

Assessing the Level of E-Health in Africa Using Nigeria as a Model; Barriers and Innovations

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Abstract

Despite the growing success in global e-health and transition of most health care system to a more accessible form of health care for all (e-health), not all countries or parts of the world find it easy to adopt this trending health format. Most countries are posed with huge challenges with e-health transition. This study is aimed to highlight some challenges faced by most countries especially the Low-and Middle-Income Countries (LMIC) in Africa, using Nigeria as a model in the transition to and adoption of e-health. There are a number of possible limitations/barriers to the adoption and full scale implementation of e-health in Nigeria, some which include; Poor leadership and governance, Legislation, Policy and Compliance, Infrastructure, and Workforce etc. Thus for a full scale implementation of e-health the aforementioned must be properly considered and solution proffered. Some of such solution may include implementation of a robust nationwide implementation of Electronic Medical Records (EMRs) both in the primary health care centers and all health care outlets in the nation, regular dissemination of the right health information to a targeted population (caregivers, patients, etc.) through designated medical apps, and so many others.

Keywords: e- Health; m-health; COVID-19; Electronic medical record

Introduction

There has been some age long saying that "Health is wealth" which is true as it's only a person who is healthy that begets and enjoys wealth. Again, there has been a saying that "Water is life" and that's true as well, water indeed breathes and gives life. However true these sayings are the fact remains that Health determines our quality and standard of life. Health indeed, gives meaning to life, in most severe cases, certain illness or disease deprives one or takes away life's meaning. Let's take for instance, the present global pandemic that has posed a major public health threat and has equally put a huge strain on not just the global health but also on the global economy and our individual daily and social life activities. The pandemic has caused a major disruption/change to life's meaning, the way we

go about our daily life and how we interact with others. The quagmire and perplexity faced with ensuring a safe and healthy environment for all is as a result of the increasing/continuous emergence of diseases that requires intervention. Still on the pandemic instance, prior to the COVID-19 pandemic, the corona viruses were known to be a Zoonotic disease that is usually transferred from animals to humans. However, with the emergence of the human to human transmitting strain of the virus, which has held the world to ransom, there has been a significant increase in the public demand for health care. This further exposes the wobbling standard of health care in most developing countries and the strong need to improve the standard of health service by scaling-up existing e-health technology applications or providing more innovative means to ensure a healthy society. It's for these reasons and more that health remains a global challenge and concern. Now, let's talk about the meaning of health, what exactly does it mean to be healthy?

However, before talking about health, let's first identify what hygiene is all about, as one can't talk about health without talking about hygiene. Hygiene is from a Greek word "Hygeia" which means "the goddess of health". Thus, hygiene is referred to as the practice or principle of keeping yourself and your environment clean in order to maintain health and prevent disease. Some of these practices include bathing, washing your hands, coughing into your elbow and so on. Good personal hygiene is very important in today's society for both health and social reasons. It is vital in stopping the development and spread of illness and infection. Maintaining a good hygiene is very crucial and equals having a quality health. Now, what exactly is health? Health according to the constitution of the World Health Organization (WHO), enacted on April 7, 1948 [1]. Health is defined as a state of complete physical, mental and social well-being. Before this definition by the WHO, the meaning of health in the past has changed over time, health in the biomedical paradigm, was defined as the body's ability to function; a state of normal function that could be disrupted from time to time by disease. Another example of such definition of health is; a state characterized by anatomic, physiologic, and psychological integrity; ability to deal with biological, psychological and social stress. Nonetheless, the WHO definition now includes requirements by which a person is can be declared healthy [2]. Although, this definition was well received by some as being

innovative, it was also criticized as being vague, excessively broad and was not designed to be measurable or feasible. For a long while, it was set aside as an impractical ideal and most discussions of health returned to the practicality of the biomedical model. The WHO definition elaborates more on health as it describes the different types and kinds of health which is not dependent only on criteria of abnormality identified by a medical practitioner. Health as a physical well-being means that the particular individual is physically whole with no visible or observable deformity or challenge however, physical well-being alone is not sufficient enough to affirm an individual to be healthy, not all physically whole individuals are healthy some maybe experiencing one mental health issue or the other (Depression, Trauma, Anxiety, etc.) and thus even though they are physically whole still, they can't be said to be healthy as they haven't completely met all other requirements of a healthy individual. People with certain mental health problems are prone to have a strain in their social relationships with others which in turn affects their social well-being.

There are a number of factors that influences the health of individuals and communities. Circumstances and Environment are known to be the determinants of whether people are healthy or not. However, to a broad extent, factors such as where we live, our environmental state and surrounding, genetics, our income, level of education, and relationship with friends and family all have considerable impacts on health, whereas the more commonly considered factors such as access and use of health care services often have less of an impact [3]. More so, the context of people's live determine their health and so blaming individuals for having a poor health or crediting them for good health is inappropriate. That being said and in addition to the aforementioned, the main determinants to health are summarized into settings including:

- The Social and Economic Environment.
- The Physical Environment.
- The person's individual characteristics and behaviors.

The above listed factors and determinants particularly social influence on behavioral interaction further impacts the progress of health by influencing the adoption and uptake of health care information technology in various settings despite its proven recorded success. These health care information technologies are generally referred to as Information Communication Technologies (ICTs).

Materials and Methods

Information and Communication Technologies (ICTs)

Although there is no universally accepted definition for Information and Communication Technologies (ICTs) which is a broader term for Information Technology (IT). However, ICT refers technologies used to convey, manipulate and store data by electronic means, which include e-mail, Short Messaging Service (SMS), video chat (e.g., Skype, Zoom), and online social media (e.g., Facebook, Instagram). It also includes all the different computing devices (e.g., laptop computers and smart phones) that carry out a wide range of communication and

information functions [4]. Furthermore, ICTs include; the internet, wireless networks, software, middleware, social networking, and other media applications and services enabling users to access, retrieve, store, transmit, and manipulate information in a digital form. There are so many other definitions of ICT, each defining in its unique style and language, one of such definitions is that ICTs are also used to refer to the synergy of media technology such as audio-visual, telephone networks and computer networks by means of a unified cabling system (including distribution and management of signals) or link system [5]. However, as earlier stated there is no universally accepted definition of ICTs considering that the concepts, methods and tools involved in ICTs are steadily evolving on an almost daily basis. From the above given definitions, one can deduce that there are a variety of uses of ICTs in a good number of industries. The advent of ICTs ushered in an era of innovations in different industries and sectors. Industries across all sectors can leverage the power of information and communication technology, for instance, the benefits of ICT in teaching and learning often referred to as e-learning, include the development of new, innovative ways to interact and communicate with students, higher engagement rates, faster learning and improved teaching methods. ICT also plays a key role in the global economy and poverty reduction. The internet, email, collaboration software and other ICT tools help connect all local and central government department, improve living standards, and assist international economic integration and more. It has found its use and application in Agriculture and it's referred to as eAgriculture. Other uses and applications of ICTs include, eCommerce, eBanking, eBusiness, and so on. Most importantly, ICT has further found its application in the health sector. The advent of health care information technology (as referred to as ICT) has shown significant progress and success in the health care system a lot of illnesses or diseases that seemed undetectable and undiagnosable can now be detected and diagnosed, this gives hope to the previously neglected asymptomatic individual in any given disease population. The application of ICT in health is generally referred to as e-Health.

e-Health

The term ehealth was barely in use before 1999, but afterward has become a generally used word to characterize not only "internet medicine" but also virtually everything related to computers and medicine. The term was first created and used alongside other "e-words" (e-commerce, e-business, etc.) by industry leaders and marketing people rather than academics. This further gave rise to some controversy in establishing a definition to e-health in an academic environment. Due to the dynamic nature of e-health and its uses and application it's said that stamping a definition on something like e-health is somewhat like stamping a definition on 'the internet'; It's defined as it is used [6]. The definition cannot be pinned down, as it is a dynamic environment, constantly changing. However, e-health can be defined as an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a

state of mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.

According to the Pan American Health Organization (PAHO), e-health is the application of Information and Communication Technologies (ICTs) to health and a means of improving health services access, efficiency and quality [7]. Prior to the advent of e-health, generally access to health services were done in-person and with the increase in disease emergence and the increasing number of people who are sick and the increasing cost of maintaining the generally sort after global health, access to these health services became difficult and narrow by the day. The global mortality rate at the time was rapidly sky-rocketing, most especially in areas and regions with endemic tropical neglected diseases. The poor quality of health obtained in those areas resulted in the deaths of women and children in their numbers to these so-called neglected diseases which were as a result of many misdiagnosed cases. However, with the advent of ICTs in health a significant improvement has been recorded in this endemic population. Most diagnosable disease was now detectable using these technologies. Let's take for instance, the case of the asymptomatic individuals in malaria endemic populations like Africa. This unique population has greatly contributed to the incessant malaria transmissions obtained in this malaria-endemic population as they serve as parasite-reservoirs for transmission. However, these individuals have in the past, escaped detection and therefore can't be diagnosed thus, frustrating the efforts of malaria interventions. Worst still, is that these individuals show no known signs or symptoms associated with malaria. Fortunately, with the intervention of ICTs in health (e-health) and the application of highly sensitive technologies such as the Single Nucleotide Polymorphism (SNP)-genotyping/barcoding, Polymerase Chain Reaction (PCR), qPCR, and qRT-PCR which possess a remarkable low limit of detection, these asymptomatic individuals are presently detected and diagnosed within the population. This further impacts the potential to accelerate the malaria-transmission curve to zero. Aside the aforementioned, there are other applications of ICTs in health and components of health, some of which among others includes; Electronic Medical Records (EMRs), e-learning and continuing education in ICTs for health professionals, interoperability, and standardization, telemedicine and telehealth, and most common of all m-health.

m-Health

m-Health is a component of e-health, more like a subset of e-health. m-Health, just as e-health has no standardized or established definition till date. However, according to a survey conducted by the Global Observatory for e-Health (GOe) series Vol. 3, m-health (mobile health) is defined as a medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, Personal Digital Assistants (PDAs) and other wireless and/or wearable devices [8]. It involves the use and capitalization on a mobile phone's core utility of voice and Short Messaging Service (SMS) as well as more complex functionalities and applications including General Packet Radio Service (GPRS), third and fourth generation mobile

telecommunications (3G and 4G systems), Global Positioning System (GPS), and Bluetooth technology. m-Health presently has a growing application in all spheres of the health care system for instance, following a recent announcement by the Brigham and Women's hospital on m-health intelligence health care media, the Boston-based hospital plans to launch an m-health program to track medication adherence for patients who have been prescribed opioids, using Covectra's control track mobile health platform in the program, which gathers connected health data from providers and pharmacists and calls on the patient to track and transmit medication use in real time.

Results and Discussion

Nigerian health care system and application of ehealth in Nigeria

Despite the strategic position of Nigeria in Africa and having been referred to for years as "the giant of Africa", the country still, is greatly under-served in her health care sphere and has suffered several down-falls. The Nigerian health care had suffered several infectious disease outbreaks year after year and each time leaves the health system weaker than it was. Being a crucial component of national security, public health not only functions to provide adequate and timely medical care but also track, monitor, and control disease outbreaks. Since after Nigeria got her independence in 1960, the country has embarked on several national reform attempts including reforms and developmental programs in health care delivery. Successive Nigerian Government has adopted different National Development Plans (NDP) to help address development challenges in the country at different regimes. Some notable achievements in the NDP for the health sector include the 1975-1980 NDP that witnessed a significant progress in health care facilities within communities and villages through the Basic Health Service Scheme (BHSS). The subsequent NDP (1981-1985) further grouped health care services to be delivered across 3 levels of care within the public sector which include; the primary, secondary, and tertiary health care systems which also reflects the three tiers of government in Nigeria which are Local, State, and Federal Government (**Figure 1**) [9].

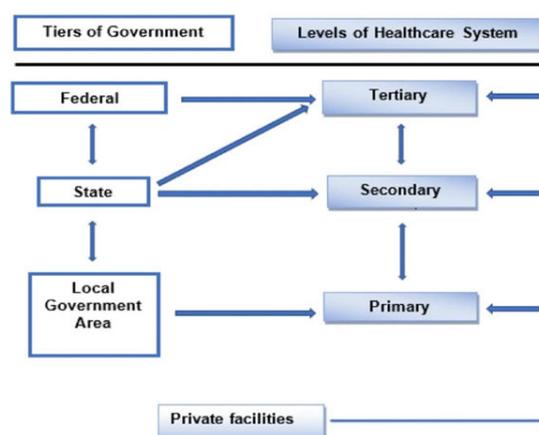


Figure 1: Levels and structure of health care delivery in Nigeria [9].

There are 774 Local Government Areas (LGAs) in Nigeria and these LGAs are responsible for the management of the nation's primary health care system, they are however supported by their respective state ministries of health as well as private medical practitioners. There are sublevels the primary health care system includes the villages, districts, and LGAs. The ministry of health at the state level manages the secondary health care system. Patients at this level are often referred from the Primary Health Care (PHC), which is the first level of specialty services and is available at different divisions of the state. The state primary health care comprises of laboratory and diagnostic services, rehabilitation etc. The teaching hospitals and specialist hospitals provide the tertiary health care for patients. The federal government at this level, works also with voluntary and NGOs, as well as private practitioners [10]. However, this is not what's obtainable at the present day Nigerian health care systems due to the crippling of PHCs by the continuous lack of the necessary funds, infrastructure, adequate staffing and qualified personnel to maintain these facilities within the communities. Thus, what's obtainable is that, the usual first point of call for health care services are the secondary and even tertiary health care without the proper reference from either a primary health center or secondary health care as the case may be. This change and gap in health care deprives rural communities and the vulnerable populations access to adequate, basic health services when in dire need of it, hence, resulting in unnecessary loss of lives in these communities. Let's for instance a situation which took place in a rural community in Nigeria, a little child while playing out with his fellow kids sustained an injury which subsequently due to lack of proper health services festered as a result of a tetanus infection, the child later on died as there were no functional health center nearby. This could very much have been prevented if there was a functional primary health center nearby that could have administered a tetanus toxoid injection or better still, if the parents, guardian or a member of that community had the slightest basic health care training or information of washing and carefully cleaning of the wound surface and carefully protecting the wound from any form of infection until it heals there are high chances that the child would have lived. There are a number of such cases every year, all of which could have been prevented if there is access to health care services or the right health information. Besides the aforementioned reform, there are still other health care reforms launched in Nigeria such as the ten-year developmental plan which was launched before the country's independence in 1960 to enhance health care delivery, there's also the Nigerian Health Insurance Scheme (NHIS) established in 2005 as an effort to revitalize the worsening state of health in the nation [10].

The above stated reforms have their individual levels of success or impact in Nigeria's health care system however, they weren't sufficient enough to meet the increasing demand for health services and the need for proper documentation and inventory of patient's medical history. Hence, the need for the implementation and adoption of e-health in the Nigerian health care system to help revitalize the worsening state of nation's

health care and to meet the country's demands for proper and effective health services. The benefits of e-health system to the institutions could be summarized as; effectiveness and efficiency in the process, easy accessibility to patient's record, organized database, improved protection and security, aid proper decision making and finally, enables visualized resource allocation [11]. Following the rate of global adoption of e-health into national health care systems, the Nigerian health care systems were not left out, as most Nigerian medical experts believe that electronic health (e-health) and mobile health (m-health) have the capacity to ensure Universal Health Care (UHC) by increasing enrollment in the Nigerian Health Insurance Scheme (NHIS) and rendering health services to rural and hard to reach areas. They are confident that introduction of these technologies will reduce misdiagnosis and over-diagnosis of diseases, medical errors, fake medicines and poor health outcomes in Nigeria. Some concerned stakeholders are exploiting the growing worldwide and nationwide popularity of mobile phones, smart phones, and other mobile electronic devices to create more convenient health care for all [12]. However, just as the popular saying goes "necessity leads to innovation", the necessity to ensure adequate, easily accessible health services has led most Nigerian entrepreneurs to aptly seize the opportunity that has given rise to many local innovations such as

- Online health insurance subscription by Avon Health care Limited.
- Telemedicine by Kangpe Healthcare and Mobidoc (a mobile wellness platform) who provide users with online access to health information from doctors.
- Blood center services by Life bank; a blood transportation start-up that smartly connects blood banks with hospitals and mobilizes voluntary blood donations.
- Electronic Medical Records (EMRs) by Helium Healthcare; helium health care provides EMRs services for a number of hospitals in Nigeria, though this is not widespread yet.

More so, some tech-savvy entrepreneurs have further developed and launched several medical apps that provides the general public with different forms and aspects of health services for instance, there are presently apps on maternity and childcare such as the Omomi (meaning my child) childcare app, there are some focused on health and fitness (e.g. mypaddi app), some others allow users connect with health professionals to seek medical help and call for ambulance faster, others simply helps users locate nearby health facilities through a GPS navigation. Additionally, according to the Nigerian Food and Drug Regulatory Agency (FDA) referred to as National Agency for Food and Drug Administration and Control (NAFDAC) [13], in 2010 the Agency deployed a Mobile Authentication Service (MAS) Scheme as one of the counterfeiting strategies to detect substandard and falsified medical products (e.g. Drugs). The scheme was designed to make use of scratch codes and Short Messaging Service (SMS) as a means to verify the authenticity of medicines, this verification can be done at the point of purchase thus, and putting the power of detecting counterfeit in the hands of those most concerned the consumers. After the consumer scratches the panel (usually silver coated) on the product which reveals a unique, one-time use PIN, the consumer sends the PIN toll-free to a short code using any GSM operators

and then receives an almost instant response in form of a text message (SMS) stating the details of the product as either genuine or suspected fake. Furthermore, the filling of form to report Adverse Drug Reactions (ADRs) is presently done online without having to visit any of the agency's offices therefore, making reporting ADRs easier and accessible to all.

Barriers of eHealth in Nigeria

Despite the aforementioned progress and applications of e-health in Nigeria, there are still some major limitations and barriers that influence the full scale implementation and adoption of eHealth in Nigeria, which must be properly addressed for the full success of eHealth application in Nigeria. These barriers have held and hinder the progress of e-health adoption and implementation in Nigeria thus, has kept the level of Nigeria's e-health adoption at the lower ebb. A good number of studies have addressed different areas of limitations and barriers to eHealth in the Nigerian health care system. However, for this study, barriers to eHealth would be addressed under three major fundamental divisions or categories which include.

Individual or personal barriers

This comprises cognitive, motivational, accessibility, level of education, and trust-related barriers of individual consumers, all of which can influence how consumers especially non-health care professional relate to and accepts these e-health technologies [14]. More so, the perceived usefulness of these technologies, low literacy level and experience in using the e-health technology applications, belief, willingness, as well as the attitude of healthcare professionals have a profound impact on the intention and desire to adopt and use the e-health technologies; without the right motivation, trust, belief, willingness as well as attitude and most important the accessibility to these technologies by their intended users, there can be no adoption nor full scale implementation of e-health technologies in the routine health services. In rare cases where these technologies are available in health facilities they still end up not being properly utilized or optimized partly as a result of the lack of robust expertise of the technologies or limited power supply, which brings us to the next category of the barriers to e-health.

Environmental and organizational barriers

This includes organizational structures, political barriers, financial issues, legislation and national policies on the implementation of e-health technology applications, poor leadership, administration, and governance, present government's disposition to e-health, all these constitute environmental and organizational barriers. This category of barriers to e-health is said to be the most disturbing of all forms of barriers as it also influences other forms of barriers. One major organizational barrier to e-health is the issue of finance and lack of adequate funding for the health sector in Nigeria. Nigeria's yearly budget for her health sector is highly below the recommendation and benchmark of the World Health Organization (WHO), which requires all countries to allocate 13% of their annual budget to the health sector [3]. However,

Nigeria's budget for her health sector has been within the range of 4.4% (2016) and 4.1% (2017) [15]. In 2020, even with the hit of the dreadful pandemic Nigeria budgeted only 4.14% of her annual national budget for the health sector, which is grossly inadequate in comparison with other developing countries. Furthermore, the inadequate supply of electricity in Nigeria greatly affects the implementation of e-health technologies. What essence is there in purchasing these technologies to facilitate health service if there's no electricity with which to power and use them? This and so much more dampen the spirit and willingness of health care professionals to adopt these technologies.

Technical barriers

This encompasses the user friendliness of these technologies, unsuited services or design not fitting to the user's needs, poor functionality of the technologies and high level techniques required to operate them are all among the technical barriers. Designing highly technical devices for use in the health care increases the likelihood of apathy for e-health technology applications, consumers become bored easily and would rather sort after a manual format that to take up a highly technical technology even with its proven accuracy and efficiency.

Additionally, security concerns of these technologies possess another form of barrier on its own, because most often systems and network-enabled medical devices fail to provide an acceptable level of security. Furthermore, most of the medical devices have missing support system (who to call help if the need arises), missing standards for both patient data and for data exchange, and missing system feedback leading to unclear benefits are all forms of barriers for e-health services [14].

Potential innovations and possible interventions for e-health in Nigeria

Having identified the level of e-health and its specific areas of applications in Nigeria and also addressed some of the barriers to e-health in the country, let's look at possible innovations and areas of interventions which can improve the level of Nigeria's adoption, implementation or application of e-health technologies in their routine health services.

Electronic Medical Records (EMRs)

This is a digital application that allows hospitals and health care facilities store patient's medical information electronically in contrast to the manual paper format that unfortunately is still in use in most Nigerian hospitals. There are so many drawbacks to the use of manual paper format of storing patient's information that EMRs has been able to address. With EMRs patient's information can easily be accessed both offline and/or online, there are also a number of added features that comes with it that can never be found using a paper archiving system [11]. Most EMRs applications have an option to automatically contact and inform patients once there test results are ready. One of Africa's top EMRs application providers is Helium Health care; they also provide this service to a number of hospitals in Nigeria with the capacity to purchase it. However, there is still a

strong need for a general, nationwide use and application of EMRs in Nigeria.

e-Health card

This is a smart ID card small enough to fit into a wallet or pursue ease in mobility; it can be likened to the popular credit cards commonly referred to as Automated Teller Machine (ATM) cards. The e-health card is designed to contain medical records as well as doctors' prescriptions for the patient, and will provide access to the patient's Electronic Medical Record. This can easily save cost, time and lives as it reduces the over-dependence on a single personal doctor or hospital for one to receive medical treatments and services in a case of an emergency. This also reduces the delay in time to ascertain a patient's blood compatibility details in a case emergency and unconscious patient in dire need of a blood transfusion. This will really be beneficial as it can allow the patient make use of any nearby health facility and still have their records accessible by a medical practitioner who has no prior knowledge of the patient [16].

Medical/health apps

This refers to digital applications on mobile phones that provide relevant health information to users. This sort of health information can come in handy in communities or in situations where there's little or no access to a nearby health facility, these apps provide the user with basic health information and steps to take in such situations to save lives. Although there are a number of such apps that have been developed in Nigeria however, the problem remains that there's little or no awareness about these apps and when the intended users aren't aware of these useful products they can never be able to take possession of such wonderful opportunities. Therefore, there is a need for proper awareness and communication of the benefits and uses of these apps to their intended users in order to achieve their intended purposes [17].

Furthermore, there are still other forms of e-health innovations/interventions and technologies that are and can be very useful to improve and revitalize the Nigeria health care system. Some of such interventions include; establishing a robust technology infrastructure that supports e-health system, provision of high speed broadband width internet services to support the use of these technologies, adequate investment in e-health technologies and proper funding of the health care.

Conclusion

This study identifies the current structure of the Nigerian health care system, its weakness and the level and presence of e-health application in Nigeria and areas in which e-health technologies can improve and revitalize the crippling state of the health care system of Nigeria. The study further provides different areas of e-health in which some Nigerian entrepreneurs have been able to seize the opportunity of the necessity for easy access to adequate health care services. From

the findings of this study, most of the applications of e-health in Nigeria are not yet widespread throughout the nation. Most of the target audience/consumers of these e-health technologies are either not aware of the existence of these technologies that would significantly improve their standard of health outcome and even those who have knowledge of these technologies are either resistant to adopting them or lack the technical capacity and literacy to utilize these technologies. Aside the aforementioned, there are yet other barriers to the adoption of e-health in Nigeria which are highlighted in this study. More so, the study highlighted potential innovations and possible interventions of e-health in Nigeria, and also target areas for the scaling-up of e-health technology applications in Nigeria.

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