and availability of patient information."

Other benefits that the participants mentioned include access to information, easier management of patients' records, improved communication, increased knowledge since they could use the internet to get some information, and reduce transport caused by movements of patients.

C. Challenges

To establish the barriers towards the realization of e-health benefits in the rural hospitals, a total of 36 participants (managers and other staffs) were given certain options in the form of questionnaires. The options included in the questionnaires are listed below:

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
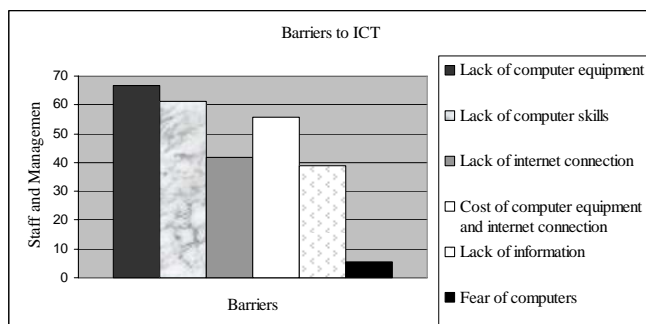Option 9: Lack of information

Fig. 2 Barriers to ICT in rural areas

Fig. 2 depicts the graphical representation of the results on the challenges.

From the results of Fig. 2, the major barriers that the participants pointed out include lack of computer equipment, lack of computer skills, cost of computer equipment and internet connection. Other barriers that the participants pointed out included lack of internet, lack of information and fear of computers as other barriers.

V. Discussions

Based on the above findings, it can be concluded that the application of e-health solutions in the developing countries is still scanty. The ICT infrastructures that are currently in place are a few computers, internet and information systems in the pharmacy and at the finance offices. However hospital information systems, electronic health records or telemedicine services are not yet available.

Even if these systems are to be implemented the tools that are required like computers and its accessories are few, therefore more ICT technology equipments need to be put in place. Additionally the participants seem quite aware that ICT can improve the quality of services and that there are benefits from use of ICT and e-health solutions but the existence of the barriers render this awareness ineffectual.

The main barriers to implementation of ICT in the rural hospitals are lack of computer equipment, lack of computer skills and cost of computers. Therefore from the findings the current ICT technologies in place within the rural areas in developing countries are still unreliable, inaccessible and not sustainable. Fig. 3 depicts the current model in the rural areas.

Unless these challenges are addressed, the rural hospitals will continue to provide services that are inefficient, costly, inaccessible and substandard as is the case currently. This calls for a way to deal with these challenges, which have crippled the implementation of e-health solutions.

In regard to the challenges at hand, the following questions should therefore be addressed in the case of rural hospitals. What cheaper ICT options exist for rural hospitals? How can staff be equipped with basic knowledge of ICTs? How can rural areas be upgraded to provide better services and therefore promote services at the rural hospitals? Which organisations, government ministries or individuals have the power to change the conditions in the rural areas thereby promoting services in rural hospitals? To answer these questions it is imperative that the following be done:

i.   ***Training.*** The majority of staff do not know how to use computers. Some basic form of training is needed if e-health implementation is to take place, otherwise they may reject any projects implemented. There is need to educate them in order to benefit from the vast information on the internet including the e-learning opportunities that are available. Most of the management seem unaware of how to go about e-health implementation. There is need for them to be educated on the topic and be equipped with information so that they can visualize the benefits of e-health solutions as this can make them push for the

World Academy of Science, Engineering and Technology
International Journal of Humanities and Social Sciences
Vol:2, No:4, 2008

implementation of e-health solutions in their respective hospitals.

ii. ***Cheaper options.*** Rural hospitals have a problem with funding. Purchase of on-shelf software may therefore be an answer to their problem. Therefore the authorities should opt for the use of open source software and facilitate the implementation of hospital information systems and electronic health records in district hospitals, health centres and dispensaries, since rural hospitals may find other type of software highly costly. The open source software should be for various applications including operating systems. This would save a lot of money and yet still promote services in rural hospitals.

iii. ***Infrastructure.*** The transport system to rural hospitals is a problem for rural inhabitants. There needs to be a way of accessing hospitals especially where roads are not tarred and it rains. Therefore the transport system to the rural areas should be improved. This would make hospitals accessible and create business centres allowing service providers of ICT technologies to render services in such places. In addition, places where there is no electricity may suffer as rural hospitals do not have enough money to buy power generators and hence are unable to put ICT infrastructure in place. The governments need to speed up rural electrification even as other alternatives are sought.

iv. ***Cross-sector linkages.*** The Government ministries need to work hand in hand when necessary to help deal with some of the rural sector problems. This will in turn upgrade the services provided within rural hospitals. The Ministry of Health needs to work together with the Ministry of Information Telecommunications Technology, the Ministry of Roads and the Ministry of Energy to improve services in rural areas which in turn will improve services at rural hospitals.

v. ***ICT expertise.*** Rural hospitals need to contract ICT professionals to maintain their systems or support them in maintaining networks, and also in systems programming and training of staff members.

vi. ***ICT infrastructure.*** More computers need to be purchased for rural hospitals together with computer accessories including printers and fax machines. Networks also need to be in place including internet connections in order for management to get information easily.

vii. **Government policies.** Government policies should be changed to support the use of IT within hospitals.

When these barriers are addressed as recommended, the conditions of rural hospitals will be improved thereby improving the quality of services through e-health implementations. Fig. 4 depicts the proposed model for implementation in the rural hospitals.

REFERENCES

[1] T. Clark, "Adopting health care informatics and technologies", Am J Health-Syst Pharm, vol. 64, Jan. 2007.
[2] M. L. Bernstein,T. Mccreless, and M. J. Côté, "Five Constants of Information Technology Adoption in Healthcare," Winter Journal, vol. 85, no. 1. 2007.
[3] C. R. Alvarez, "The promise of e-Health- a Canadian perspective". Journal of e-health Int., vol.1, no. 4, 2002.
[4] S. Denise, "The case for e-health,"2003, [online] Available at: http://www.eipa.nl/Publications/Summaries/03/2003_E_01.pdf, Accessed on: 23/02/7
[5] S. Y. Kwankam, "What E- Health can offer," Bulletin of World Health Organ, vol. 82, no.10, Genebra Oct. 2004.
[6] P. L. Reichertz, "Hospital information systems, Past, Present, Future," International Journal of Informatics, vol.75, pp 282-299, 2006.
[7] J. K. H. Tan, Health Management information Systems; Methods and practical Applications. 2001.
[8] N. Mbananga, Introduction to health informatics. Notoro publishers, SA. 2006.
[9] C. W. Hanson, Healthcare Informatics. Mc Graw Hill. 2006.
[10] G. Riva," From Tele-health to E-Health: Internet and Distributed Virtual Reality in Health Care", Cyber psychology & Behaviour, vol.3, no.6, 2000. Mary Ann Liebert, Inc.
[11] IOM ANNUAL MEETING, "Information Technology: It's Strategic Role in Biology, Medicine, and Health", 2001.
[12] S. C. Anthony, M. Bensik, N. Armfield, J. Stillman and L.Caffery, "Telemedicine and rural health care applications," Journal of Postgraduate Medicine, vol. 5,no. 4,Oct. - Dec. 2005.
[13] M. M. Maheu, P. Whitten & A. Allen, E-Health, telehealth and telemedicine: A guide to start up and success, Jossey-Base, 2001.
[14] K. Novak," Reducing costs through Electronic Health Records and Services ", Benefits and Compensation Digest, 2005, [online] Available at: www.ifebp.org
[15] R. Blair "Disaster-Proof Patients", Health Management Technology, vol. 28, no. 2, Feb 2007.
[16] A. I. Veletsos, "Reliable Mobile Computing," Health Management Technology; vol. 28, no. 2; Feb 2007.
[17] C. B. Thielst. "The New Frontier of Electronic, Personal, and Virtual Health Records," Journal of Healthcare Management, vol. 52, no. 2, Mar. /Apr. 2007.
[18] M. Thakkar and D. C. Davis," Risks, Barriers, and Benefits of EHR Systems:A Comparative Study Based on Size of Hospital", Perspectives in Health Information Management 2006, [online]. Available at: http://library.ahima.org/xpedio/groups/public/documents/ahima/bok1_03 1769.pdf, Accessed on: 20/05/07.
[19] G. Eysenbach and T. L. Diepgen. "The role of e-health and consumer health informatics for evidence-based patient choice in the 21st century". Clinics in Dermatology, vol. 19, no. 1, pp. 11–17, 2001.
[20] M. McMullan." Patients using the Internet to obtain health information: How this affects the patient–health professional relationship". Patient Education and Counselling, vol. 63, no. 1–2, pp. 24–28, Oct. 2006.
[21] T. R. Welch."Who provides physicians with advice over the internet? A study of a paediatric subspecialty discussion group". Journal of Paediatrics, vol. 151, no.1, pp. 96–97, 2007.
[22] J. Tan. E-Healthcare information systems; an introduction for students and professionals. Jossey bass. 2005.
[23] E. Tomasi, L. A. Facchini, and M. de F. S. Maia," Health information technology in primary health care in developing countries," Bulletin of the World Health Organization, vol. 82, no. 11, Nov. 2004.
[24] World Health Organisation,"Global observatory for e-health,"2006, [online] Available at: http://www.who.int/GOe., Accessed on: 15/06/07.
[25] S.O OJO,University of Botsana, "Rural e-Healthcare Services Open source System (ReHSOS):Research Project Overview". Postgraduate seminar, Tshwane University of Technonology. Pretoria. 2007.

World Academy of Science, Engineering and Technology
International Journal of Humanities and Social Sciences
Vol:2, No:4, 2008

[26] J. B. Coombs,"Quality of care in rural settings: Bringing the New Quality to rural practice," in Text book of rural medicine, Geyman, T. E. Noris, and L. G. Hart Ed., 2001.

[27] T. C. Rickets, "The rural patient," in Textbook of rural medicine, Geyman, T. E. Noris, and L. G. Hart Ed., 2001.

[28] D. Rowland and B. Lyons,"Tripple jeopardy; rural, poor and uninsured," Health services Res, vol. 23, no.6, 1989.

[29] Institute of Medicine (IOM), 2001. Crossing the quality chasm: A new health system for the 21st century. [Online]. Available at: http://www.iom.edu, Accessed on: 08/07/07.

[30] ABARD News. "Why E-Health?" e4, Nov, 2005. 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 on: 17/05/07.

[31] ASEM, "ICT and Empowerment for Elderly Care," 2006, [online] Available at: http://www.asemictmin.vnn.vn/UserFiles/Document/0ASEM%20ICT%20MIN%20project%20proposal%20-%20%20%20Healthcare.pdf

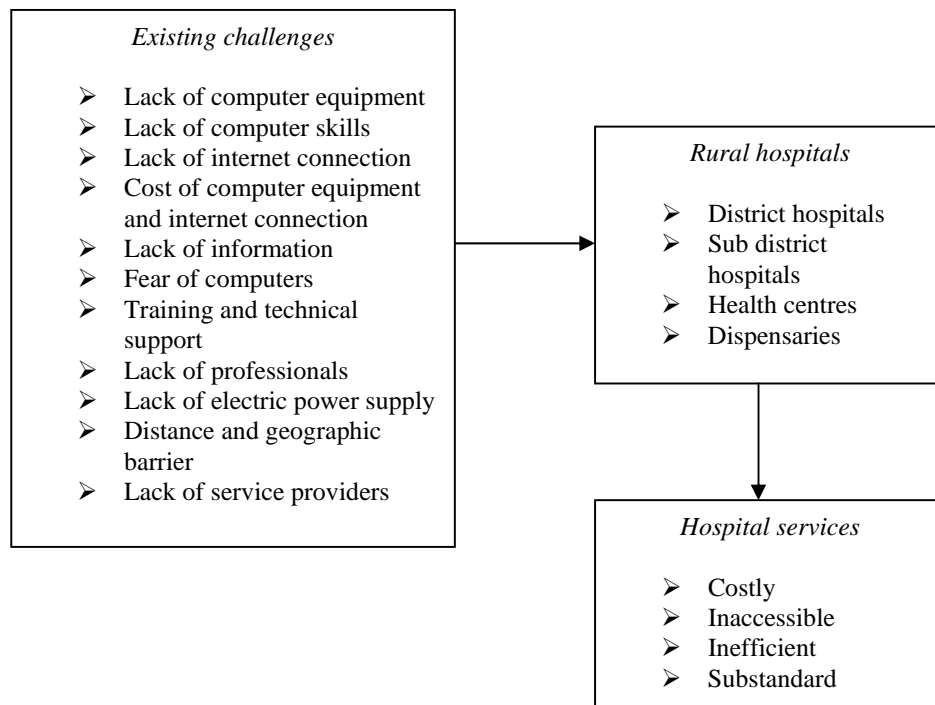Fig. 3 Current model within rural areas

World Academy of Science, Engineering and Technology
International Journal of Humanities and Social Sciences
Vol:2, No:4, 2008

ICT infrastructure

➢Computers
➢Internet
➢Networks
➢Computer
  accessories
➢Telemedicine
  equipments
➢Application
  software's
➢Operating systems

Cross-sector links

➢Ministry of Health
➢Ministry of
  Information
  Communication
  Technology
➢Ministry of
  Transport
➢Ministry of
  Energy

Cheaper options

➢Open source
  application software
➢Open source operating
  systems

**Purchase of
equipments**

➢Revenue from
  hospitals
➢Funding from
  ministry of health.
➢Donor funding

ICT expertise

➢Hardware
  technologies
➢Software

Government

➢Policy changes

Training for

➢Management
➢Doctors
➢Clinical officers
➢Nurses

**Improved
infrastructure**

➢Transport systems
➢Power supply

Rural hospitals

➢District
  hospitals
➢Sub district
  hospitals
➢Health centres
➢Dispensaries

**Hospital services
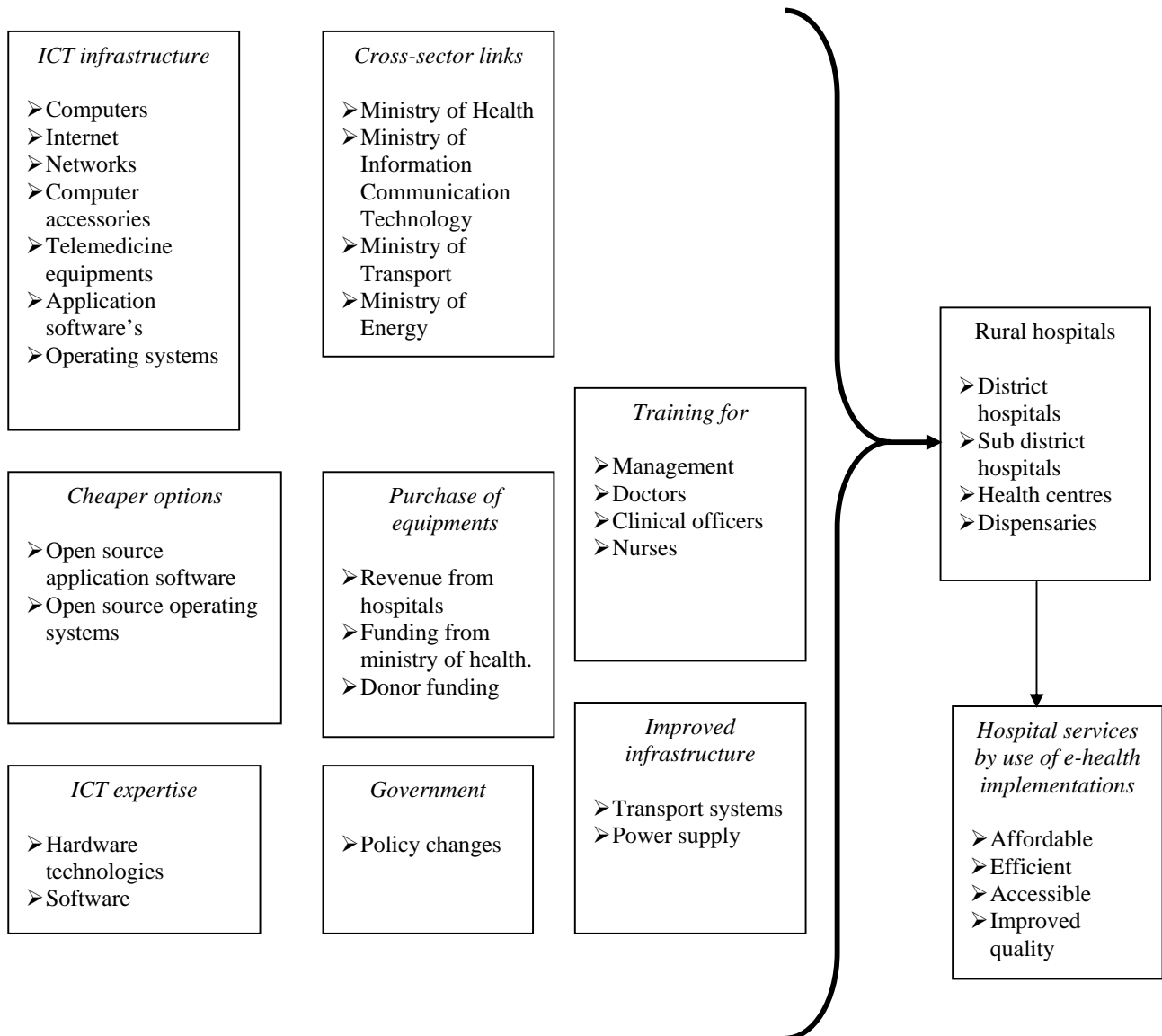by use of e-health
implementations**

➢Affordable
➢Efficient
➢Accessible
➢Improved
  quality

Fig. 4 Proposed model for rural areas