



A Review of the Development of Telemedicine in Selected Countries in Sub Saharan Africa (Cameroon, Ghana, Kenya and Nigeria)

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ABSTRACT

Information and communication technologies (ICTs) have great potential to address some of the challenges faced by both developed and developing countries in providing accessible, cost-effective, high-quality health care services. Telemedicine uses ICTs to overcome geographical barriers, and increase access to health care services. This is particularly beneficial for rural and underserved communities in developing countries – groups that traditionally suffer from lack of access to health care. This paper titled “a review of the development of telemedicine in selected countries in sub Saharan Africa” is aimed at providing an inside in the advancement of telemedicine in Cameroon, Ghana, Kenya and Nigeria. The method used is a systematic review of the documented information on functional telemedicine in the respective countries. Very little documentation is done on this topic in Cameroon as compared to Kenya, Ghana and Nigeria we concluded. It was also concluded that with the advancement in ICTs in these countries especially with the expansion in mobile telephone networks and internet availability, governments should develop clear policies to support and enhance the development of telemedicine to assist in the provision of quality health care especially in rural communities.

INTRODUCTION

For more than 30 years, health professionals and researchers have been investigating the use of advanced telecommunications and computer technologies to improve health care. At the intersection of many of these efforts is e-health - a combination of mainstream and innovative information technologies. Information and communication technologies (ICTs) have great potential to address some of the challenges faced by both developed and developing countries in providing accessible, cost-effective, high-quality health care services. Telemedicine uses ICTs to overcome geographical barriers, and increase access to health care services. This is particularly beneficial for rural and underserved communities in developing countries – groups that traditionally suffer from lack of access to health care.

In light of this potential, the World Health Organization (WHO) established the Global Observatory for e-Health (GOe) to review the benefits that ICTs can bring to health care and patients' well-being. The Observatory is charged with determining the status of e-Health solutions, including telemedicine, at the national, regional, and global level, and providing WHO's Member States with reliable information and guidance on best practices, policies, and standards in e-Health. The observatory indicates insufficient efforts to optimize the use of telemedicine in most African countries, especially those at the south of the Sahara. With declining economic performances, a history of political instability and low levels of development, the health sector in most of Africa lags far behind its counterparts in the industrialized World. Given that at least 60% of African populations live in large underdeveloped rural areas the problem of healthcare delivery is even more serious. The other set of challenges that face Sub-Saharan Africa, arises from managing a dual healthcare system: these are the Western medicine and the Traditional African medicine. In the poor peri-urban and rural areas, the traditional healthcare centers are more accessible than those for modern medicine. Hence a high percentage of cases that reach modern healthcare facilities are likely to be emergency cases that have passed through the traditional medical system.

The African healthcare system in general is over stretched, with doctor to patient ratios as high as of 1 to 10000 or more in certain cases. Furthermore, research and technological facilities are very limited which reduces possibilities for enhancing the work of health workers. The general state of technological and infrastructural development in many African countries remains a major hindrance to optimal research and communication. In most remote parts of Africa access to ordinary telecommunications and electronic facilities is a virtually non-existent.

Against such a background, it is not surprising that in Africa the use of information and communication technologies (ICTs) in the health sector is largely limited to urban centers.

For a continent that has seen fatal outbreaks of Ebola, Malaria and is currently faced with alarming rates of HIV/AIDS infection, it is quite clear that an increased practice of telemedicine would contribute to the improvement of healthcare delivery. It follows therefore that increasing the use of ICTs would effectively improve the practice of telemedicine and further address academic and research concerns that are necessary for Africa to more efficiently deliver healthcare to its inhabitants. Telemedicine should therefore be of concern to health policy makers. "The idea behind telemedicine is said to be to ensure a health service to all people regardless of their situation. Access to medical services may be limited by geography, climate, communication, transportation and economy, as well as shortage of trained personnel."

Conceptualizing the Development of Telemedicine Components

The terms e-health and telemedicine are often used interchangeably but telemedicine is a field within e-health. However, our focus is on telemedicine.

E-health/Telehealth

E-health is the provision of health-related services and their attendant information using telecommunication facilities. It comes in many forms and shapes, depending largely on the telecommunications and IT infrastructure of the region in question, and the sorts of medical or health needs of the target population.

Telemedicine

Telemedicine which literally means "healing at a distance" is the provision of clinical health care remotely using telecommunications. The American Telemedicine Association (2013) defines telemedicine as "the use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or healthcare provider and for the purpose of patient care." As broadly defined by the WHO, telemedicine is "The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities".

History of telemedicine

Historically, telemedicine can be traced back to the mid to late 19th century with one of the first published accounts occurring in the early 20th century when electrocardiograph data was transmitted over telephone wires. Telemedicine in its modern form, started in the 1960s in a large part driven by the military and space technology sectors, as well as a few individuals using readily available commercial equipment. Examples of early technological milestones in telemedicine include the use of television to facilitate consultations between specialists at a psychiatric institute and general practitioners at a state mental hospital, and the provision of expert medical advice from a major teaching hospital to an airport medical centre.

Recent advancements in, and increasing availability and utilization of ICTs by the general population have been the biggest drivers of telemedicine over the past decade, rapidly creating new possibilities for the health care service and delivery. This has been true for developing countries and underserved areas of industrialized nations. The replacement of analogue forms of communication with digital methods, combined with a rapid drop in the cost of ICTs, have sparked wide interest in the application of telemedicine among health-care providers, and have enabled healthcare organizations to envision and implement new and more efficient ways of providing care. The introduction and popularization of the internet has further accelerated the pace of ICT advancements, thereby expanding the scope of telemedicine to encompass Web-based applications (e.g. e-mail, teleconsultations and conferences via the internet) and multimedia approaches (e.g. digital imagery and video). These advancements have led to the creation of a rich tapestry of telemedicine applications that the world is coming to use. The early forms of telephonic and radio communication in telemedicine have a largely been supplanted by video telephony and telemedical gadgets that enable in-home health care access.

Types of Telemedicine

Broadly telemedicine can be classified into three major types, namely:

- Store and forward
- Remote patient monitoring
- Interactive or real time services

Store and forward

In this type of telemedicine, there is no physician-patient interaction or the presence of both the parties concurrently. The patient information in the form of medical images or bio signals are transmitted via electronic media to the physician, who reviews it at a

convenient time and provides expert opinion. A precise and well-structured history and clinical background of the patient, preferably in electronic form is included along with the images for the benefit of the physician.

The 'store and forward' type of telemedicine is useful in the medical diagnostic fields of pathology and radiology, and dermatology. The major drawback of this form of telemedicine is that the physician cannot obtain the medical history directly from the patient or perform a physical examination, but instead has to rely on the information provided in electronic form.

Remote patient monitoring

This type of telemedicine involves monitoring the patient remotely using various technological devices. It is especially useful in the follow-up of chronic conditions such as diabetes, asthma, and heart disease. The outcomes appear to be comparable to traditional physician-patient encounters. It might be cost-effective and saves patients the trouble of traveling long distances with their health condition for frequent follow-ups.

Other applications of remote patient monitoring include management of joint disease and home-based nocturnal dialysis, to name a few.

Interactive and real time services

In this type of telemedicine, there is an interaction between the physician and the patient, for example, over videoconferencing, with the need for both to be present simultaneously. It is possible to obtain a history and perform several assessments in this form of telemedicine.

Specialties where Telemedicine can be used

Telemedicine is used in the following specialties:

i. Telenursing involves the use of information and communication technology to provide nursing care and services to patients even in the presence of physical distance.

ii. Telepathology is another area where the transmission of high quality microscopic images through the internet can be used for teaching, diagnostic and research purposes. It is necessary for a qualified pathologist to choose the appropriate, representative high quality image to be sent for analysis.

iii. Teleradiology Radiology is one of the areas where telemedicine is employed in a big way. Radiological images such as x-rays, CT scans and MRI are transmitted via the internet to a radiologist or physician, who needs to have a computer with a high quality screen display, and if possible, a printer that prints high quality images.

iv. Telepharmacy - In telepharmacy, pharmaceutical care is made accessible to patients at locations where they may not have access to a pharmacist. The pharmacist can monitor treatment, counsel patients about intake of medications, and authorize prescription drug refills using teleconferencing or video conferencing.

v. Teleophthalmology: Using digitized medical equipment and communication technology, optimal eye care facilities and monitoring of chronic eye conditions such as diabetic retinopathy can be done for patients living in remote locations. This helps in providing low-cost eye care and access to eye specialists for poor and uninsured patients.

vi. Telecardiology: Specialist care and opinion in fields such as cardiology may be made accessible to patients by transmitting their ECG's and other test results using the internet to experts at the receiving end.

vii. Teledentistry: involves the use of electronic media for the purposes of dental care, and consultation and creation of public awareness regarding dental health.

viii. Telepsychiatry: Videoconferencing and other communication technologies can be used to make

accessible specialist psychiatry services to persons living in underserved locations.

ix. Teledermatology: Involves the use of audiovisual data transmission of skin conditions for specialist consultation, diagnosis and treatment. Teledermatology can also be used for educational purposes. In this way, patients living in places where specialist care is inaccessible can be served.

x. Telerehabilitation: refers to the use of communication technology to provide rehabilitation services to patients that include speech therapy, occupational therapy, neuropsychology, physical therapy and audiology.

xi. Teletrauma care: Uses modern communication tools to provide expert health care to patients in a trauma or disaster situation. Doctors and health personnel at the scene of disaster or trauma can interact with specialists via the internet or smartphones to help in assessing the severity of injuries and to determine management, and whether a particular patient might have to be shifted to a secondary or tertiary care center for further management.

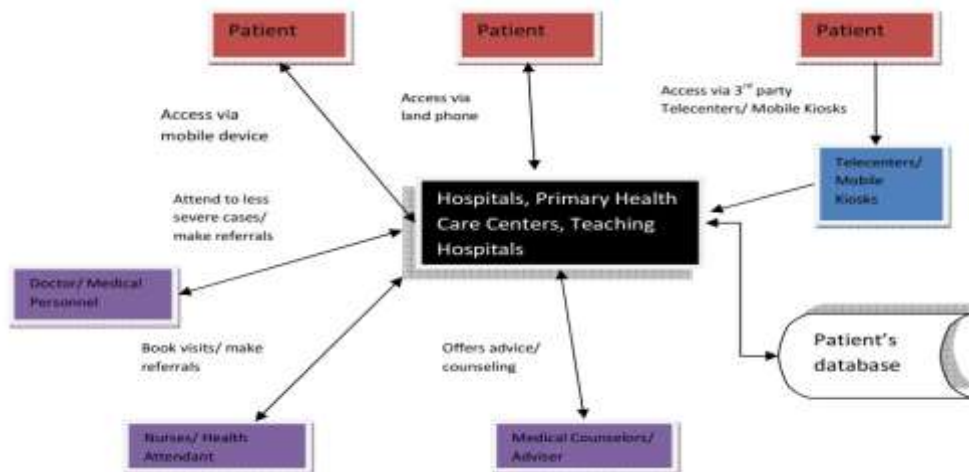


Figure 1: Architecture of a telemedicine setup

Global statistics and facts on telemedicine services

Statistics according to the WHO region related to the four fields of telemedicine-teleradiology, telepathology, telepsychiatry and teledermatology are mentioned below:

- Regions of Southeast Asia, Europe and Americas had the highest proportion of established telemedicine services.
- Southeast Asia and Europe had high level of established teleradiology programs compared to the global rate.
- African and Eastern Mediterranean had the lowest proportion of established telemedicine services.
- High income countries have a higher proportion of established telemedicine programs, probably due to presence of well-developed information and communication technology systems, and allocation of funds for health care.
- Store and forward initiatives are generally implemented with lesser difficulty compared to real time services, since they require less bandwidth for videoconferencing purposes.
- Telepathology, teleradiology and teledermatology services are less bandwidth intensive and more

often employed than telepsychiatry, which requires a real time doctor-patient interaction.

- Globally, 25% of countries reported having a national telemedicine policy or strategy.

The Advantages/Benefits of Telemedicine.

To Patients

- Enhanced access to a specialist leading to more accurate and earlier diagnosis and better treatment outcomes leading to reduced burden of morbidity
- Reduction of patient's waiting time and hospital stay days
- Reduction of expenses (travelling, accommodation, consultation fees in referral hospital)
- Availability of healthcare to patients living in rural or underserved areas without necessity to travel to the hospital.
- Useful in post-disaster, natural calamity situations or other emergency situations when traveling is not possible.
- Elderly patients and persons with chronic illnesses can have regular follow-up and monitoring through telemedicine.
- The time for travel is saved and the cost of treatment may also come down.
- Allows patients to participate in the decision making process since knowledge is made available to them.
- Home-based dialysis options are available to patients through video link supervision, whenever needed.

To Health care Providers

- Saves work-loss time and increase productivity
- Joint consultation with expert Consultants for better management of complicated disease.
- Telemedicine is an excellent opportunity to share the knowledge between Health Professionals all over the world
- Local doctors can be updated at any time with the most recent advancement in medicine.
- More efficient screening of patients with medical problems
- Better follow-up of patients with selected medical problems
- Monitoring of drugs and dose management can be done through telephone.
- Facilitates health education by allowing students or health workers to observe and listen to experts in their respective fields. Medical teaching is possible by making available academic material and case presentations through webcasts, and teleconferencing.
- Electronic search engines, online medical sites and journals provide latest research news helping health professionals to stay updated. Specialists

can also communicate with each other to solve difficult cases.

- Presence of computerized database, especially in primary care settings allows the physician to access patient records and for multidisciplinary collaboration whenever needed. This could improve the quality of patient treatment.
- Can possibly overcome the risk of transmission of infection between health care professional and the patient, or between patients.
- Accuracy of diagnosis / reduction of medical errors.

Although telemedicine clearly has a wide range of potential benefits, it also has some disadvantages.

Disadvantages/Challenges/Drawbacks of Telemedicine

The following may be considered as possible downsides of telemedicine:

- Lack of direct interaction between the physician and the patient.
- High cost of communication and data management equipment and its maintenance, which may not be easy for older people living alone.
- Necessity to train personnel technically to handle communication and data management equipment.
- Possibility of error when health care is delivered in the absence of a trained health professional.
- Possibility of misuse of patient data through electronic transmission(confidentiality).
- In certain instances, time taken to provide health care through telemedicine may actually be longer than traditional consultations because of increased time taken to assess and treat patients through virtual interactions.
- Poor quality of records or images made available to the physician at the receiving end and omission of relevant clinical information might affect the quality of health care delivered.
- Absence of proper legal regulations for some of the telemedicine practices.
- Difficulty in claiming insurance or reimbursements in certain fields.

TELEMEDICINE IN AFRICA

Despite the bleak background painted about telemedicine in developing countries in general and Africa in particular, some efforts with respect to telemedicine are worth mentioning. The purpose of this study is to identify some African countries where telemedicine is used, how they function, their benefits and challenges. The scope of the study is limited to four countries, namely: **Cameroon, Ghana, Kenya and Nigeria.**

Telemedicine in Cameroon

Shortages of skilled health personnel in remote areas, deficient infrastructures and equipment as well as the limited purchasing power of a large proportion of the population are factors that threaten the health of many in Cameroon. Because of this, people in rural and remote areas have great difficulty in accessing basic health care and appropriate treatment. Telemedicine (care and health services, social services, preventive or curative, done remotely via technology and communication) has the potential to reduce inequality on health care quality between urban and rural areas. It also reinforces health care workers isolated in rural areas by giving access to a sound medical knowledge base.

There is no official framework for the promotion of telemedicine in Cameroon; however some private initiatives have been put in place.

Case 1: Genesis Telecare

Genesis Telecare SA is the first telemedicine company in Cameroon, created on April 21, 2009 by Jacques Bonjawo, also CEO of the group which Genesis Telecare lies under: Genesis Futuristic Technologies Inc., a U.S. software firm which has the bulk of its operations based in India.

Objectives

- a) Bring the patient's physician closer, reducing wait times and maximize the effectiveness of medical consultations;
- b) Enabling rural access to examinations and specialized services such as medical support for cardiovascular disease, or monitoring of difficult pregnancies or other treatments during early childhood.

Approach

Genesis Telecare opened the first telemedicine center in Cameroon in April 2009.

The project is composed of a team of general practitioners, nurses, engineers and skilled technicians in advanced technology. Their collaboration provides a real-time interaction between physicians and patients through a highly secure computer system where each patient has a complete electronic medical record.

To date, there are six telemedicine sites in several localities in Cameroon: Yaounde (where the technical platform is found), the regional hospital of Abong Mbang (in the East), Regional Hospital Yagoua (in the Far North), the health center at the SOSUCAM Nkoteng (in the central region) and the medical Center in Akonolinga of the Endom district (in the central region). For each center, nurses are trained specifically to the technologies used. Medical specialists remotely perform interpretations of tests either in real time or delayed, and if required, other physicians, based in India, France and

the United States are asked to analyze some complex cases corresponding to their specialty.

To overcome the problem of frequent power outages in rural areas in Cameroon, generators have been installed in each telemedicine center and some instruments are being developed to run on solar energy. Following the success in Cameroon, telemedicine centers are being created in Gabon, Chad and the Democratic Republic of Congo.

Benefits

- a) Easy access to medical specialists without having to travel long distances + electronic medical records
- b) Low care costs which are affordable for the poor
- c) More than 15,000 patients consulted since April 2009; 2000 electrocardiograms and 1500 ultrasounds performed.

Case 2: DigitalMedLab

Cameroon government has a low tax base and therefore limited power to provide ICT infrastructure especially on areas addressing healthcare. One startup, digitalMedLab has been established in Cameroon to meet this end. Founded in 2012 in Zürich, Switzerland by Cameroonian physician Dr. Patricia Sigam and Australian developer Andreas Lorenz this is set to facilitate African telemedicine, eHealth and mHealth. And it is not just useful for the African context but should have universal appeal.

According to Dr. Sigam, "Health Systems in Africa are mostly institutional and public. The early Ebola outbreak has shown the mistrust of the population regarding Healthcare Services and NGOs. The private sector could play an important role, by offering sustainable healthcare [tech] solutions at an affordable price. One of such is the +WoundDesk app. It is a mobile app designed for wound management. It captures patient's health records and conducts semi-automatic wound management processes. It has a decision support system mechanism that incorporates alerts and notifications. And is already in use in a French nursing home in France and a rural hospital in Cameroon. With this app, doctors are able to exchange data with colleagues in a secure and confidential environment. The app has the capacity to reduce the number of wound patients that need to travel for these services.

The founders decided to focus on wound management, as a critical issue in both African and European countries. But as many health practices across Africa are far from optimal, the app also offers numerous additional benefits. The most pressing of these is that the majority of patients in Cameroon do not have medical records. This means many hospitals and dispensaries sell a miniature notebook (sometimes

called “card”) to the patient. However, this is costly for poverty stricken patients and often lost before the next visit. To counteract this, the app providers combine a patient health records with a mobile app. According to Dr Sigam's explanation of discovery of this app, that a web-based modular medical record was developed, an Android-based mobile application with a special image processing system that allows automated non-contact wound surface area measurement was built, but due to low access to internet in Cameroon, an offline modes to assure access anytime anywhere was integrated to this app. When asked whether the project could operate within our context of abject poverty and illiteracy and without many smart technologies, Dr. Sigam answered yes and also said that the app is only for trained health professionals.

Case 3: The CardioPad

The **CardioPad** is a touch pad that has embedded applications for medical use. The tablet invented in Cameroon by computer system engineer Arthur Zang, records and analyzes the cardiac activity of a patient to transmit to a specialist who will produce a diagnosis. The CardioPad is designed for remote populations.

Operation

The tablet has the following functions:

- ECG exams (acquisition of the patient signal, scanning, processing, display and printing of the examination report);
- remote and GSM network transmission of exam results to cardiologists;
- presentation on an interface;
- storage of information and notifications in an SQL database;
- remote monitoring.

This invention already equips some hospitals in Cameroon.

Beside the main cases stated above, there are other private initiatives such as Imaging Department in Mbingo Baptist Hospital and Gifted Mom that are implementing some basic telemedicine practices but very little has been documented.

Gifted Mom, a text-messaging application that gives no-cost health advice from doctors to women in rural villages across the country of Cameroon. The app is ambitious, expecting to reduce the maternal mortality rate in Africa by at least 70 percent.

As far as telemedicine is concerned, very little has been done in Cameroon as compared to other African countries. This may be due to lack of funding and

political will, to support private initiatives whose scopes are reduced.

Telemedicine in Nigeria

In 2003, the Nigerian Communications Satellite Limited (NIGCOMSAT LTD), and the China Great Wall Industry Corporation (CGWIC) signed a contract for the design, manufacture, and launch of the NigComsat-1 satellite in 2007. The satellite provided links that would allow Nigerian caregivers to consult with medical providers across the globe with ease for additional examinations and consultations.

On November 11, 2007, the National Space Research and development Agency (NASRDA), a Nigerian Federal Government establishment, along with the Nigerian Ministry of Health began an initiative to embark on a pilot project using telemedicine to improve care to Nigerians living in the rural areas, far from the country's professional health facilities. The initiative relied on NigComSat-1 and began with eight remote terminals that would serve as stationary nodes at which patients could access care from medical professionals living in Abuja or Lagos, and a single mobile unit that would travel into more remote areas of Nigeria. The satellite failed woefully in November 2008 owing to a technical error from the satellite's northern solar array.

In March 2009, Nigeria signed another contract with the Chinese government on the launch and delivery of a replacement satellite called NIGCOMSAT 1R. The new satellite was delivered and launched in December 2011.

Design and sustainability of telemedicine systems still poses a big challenge to most developing countries, despite its wide usage in developed countries. However, the advancement of technology continues to decrease this challenge. ZYcom GlobalMed, - a corporation founded in Texas of the United States of America, duly registered with the Federal Republic of Nigeria - partners with GlobalMed to leverage the fiber optic infrastructure ring trrenched around Africa, specifically Nigeria, to integrate a wireless fiber optic NODE network backhaul. With this integration, Zycom GlobalMed has been able to revolutionize telemedicine by using its wireless fiber optic node network designed to generate unlimited bandwidth. The fiber optic nodes create a stable network for video conferencing and providing an effective telemedicine solution. This also allows all areas of Nigeria to gain access to the quality and specialized healthcare they deserve at an affordable cost. Zycom GlobalMed invented telemedicine solutions directed at bridging the gap between patients and specialists globally.

Current challenges and prospects of telemedicine in Nigeria

Telemedicine still faces a lot of problems and bottlenecks in Nigeria, some of which are:

- a) Slow growth or usage of Telemedicine: There is every need for the expansion of telemedicine through education. The understanding of the telemedicine technology is very important to the expansion of telemedicine.
- b) Little or no connectivity to rural and remote communities: To enhance the application of telemedicine in health care, there ought to be access to fast and reliable internet in most cases. Such fast and reliable internet connection is not available in most rural and remote communities in Nigeria.
- c) Costs of Telemedicine in Nigeria: Notwithstanding that telemedicine reduces cost, the cost of telemedicine is still not affordable to many especially those in rural and remote communities in Nigeria and even in the Urban Areas despite these challenges, Nigeria being a third world country could benefit so much from telemedicine more than the so called technologically advanced countries.

The essence of telemedicine is to provide specialist medical care where there is no specialist. In essence, large sums of money spent by the government on its officials' regular visits abroad can be reduced to a minimum. In addition, the higher numbers of qualified Nigerian doctors in the diasporas could offer their services to hospitals in Nigeria. There could also be a multiplier effect to the extent that, rather than fresh medical graduates leaving the country for better jobs abroad, they can stay back and yet still work for foreign hospitals right here from home. This can help stem the effect of brain drain.

CONCLUSION

Telemedicine has the potential of increasing health-care delivery and making qualified health Personnel accessible by patients in remote areas. Other benefits include reducing the costs of Health-care delivery, long-queues in hospitals access to health personnel at any period of time. However, telemedicine faces a lot of problems in Nigeria.

Telemedicine in Kenya

➤ Overview of the Telemedicine in Kenya

Access to healthcare by people living in rural Kenya is still hindered by lack of physicians situated in those areas. According to a report published by Kenya National eHealth Strategy (2011), having equitable and affordable healthcare at the highest achievable standards to all citizens is one of the overall goals of Kenyan Vision 2030. Telemedicine was identified as one of the strategic areas of intervention in Kenyan e-Health strategy presented in

Vision 2030 report. Basing on the Kenyan geographic distribution, the majority of citizens are located away from hospital where healthcare specialists are located. In a study on the reliability of telemedicine systems in rural Kenya, Qin et al. (2013) noted that patients living in rural Kenya fail to receive treatment due to the high costs involved to travel to urban areas where the medical specialists are based. On the other hand, specialists located in urban areas fail to visit the rural clinics due to their busy work schedule as well as costs involved in travelling to rural areas.

Case 1: Call-a-Doctor

A recently launched service "Call-a-Doctor" initiated by a mobile phone service provider Safaricom which has partnered with clinicians to provide a tele-health consultation service, provides patients with a chance of calling a doctor to seek medical attention. This followed a move meant to spur adoption of e-health services and solutions; the Kenya government has developed a national e-health strategy through the ministry of medical services in order to help enhance health service and medical provision by utilization of information and communications technologies. The strategy is expected to among other things address the country's low doctor to patient ratio which is currently estimated to be 0.14 physicians per 1,000 people while expenditure on health care services takes up about 4.9 per cent of the GDP (GoK, 2012).

Case 2: MedAfrica

Recently, Shimba Technologies, a local software development outfit, and Nokia launched MedAfrica, a mobile application that provides information about medical solutions upon download with the aim to make healthcare information affordable and accessible to Kenyans. MedAfrica seeks to improve the health of communities and regions in which it operates by increasing access to healthcare-related information and services in Africa. Good health is a universal need that affects the output of communities directly impacting their socioeconomic standing. The MedAfrica app aims to create platforms that facilitate dissemination of information and build communities around the different issues and conditions. "The content in the platform will be provided by the government (courtesy of open data portal), private sector, academia and the general health practitioners (Ndegwa, 2012) The MedAfrica app is currently available for download in Kenya and other African countries with similar infrastructural challenges as Kenya's. The platform will be accessible via a number of channels mobile applications (Java, Nokia, and Android), mobile web, Unstructured Supplementary Service Data (USSD), web and short message service (SMS).

Case 3: SemaDoc

On August 10, 2015, First Lady Margaret Kenyatta quietly launched a service, dubbed Sema-Doc, that promises to disrupt and completely revolutionize the medical care sector in Kenya. In a first for the region, the service seeks to utilize mobile phone and Internet communications to expand the reach of health services in the country. However, the initiative has come in for lots of criticism and skepticism, especially from the medical fraternity. Doctors are wondering how patients will be able to get quality healthcare without actually physically visiting health institutions to be seen and checked by a medic. This situation is compounded by the very poor public health facilities on offer in the country, and which are frequently exposed in the media as little more than excuses of health centres with little or nothing to offer in the way of medical care.

Case 4: ConnectedMed

A Johannesburg-based eHealth startup, ConnectMed founded in 2015, has rolled out their telemedicine platform in Kenya with the aim of providing affordable medical advice to patients outside of a healthcare setting. Through the ConnectMed platform patients can schedule a secure virtual 15 minute doctor's appointment for the same day via any connected computer or mobile device. All the doctors registered with ConnectMed are screened, licensed professionals that are able to provide treatment for over 30 ailments as well as electronic prescriptions, referrals and sick notes.

The benefit for doctors being registered with the platform is that they're able to choose their working hours and save money on marketing, rent and travelling costs. ConnectMed also offers an Enterprise solution ideal for clinics experiencing a shortage of doctors, as it allows them to treat more patients and improve the medical skills of existing staff. During trials in Kenya it became evident that the top adopters of the platform were elderly patients who found it difficult to travel and university students seeking sexual and mental health advice. According to ConnectMed, to make their service more accessible to the general public they plan to roll out physical PC stations in locations such as pharmacies and internet cafes.

Other Initiatives

With the advances in information technology infrastructure in Kenya, various organizations such as AMREF (Computer Aid International, 2013), AAR healthcare services and Safaricom Ltd (Galgallo, 2013) have embarked on telemedicine projects. However, most of these projects stall for several reasons, such as human resources necessary to maintain the projects not being trained and doctors rejecting the idea of seating in a call centre to answer to patient queries. This could be because

physicians work in a different working environment with higher requirements for their qualification, professionalism, ethical behavior, autonomous practice and professional responsibilities. The result is they have dissimilar technology acceptance decision making and readiness. However, most studies that investigate factors that influence adoption of telemedicine in Kenya focus on the infrastructure, government policies and funding overlooking the fact that for an innovation to be successful the consumers, in this case, physicians and nurses, need to accept it and continue using it fully.

Telemedicine in Ghana

Ghana, a developing country in West Africa. In 1957 Ghana became the first African nation to achieve independence from its colonial ruler. Although Ghana has suffered mixed political and economic fortunes, some see Ghana as a model for North – South cooperation [Horton, R. (2001).]. With a wide area of 238,500 square kilometers and an estimated population of 20 million people it is important to realize the significance of healthcare. The life expectancy in Ghana is 57years old [1Horton, R. (2001).]. According to the CIA World Fact book, only 19.6% of the population in Ghana use the internet. Telemedicine is a developing system to better help medical institutions to better use information and technology to treat patients.

It is the use of video and informational systems to help doctors and other medical staffs better diagnose and treat patients Alves, M.,Canoui, E.,Deforges, L.,Garderet,L.,Guidet, B.,Offenstadt, G., &Maury, E. (2012). Through these information systems, doctors can locate articles and information that may have been previously used before to treat patients and use that to quickly and more efficiently treat patients in the future.

Healthcare is a growing issue in Africa, and with the spread of HIV and AIDS on the rise, it is necessary to have the tools required to be able to handle the issue of infecting others. Not only is telemedicine useful in treating patients from a distance, it can help patients who are in rural areas to receive healthcare or information necessary to be treated accordingly. By using telemedicine and the information provided through telemedicine, it can cut down on the amount of hospital space and beds significantly by remotely treating patients. Komfo Anokye Teaching Hospital is the second largest hospital in Ghana Built in 1954, it was known as the Kumasi Central Hospital and help only 500 beds. In 1975 it was converted to a teaching hospital and accredited for postgraduate training by the West African College of Surgeries and now holds 1000 beds. Telemedicine will be a huge step in the right direction regarding healthcare in developing third world countries, yet having proper medical supplies and medicines remain a major issue.

Overview of Telemedicine Infrastructure in Ghana

Ghana's telemedicine adoption rate highly depends on the support of third-party funding and the economic balance of Ghana. There are only seven health centers in Ghana [Novertis. (2011)]. One of the main obstacles hindering the use of conventional healthcare is the distance between each health center. The journey to these health centers often require 4-wheel drive vehicles in order to safely navigate to each center. E- health or electronic Health is one of the most rapidly growing areas of technology in Health today, especially in developing countries like Ghana Novertis. (2014). The use of E-health along with advances in telemedicine will dramatically improve the way patients receive care who may not have transportation to these health centers. Ghana shows promise in their efforts to develop telemedicine and other E-health applications [5].

The Novartis Telemedicine Project is stationed in the Bonasso cluster; this cluster holsters 6 villages and has an estimated population of about 35,000 people. Communities in the cluster are very diverse and separated, most of the villages are separated by miles of unpatched road and challenging terrain making it especially difficult to receive efficient healthcare without having to endure a hazardous journey to one of the seven health centers. This difficulty is furthered by the limited number of health centers, and weather conditions that may make it impossible for some cases to even receive healthcare. Taking into account the several diseases prominent in Ghana such as Malaria, Anemia, Tb, HIV/AIDS, it affects the every health of the patients in the communities. To reduce the danger in traveling and minimize traveling the health centers placed throughout the communities have taken steps to eliminate the risks almost completely. One of the many steps that have been implemented is the use of teleconsultation.

The practice of teleconsultation reduces the time needed and the overall cost of receiving healthcare dramatically [Novertis. (2014)]. Healthcare can be addressed and delegated to those who need it through protocols develops by Med Gate in Switzerland (NTP); the teleconsultation program is being pioneered to adapt and better utilize the techniques implemented by Med Gate. The first step in maximizing efficiency in telemedicine was to evaluate and assess the current need for technology. The next step was to identify and enroll medical staff and important health personnel and enrolls them into a workshop to develop their skill in telemedicine applications; during this phase of the Novartis Telemedicine Project, healthcare personnel and even doctors attended extensive workshops and were presented with mobile technology and more ways to interact with telecommunication applications as well. The benefit of this was to create a skilled group of doctors and medical staff to successfully practice telemedicine and teleconsultation services to reach

patients who do not have transportation to health centers.

With the help of the Ghana Ministry of Communications, several telecommunication stations and antenna were installed across the Bonasso Cluster, this in turn created a better range for telecommunication systems and telemedicine applications. The extended range and signal provided increased network accessibility to over 21 communities and all seven health facilities, which is necessary for the successful implementation of telemedicine throughout Ghana. Through the support of the Novartis Foundation, medical staff were able to procure mobile phones and other telecommunication devices that could be used in the advancement of telemedicine in Ghana. It is clear that telemedicine is successfully being a breakthrough in the advancement of medicine in developing countries.

Future endeavors of the Project include providing 24-hour support to teleconsultation centers, development in logistics, human resources and technical advancements, as well as a greater number of workshops that will be available to staff in order to ensure the proper use of telemedicine applications Einterz, E. (2001). The growth of telemedicine has improved dramatically since 2011. According to an online article written by YomiKazeem, Ghana could soon surpass South Africa, Ethiopia, and Mali in the construction of Telemedicine Kazeem, M., Yomi, K. 2016. A telemedicine consultation center set up in Amansie West provides a round the clock support with experienced medical staff who could provide extensive medical advice over mobile phones and networks. Ghana Health Services reports that 60% of calls were maternity-related and 54% of calls in 2013 were resolved entirely by phone. During the 3-year phase starting in 2012 the Telecommunication Center in Amansie West only served 30 communities but currently they service the entire district.

Case 1 – Teleradiology

With an estimated 250000 citizens whom are Human Immune Deficiency Virus (HIV) positive in the country of Ghana, Africa the need for healthcare and telemedicine is detrimental. Tuberculosis, a potentially serious infectious disease that affects the lungs, is very common among HIV/Aids patients. To ensure proper diagnosis and treatment, radiologic evaluations must be performed. With few radiologists available Ghana has collaborated with UNAIDS Program Coordinating Board to improve this division of healthcare in the country. The World Health Organization (WHO) recommends a ratio of 228 health professionals per 100,000 population. The director of Health Service for Greater Accra region stated the doctor patient ratio was approximately one doctor to 15,259 patients in a year Drislane, F., Frank, W., Albert, A., & Harry, W. (2014). Lack of radiologic interpretation results in higher patient morbidity and mortality. Upon the implementation of teleradiology for

the Komoko Anokye Teaching hospital from 2012-2013 they were able to use X-Ray images from 158 patients. Eighty-six percent of X-Rays performed were chest radiographs, 7.8% were spine radiographs, and the other 5.8% undocumented. Results of this implementation has changed patient management by reducing the time it takes to diagnose and also helped prevent misdiagnosis. Teleradiology has enhanced patient care by collaborating radiologists. Ghana reduced new HIV infections by 53% from 2001-2014. Ghana and the West African Region has addressed the need for better healthcare for particular populations at higher risk. These gains will help move toward an AIDS-free generation.

Case 2 – Teledermatology

With low doctor to patient ratios, dermatologists are few to none in Ghana's community, As access to mobile communication increases dermatologists are now able to use the mobile telecommunications infrastructure to provide "mobile teledermatology", which uses mobile devices to provide dermatologic services at a distance rather than face to face consultations [9]. This study evaluated diagnoses made by 3 Ghanaian dermatologist examining patients face to face compared to a Ghanaian teledermatologists using Samsung mobile platform and a U.S. teledermatologist using a computer. 34 patients with skin symptoms were randomly selected from the cities of Accra and Kumasi in Ghana. As the face to face visits were made images and data were collected with the use of a Samsung mobile telephone and sent to the U.S. and Ghanaian teleconsultants. Through on the phone access to the world-Wide Web-based interface the Ghanaian and U.S. teledermatologists diagnoses were in accordance with the face to face Ghanaian dermatologists. The degree of accuracy comparing face to face visits with the Ghanaian and U.S. teleconsultants were 80%, with eczematous eruptions most common, followed by acne, drug rash, pigmentary alterations, tinea versicolor, and others Osei-tutu, A., Ting, S., Alyx, R., Nathan, A., Rajiv, N., Daniel, S., & Carrie, K. (2013).] Mobile teledermatology is a positive step in the healthcare in Ghana and has helped eliminate costly equipment, providing a cost effective solution.

Case 3 -Teleconsultation

In Ghana it is extremely difficult to receive health care without traveling long distances. Most patients can never make it to a healthcare facility due to the lack of transportation and safe means of delivery to each location. Due to the extreme road conditions and lengthy distances between health centers and communities, patients rarely, if at all, receive healthcare and most likely end up dying or suffering severe illness or disability. Although health centers are placed in highly populated areas, it is the rural areas and communities that need the most help. There are new applications and new means of getting healthcare to these patients as

well. The method that is becoming a standard in healthcare in rural areas is teleconsultation. Teleconsultation is the consultation between doctors and other doctors or doctors and patients on a video link or channel. With teleconsultation the amount of risk involved in receiving healthcare in rural areas can be reduced for the patient. A Teleconsultation service was introduced in the Amansie-Westdistrict in 2010 Opoku, D., Scott, P., & Quentin, W. (2015) it linked communication between the district hospital and the local teleconsultation clinic. The service was placed there to assess the healthcare professionals perceptions of the benefits and challenges of servicing this area, and to identify possible areas of improvement [Opoku, D., Scott et al.. The trial received positive feedback from medical staff and was described a dramatic improvement to the quality of care, which in turn reduced the need to refer patients to the district hospital. Some problems occurred such as phone service delays, stressful workloads on the telecommunication staff, and inadequate information received from phone calls, but steps have been taken to rectify problems that arose. In conclusion, the teleconsultation service had the potential to improve the quality of care to those who needed it the most; however, problems due to technical difficulties threaten the potential effectiveness of the teleconsultation. Through proper training and maintenance, teleconsultation should be the future of medicine in Ghana.

Case 4 – Teleradiology

At Korle Bu Teaching Hospital in Accra, Ghana a study was conducted to analyze nephrectomies performed in adults over a twelve-year span. Nephrectomy is the removal of a kidney and is used for malignant as well as benign lesions. In evaluations of renal pathologies they have used abdominal ultrasound, urography, abdominopelvic computerized tomography (CT) scans and radioisotope renal scans. Over the twelve year study sixty-two nephrectomies were carried out. The average age of the patients was forty-nine plus or minus sixteen years, and the male to female ratio was 1:1. The data was taken and analyzed using a Statistical Package for Social Sciences for Windows operating system version 19. Studies showed that 85% were proven to be malignant, while 14.5% were found to be benign [Kyei, M., Klufio, G., Mensah, J., Gyasi, R., &Gepi-Attee, S.(2015).].

Recommendations

- a) The medical staff should be exposed to telemedicine during training and technicians available to guide them in its usage.
- b) General medical policies should be reviewed to introduce the remuneration of doctors who give consultations using media as a way of encouraging the use of the system.

- c) They should be a limitation to the kind of health care that can be given via telemedicine as many of the other doctors were found to be more hesitant in embracing this technology..
- d) During the establishment of new telemedicine infrastructure the medical staff should be consulted so as to allow for the adoption and use of the equipment.
- e) More medical staff should be encouraged to use telemedicine to improve service delivery.
- f) Because of the unstable nature or lack of electricity supply, hospitals should be equipped with solar energy or stand-by generators.
- g) One way in which the international community may assist Africa to develop telemedicine is by establishing regional centers of excellence in telemedicine, equipped with state-of-the-art equipment for training and research.

GENERAL CONCLUSION

Most African countries have suffered many decades of poor healthcare, a state of affairs usually attributed to the prohibitive costs of setting up public health facilities and training medics. Telemedicine is the future of healthcare in rural areas as well as urban areas in developing countries. With the support of Government-based programs and third-party funding, telemedicine can successfully make its way to patients in secluded and diverse areas. Improvements in Telemedicine project continue to provide telemedicine applications and workshops to educate and inform medical staff and medical institutions so that telemedicine can be effective and affordable. The extended range provided satellites will service rural areas thoroughly to reduce the need and cost of transportation to medical institutions dramatically. Through proper training and methods of distributing technology to doctors, telemedicine will lead the way in cost-efficient, safe, and reliable healthcare provision. African countries are still developing, with a structured healthcare system being set in motion, telemedicine will influence the way medicine is delivered, especially to rural areas.

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