
Review Article

Telemedicine Diffusion in a Developing Country: A Case of Nigeria

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Abstract: Nigeria has continued to suffer major set-back in the area of Public Healthcare which has purportedly resulted in high mortality rate and economic meltdown. According to the United Nations Sustainable Development Goals (SDGs), healthy lives and proper well-being of individuals must be maintained by year 2030. Despite the steady rise in Nigeria population growth, health care coverage continues to be an expensive worldwide epidemic. Telemedicine along with other Information and Communication Technology (ICT) Solutions have played a huge role in ensuring this goal is achieved because of its convenience and benefits. This study explores the various ways telemedicine has assisted in achieving sustainable development goals on Global Healthcare Coverage, it also poses its significance. Questions about current state of telemedicine are also being raised. Systematic Literature review was carried out. Qualitative analysis carried out suggests that telemedicine has proven its self to be necessary and extremely beneficial and is consistently showing signs that it will continue to thrive and service Nigeria, West Africa.

Keywords: Nigeria, Tele-Medicine, SDGs, ICT, and GHC

1. Introduction

Healthcare is a growing issue in Africa, and with the blowout of Acquired Immune Deficiency Syndrome (AIDS) and Human Immune Virus (HIV), it is necessary to have the tools required to be able to handle the issue of infecting others [1]. In 2015, high representatives, Presidents and Prime Ministers met at the United Nations Headquarters in New York, the purpose of this meeting was to introduce and adopt new global SDGs. At the Heart of these SDGs is Goal number three which says “Ensure healthy lives and promote well-being for all at all ages” [2]. Highlights of this goal was to reduce global maternal mortality, prevent deaths of newborns and children under 5 years of age, end epidemic diseases, reduce communicable diseases, reduction in global deaths, ensure universal access to reproductive healthcare services and achievement of Global Health Coverage (GHC). Despite the enormous features of information technology, they have hardly been utilized in the Nigerian health sector [3].

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 [4]. According to [5], telemedicine is a part of Socialized medicine systems which are systems that encapsulates joining of multiple health data sources. 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. By using telemedicine and the information provided via telemedicine it can cut down on the amount of hospital space and beds significantly by remotely treating patients.

In this study, Nigeria was selected and used as case study, present status of telemedicine and how it has either improved or remained constant. We will also discuss the different types of telemedicine systems that have possibly been used. Different case studies will also be discussed as far as how they

have worked and if there were any pros or cons to the methods being used. Lastly, we will discuss the possible future of telemedicine in either improving current methods or starting new ones. The study would adopt qualitative research.

2. Statement of Problem and Objective of Study

In the 21st century, some of the most effective public health interventions are Standard health care delivery, affordability and access to necessary health information [6]. Recent global technological advancements have altered the entire scenario in every field including health [3]. However, recent statistics from the WHO regarding Nigeria health status is disturbing; maternal mortality is 608 per 100,000 live births, twice as high as South Africa's 300 per 1,000 and almost 10 times Egypt's

66 per 1,000, the average life expectancy at 57 years is below the global average, which is as a result of poor health care services [7].

A visit to major health care institutions has also revealed a lot of shortcomings in the health care process. Currently, healthcare is one of the most important and expensive sectors in any economy [8]. Nigeria is yet to fully adopt the use of technology in health care delivery. This study assesses current state of telemedicine interventions carried out in Nigeria.

3. Review of Findings

Due to a lot of security and privacy issues involved, adoption of Telemedicine systems in Africa has continued to be a major challenge.

Table 1. Systematic Literature Review of Tele-Medicine in Africa.

Author	Country	Study Design	Success	Challenges
Adambounou, K., et al. (2012)[9]	Togo	A telephonographic acquisition software for visioconference	A visioconference was possible between the Trousseau university hospital in Tours, the Lomé Campus university hospital and the Tsévié regional hospital, allowing the radiologists at the expert centre	Validation of Intervention
Lester, R. T., et al. (2010)[10]	Kenya	SMS-Based intervention to monitor drug adherence 18+ adults with thw HIV-1 plasma infection	Higher adoption and adherence rates. The SMS intervention was well received by patients,	Minimal training and human resource requirements. Self-reported adherence assessment as used here has been reported to be an over-estimate of adherence
Jingi, A., et al. (2013)[11].	Cameroon	A TELEMED -CAM intervention involving the use of a telemedicine centre along with sms and voice call for communication	Significant effect of an intervention package comprising telecare support on average blood pressure levels hypertension control rates among adults	non-strict random allocation of centers/participants
Ikhu-Omoregbe, N. A., et al. (2006)[12]	Nigeria	A deployable framework for Mobile Telemedicine Applications for Tropical Diseases(MTATD)	MTATD uses medical resources available at health centers to support the health practitioners.	Not Mentioned
Mikrogianakis, A., et al. (2011)[13]	Botswana	Determine telesimulation among group of physicians in Botswana	Good cor-relation in remote versus onsite scoring of skill testing	Not Mentioned

The major priority in Nigeria, our case study is to formulate a means of making use of available IT tools to leverage healthcare delivery. Below are some case studies reviewed:

3.1. Telemedicine in Nigeria

According the Chief Exective Officer of Telemedicine Africa, telemedicine guarantees reduced patient waiting times in an efficient and cost effective manner [14]. In addition, [15] opined that high broadband penetration rate and the country's highly impressive internet speed will determine the success of telemedicine in South Africa and its positioning as a major tool in ensuring effective healthcare services in the near future. Telemedicine is still an experimental tool by health practitioners in Sub-Saharan Afrcia. As far back as 2010, some Nigerian higher institutions such as UNILAG announced the development of their own telemedicine solutions [15]. Erstwhile Chief Medical Director, Professor Akin Osibogun, attributed the success of the telemedicine solutions to government. Medical consultations in Nigeria are

carried out in hospitals and other medical facilities, leads to increase in the number of deaths due to delay in reaching health facilities. Experts profound a solution to this via telemedicine. Lack of adequate medical doctors have led to increase in mortality. The World Health Organization requires that a country maintains a standard doctor-patient ratio of 1:600. Nigeria's currently doctor-patient ratio is at 1:3500 [16].

3.2. Overview of Nigeria's Telemedicine Infrastructure

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 [17]. China Great Wall Industry Corporation, the sole commercial organization authorized by the Peoples Republic of China to provide satellites aided the successful launching of the satellite in 2007 [18]. The satellite was based on the DFH-4 platform and equipped with 4 C-band, 14 Ku-band, 8 Ka-band

and 2 L-band transponders [19]. 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 rural areas, far from the country's professional health facilities [20]. 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.

In April 2008, NigComSat-1 lost power from the southern solar array, forcing a delay on the telemedicine initiative operations. The satellite failed woefully in November 2008 owing to a technical error from the satellite's northern solar array [19].

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 [21]. 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 trenched 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 [22]. 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.

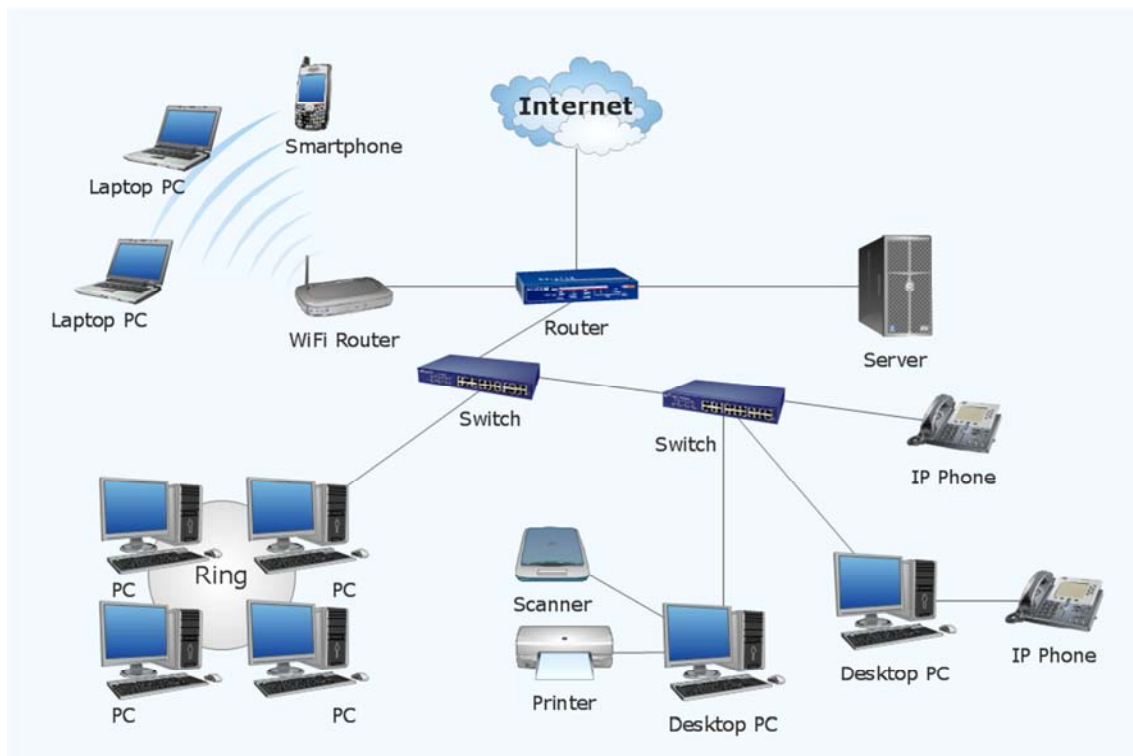


Figure 1. Telecommunications setup (Military Embedded Systems, 2016).

Medical activities in Nigeria takes place in hospitals or other medical facilities. As a result, many patients die due to delay in reaching health facilities most especially those in rural areas [23], stated that in Nigeria, a doctor is expected to have physically examined a patient before administering treatment. Most medical consultations in Nigeria are done physically as patients have little or no faith in technological means [23]. Many patients have lost their lives waiting for days, sometimes months just to see a doctor due to not enough

space in hospitals or sometimes distance [23]. Nigeria is the highest populated and one of the most economically developed nations on the African Continent. Telemedicine delivers more than \$6 billion a year in health care savings to U.S. based corporations [24]. According to [24], 37% of employers expect to offer their employees telemedicine consultations as a low-cost alternative to emergency room or physician office visits for nonemergency health issues, and another 34% are considering offering telemedicine for 2016 or

2017. The use of telemedicine will continue to increase as well as lower general healthcare cost.

Before constructing a technical infrastructure, an organization must first consider what types of telehealth services will be provided. There are several types of telemedicine that allow remote communication for doctor-patient relationships; real-time, remote patient monitoring, store-and-forward, and hybrid consultation [25]. Different types of telemedicine require different technical infrastructure setups, however, nearly all telehealth programs require access broadband, technology imaging or peripherals, staff training and access to technical support staff [26]. Some of the telemedicine equipment used to extend medical services to citizens around the country include: telemedicine carts, kiosks, digital cameras, kits, software, mobile medical devices [27].

3.3. Specific Cases of Telemedicine Projects in Nigeria

Case 1 - Barton Associates and VSee, a HIPAA-compliant telehealth app and video conferencing software company, recently partnered to examine the company's telemedicine field kit in a Shell oilfield in Nigeria. Shell, a multinational oil and gas company and longtime user of VSee has benefited from the app's delivery of clear video and real-time data to workers in remote, hard to reach areas and often harsh environments [28]. The companies collaborated to test the prospect of using the VSee telemedicine kit to convey telehealth services to employees working at the Bonga Field offshore of Shell Nigeria, Nigeria's first deep-water oil field that contributes about 10% to Nigeria's oil production. [29]. The Sea Eagle, one of the field's floating oil production rigs, or FPSOs, lays about 20 kilometers off shore and has only one medical personnel, the expertise of this personnel is focused on just general first aid and providing remedies for minor complaints such as muscle ache and respiratory tract infections [28]. With a limited health care capacity and long, tedious journey to shore, it is easy to imagine how much an impact the use of telemedicine would have on the workers on the oil rig. The VSee telemedicine kit enables all personnel to get a full medical examination for any illness. In one case the Sea Eagle clinic did a full medical illness test drive of the telemedicine kit on one of their patients' referred to as Mr. Bio, who communicated directly with a U.S. board-certified cardiologist about his concern over a recent high blood pressure reading. First, an evaluation was carried out using the telemedicine kit's portable medical devices. Next, he got physical feedback from Dr. Robert Shiroff who contacted him from Nevada, USA about his previous blood pressure readings from the pulse oximeter, e-stethoscope, and EKG monitor. Dr. Shiroff explained to Mr. Bio, in detail, the effects change in environment has on his blood pressure and recommended that he take the test again in a few days after adjusting his work schedule. Finally, the doctor ended the consultation with a conversation on the advantage of lowering blood pressure through a healthier lifestyle. They discussed how daily physical exercise, reduction in salt and sugar intake, weight reduction can assist in lowering his blood pressure and

improve state of wellbeing. The use of telemedicine allowed a remote consultation that provided Mr. Bio with completely new information that allows him to improve his health and overall well-being.

Case 2 - Another case that displays the use of telemedicine takes place at Obio Cottage Hospital in Port Harcourt, one of 27 medical centers in South-South Nigeria. A one-month old baby boy had been admitted to the hospital for about 6 days with a severe cough coupled with high fever. Medical doctors prescribed antibiotics which reduced the fever, however, his cough subsisted. The doctors concluded he might be suffering from common upper respiratory tract infection because of his rapid breathing and ordered a chest x-ray. During a virtual doctor visit with Dr. Michael Parrino, he assured the doctors that they were on a right track with the current antibiotic treatment and that the baby's belly looked normal. Dr. Parrino noticed the baby's rapid breathing so they used the e-stethoscope and pulse oximeter to determine the baby's heart beat rate. Dr. Parrino also discovered that the baby also had a relatively high heart beat rate for his age and concluded the call with suggesting an echocardiogram to rule out a congenital heart disease or defect. The experience gave inspired the doctor and encouraged the power of enabling local and remote doctors to work together through telemedicine [28].

Case 3 - Implementation of telemedicine has not only been beneficial to individual citizens of Nigeria, but has also assisted Nigeria on a mass scale. As part of its 4Afrika initiative, the software giant, Microsoft, has provided financial, technical and mentorship support to transform Sabaoth Technologies Ltd, Nigeria's foremost e-health and telemedicine consultancy firm. [30, 31]. With the assistance of Microsoft, Sabaoth technologies have developed the All Purpose Medical Information System (APMIS) on the basis that technology provides the most effective way to disrupt the entire healthcare delivery system [32]. APMIS is Nigeria's number one and only medical care platform that makes it possible for medical care facilities to capture, store, and exchange relevant data at an affordable cost, easily and securely [33]. Recently, APMIS of Sabaoth Technologies have agreed on terms with 40 private and public healthcare facilities in Cross Rivers and Akwa Ibom states. This agreement allows APMIS to provide and digitize the records of more than 10,000 patients into APMIS in a hospital in Ilorin, Kwara State. APMIS continues to reach thousands of citizens in Africa with over 182,000 patient health registrations documented electronically and over 10,000 prescriptions assessed electronically [34].

4. Discussion

The role played by telemedicine has aided in assisting patients, easing health care disaster during major events and epidemics. Telemedicine has also been grabbing the attention of those around the world and showing them that telehealth systems have improved and continue to improve daily. Being that telemedicine is limited due to lack of facilities, it has been

adopted by the few doctors and nurses who are equipped to operate the telehealth systems. In order for an even more efficient system there must be a few promising acute success factors that could help SSA as a region.

Telemedicine is an important asset in the healthcare system and is most significantly used in times of disaster. However, in Nigeria, telemedicine is in high demand because the country does not have many updated resources to begin with. This makes the telemedicine indispensable to the country of Nigeria because of what has provided. Multiple steps have to be taken in order to keep telemedicine an essential tool in the country of Nigeria. Without structure and a blueprint, the project would fail tremendously in the end. In general, if the companies who provide telemedicine in SSA take the following steps, the positive movement will be maintained [35]:

- a) Vision Layout: This will display where the project wants to go as far as setting certain goals, and completing milestones. Listing strategical objectives is important as well. Observing what audience to impact is a start for telemedicine programs. During this step, the initial costs should be established as well as ways to have access to the actual health care program.
- b) Finance Layout: In this step, the program should consider funding and support strategies. There should be short and long term financial goals in order to keep the program running in good condition. During the finance layout is where revenue models and strategic ways to save costs should be inputted.
- c) Location: Telemedicine is virtual, meaning that the necessary equipment should be accessible when a patient is seeing a physician. Rooms should be laid out just like regular patient room. Things to take into consideration are lighting, privacy, and a patient-like atmosphere. It is important for the telemedicine program to establish a fond location to conduct valuable work.
- d) Training Programs: Training programs is necessary, in order to secure successful practices on those in need. Trainings should include the technical aspect, along with communication. When dealing with another life, it is important to stress the realism and approach while training. This is where the protocols are developed.
- e) Enough Doctors on call: A problem stressed in Nigeria was the doctor to patient ratio. A main reason the telemedicine was invented was for this reason. Therefore, programs have to keep a certain amount of doctors on call at any moment. Time waits for no one and health problems are developed at any given time.
- f) Market: The more people know about Telemedicine, the better ways it can be used and the more success it will have. It is a win-win situation when everybody knows about the program because lives are saved along with the business meeting financial goals. If not many people know about the successes of telemedicine, the business will not fully serve its purpose.
- g) Hierarchy: Every successful movement starts with great leadership. It is imperative to have the right people in

charge, in order to keep the hope of Telemedicine alive.

5. Conclusion and Future Work

Telemedicine has opened up a world of healthcare by building bridges from patients in remote, underdeveloped countries to adequate healthcare that at one point seemed inaccessible. Nigeria is one of the many examples of countries that have benefited tremendously from telemedicine. Combating many issues by being cost effective, addressing shortages of healthcare providers, supporting clinical education programs, and increasing access to health care telemedicine seems to have become the solution to a devastating problem effecting many Sub-Saharan countries [36]. With the implementation of different software, apps, programs, and new cutting-edge equipment, telemedicine continues to grow and help the people of Nigeria and countries facing the same issue. Telemedicine will soon be just another way to see a health care professional, video-based communications such as skype [37]. Telemedicine has proven to be very important and tremendously beneficial and is consistently showing signs that it will continue to thrive and service the country of Nigeria and surrounding Sub-Saharan countries just like it.

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