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E-HEALTH AND TELEMEDICINE PRACTICE IN NIGERIA (1999-2017): CHALLENGES AND PROSPECTS

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ABSTRACT

Background: *One of the global milestones in medicine is e-Health – which is about leveraging on ICT to deliver efficient health care services to citizens. Nigeria with poor infant and maternal indices, poor physical infrastructures and scarce health practitioners is expected to leverage on the potentials of e-health to strengthen the country's health service delivery by fully adopting the right policy framework for ICT in the health.*

Objectives: *To assess the extent of adoption and practice of e-health and telemedicine in the country between 1999 and 2017; and the current benefits, challenges and prospects of implementing them in Nigeria.*

Method: *Relevant literatures were reviewed from medical journals, textbooks, library search, Yahoo and Google search and internet scientific publications.*

Results: *Although e-health and telemedicine were introduced in Nigeria about the year 1999 and 2007 respectively; it was not until 18 years later, that the e-Health Steering committee and the National e-Health Strategic Framework document were inaugurated and produced respectively. Recent assessments of e-health growth showed that Nigeria has moved from an early adoption (experimentation) stage to developing and building up stage. The implementation of e-health initiatives in the country has been largely piecemeal and uncoordinated; and existing pilots were rarely scaled- up. Most e-health initiatives witnessed were largely delivered by the private sector. Underfunding, inadequate human resource capacity, poor electric power supply and internet connectivity, low level of awareness of e-health and its benefits, are among the main challenges of e-health in the country.*

Conclusion and Recommendation: *Nigeria is yet to enthrone a full utilization of e-health to maximize its benefits especially in strengthening Nigeria's healthcare system. For an effective adoption and sustainability of e-health in the country there should be provision of adequate power supply, effective broad band internet connectivity, improved funding of e-health, continuous stakeholders' education, and incorporation of e-health and telemedicine into medical/health training curriculum.*

KEYWORDS: *E-Health, Telemedicine, Practice, Benefits, Challenges, Prospects, Nigeria*

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INTRODUCTION

Overview of E-Health & Telemedicine

Electronic Health (e-health or e-health) is a new terminology for healthcare practice powered by electronic processes and communication, coming up as early as 1999 in Nigeria.[1] The World Health Organization (WHO) defines Electronic Health (e-Health), as the use of information and communication technology (ICT) to support healthcare.[2] Eysenbach G, a well known e-health ace sees it as a developing field in the interaction between medical informatics, public health and business.[3] The e-health is like an umbrella of all that happens in the space of health and information communication technology (ICT). Thus, whatever tool or services of ICT that is used in health care, is e-health. E-Health therefore comprises several component applications relating to medicine and ICT, including:[4] **Electronic Health Record** (EHR): which enhances access to patients data by the various healthcare professionals (GPs, specialists *etc.*); **Telemedicine** which is about getting a health care delivery over a distance to a population that does not have access through a phone call. This distance could be geographical or it could also be another location within the same system (e.g. a hospital) whereby you need to have access to a senior healthcare provider for second opinion. The health care services provided range from physical and psychological diagnosis, and treatments to tele-monitoring of patients' body functions over a distance; START!!!**M-Health** which includes the use of mobile devices in collecting health data at patient level, providing healthcare information to practitioners, researchers and patients; doing real-time monitoring of patient vital signs, and direct provision of care via mobile telemedicine; **E-Prescribing** which involves having access to prescribing options, printing prescriptions to patients and sometimes electronic transmission of prescriptions from doctors to pharmacists; **Computerized Physician Order Entry** which is a means of requesting diagnostic tests and treatments electronically and receiving the result; **Clinical Decision Support System** making available protocols and standards to use in diagnosing and treating patients electronically to healthcare professionals; **Customer Health Informatics** which involves the use of electronic resources by healthy individuals or patients to access useful information on several medical topics; **Health Knowledge Management**; which provides physicians access on the overview of latest medical journals, best practice guidelines or epidemiological tracking (examples include physician resources such as MEDLinx and Medscape); **Virtual healthcare teams**; consisting of healthcare professionals who collaborate and share information on patients through digital equipment (for transmural care); **Health Informatics and Healthcare information Systems** which refer to software solutions for appointment scheduling, patient data management, work schedule management and other administrative tasks surrounding health; **Medical Research using grids** which has powerful computing and data management capabilities to handle large amounts of heterogeneous data; **Cyber medicine** which is the use of the internet to deliver medical services, such as medical consultations and drug prescriptions. It is the successor of telemedicine, wherein doctors would consult and treat patients remotely via telephone or fax.

One of the global milestones in medicine is e-Health – leveraging on ICT to deliver efficient health care services to citizens. As part of achieving the Millennium Development Goals, the World Health Organization (WHO) have developed the e-Health initiatives that focus on the adoption and use of ICT for health systems development, the enhancement of a wider access of the public to health information and education and the execution of effective public health action through the collaboration and contribution of many stakeholders which includes citizens, health professionals, institutions, health authorities, researchers, academia and industry. The WHO also, sees e-Health as a cost-effective and secure means of using information and communications technologies (ICT) in support of health and health- related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research. [2] The

importance of deploying ICT tools to health cannot be overemphasized. The key declaration of the World Summit on Information Society (WSIS) is aimed at using the potentials of ICT among others to reduce infant mortality rate, improve maternal health, combat HIV/AIDS, Malaria and other diseases. To achieve this, WSIS prescribes the connection of villages, health centres, hospitals, scientific and research centres with ICTs and the establishment of community access points. It also emphasized the development of human capacity for e-health and to encourage a public private partnership (PPP). It must be stated that the introduction of ICT to the health sector especially in the developed world, has helped to bridge the relationship between patients and health service providers, and improve the transmission of data from institution to institution and the communications between health professionals. [5]

Nigeria is currently practicing 19th or 20th century health care system in which ICT tools are scantily and sparsely deployed; the healthcare delivery system highly fragmented, and where physicians, hospitals and other healthcare organizations function autonomously. [6] Patient's role is passive with little or no control over treatment decisions as they mainly rely on the physician's training and experience for guidance, while the physicians rely on their own experience to make best decisions. In sharp contrast, "medical practice in many developed and developing countries are now in stage four (4) healthcare developments which is the health system of the 21st century. In stage four (4) healthcare practice, healthcare organizations have the characteristics of high performing organizations and focus on the six aims for improvement: safety, effectiveness, patient-centeredness, timeliness, efficiency and equity. Patients have as much control as they want over treatment decisions; and services are coordinated across practices, with generous use of ICT systems." [5]

Nigeria seems to lag behind in embracing e-health to address the challenges in its healthcare system. The country loses more than N81 billion annually to medical tourism.[5] With poor physical infrastructures and small numbers of health practitioners, e-health has the potential to strengthen the country's health service delivery once the right policy framework for ICT adoption in the health industry is adopted as has been the case in countries like India, Rwanda, Kenya and Uganda.[5] Although the country had on the 10th March, 2016 ratified the National e-Health Strategic Framework (2015-2020) document during the 58th session of the National council of health as the roadmap for strategic adoption and application of ICT in health, and had equally gone ahead and inaugurated e- health steering committee on the 14th September, 2016; much fears are still being expressed in several quarters as whether the national e-health project will not naturally go down the way of others considering the high failure rates of many reforms in the past. It is therefore advised that the present government should muster strong political will and sustained commitment to guarantee maximum support in the area of adequate funding and provision favourable enabling environment to make the project succeed.

The major advantage of e-Health is that it facilitates the communication of patients' data between different health care professionals via electronic health records. It encourages treatment at a distance and real time monitoring of patients via telemedicine. It also includes the use of mobile devices in collecting patients' health data for easy transmission to medical practitioners and researchers. Although the "e" in e-Health generally refers to "electronic", Eysenbach G. has expounded the meaning of the 'e' in e-Health to serve as a definition of the purpose of this technology: [3] Efficiency - e-health promises to increase efficiency in health care and thereby decreasing costs through avoidance of duplicative or unnecessary diagnostic or therapeutic interventions through enhanced communication possibilities between health care establishments, and through patient involvement; Enhancing quality of health care for example by allowing comparisons between different providers, involving consumers as additional power for quality assurance, and directing patient streams to the best quality providers; Evidence based e-health interventions in a sense that their effectiveness and efficiency should not be assumed but proven by rigorous scientific evaluation; Empowerment of consumers and patient by making the

knowledge bases of medicine and personal electronic records accessible to consumers over the internet, e-health opens new avenues for patient-centred medicine, and enables evidence-based patient choice; Encouragement of a new relationship between the patient and health professional, towards a true partnership, where decisions are made in a shared manner; Education of physicians through online sources (continuing medical education) and consumers (health education, tailored preventive information for consumers); Enabling information exchange and communication in a standardized way between health care establishments; Extending the scope of e-health care services from those of simple medical advice and counselling to more complex interventions or pharmaceutical products which consumers can easily obtain online from global providers; Ethics - e-health involves new forms of patient-physician interaction and poses new challenges and threats to ethical issues such as online professional practice, informed consent, privacy and equity issues; Equity - to make health care more equitable is one of the promises of e-health, but at the same time there is a considerable threat that e-health may deepen the gap between the "haves" and "have-nots". People, who do not have the money, skills, and access to computers and networks, cannot use computers effectively. As a result, these patient populations (which would actually benefit the most from health information) are those who are the least likely to benefit from advances in information technology, unless political measures ensure equitable access for all. The digital divide currently runs between rural vs. urban populations, rich vs. poor, young vs. old, male vs. female people, and between neglected/rare vs. common diseases. In addition to these 10 essential e's, e-health should also be easy-to-use, entertaining (no-one will use something that is boring!) and exciting.

Electronic health records (EHR) involves the use of computer software to gather, collate, analyze and store health data. It has been around for a while, since the 1950's and since then many hospitals and doctors in the U.S (over 78 %) and most of Europe (80 % in the U.K) have opted for the electronic health record over paper records. The reason for the switch is quite obvious to industry experts, as this improves efficiency and overall quality of the healthcare delivery process; boosts the confidence of consumers in their healthcare provider; saves cost; provides accurate health data (not mere estimates) that help government plan policies and for monitoring and evaluation of current hospital policies. [7]

E-Health in general, and telemedicine in particular, is a vital resource to remote regions and communities in developing countries, but is often difficult to establish because of the lack of communications infrastructure. [7] In many African states and communities, the majority of the local people face a lot of challenges in terms of access to medical care due to difficult financial situations, severe weather conditions, inaccessible facilities due to flooding during the rainy seasons in some places and even significant lack of facilities and trained health professionals. [8] There is also no access to e-Health because there is no internet access in remote villages, not even a reliable electricity supply in most places. Internet connectivity, and the benefits of e-Health, can therefore be brought to these regions using satellite broad band technology. Satellite often remains the only solution where terrestrial access may be limited, or of poor quality, and one that can provide a fast connection over a vast coverage area. [9] Knowledge of the socio-economic performance of e-Health is limited. This is because the socio-economic evaluations of e-health are somewhat difficult to assess due to the fact that the domain of e-Health is very broad and large having too many variables; tortuous, intangible cause and effect links. However, socio-economic evaluations of some narrow types like m-Health can rely on health economic methodologies. It should be noted that findings from evaluations are however, often challenging for transfer to other settings. [10]

General objective: To review the adoption, benefits and challenges of e-Health and telemedicine practice in Nigeria between 1999 and 2017. The specific objectives include: 1) To ascertain the extent of e-health and telemedicine initiatives and practice in Nigeria from 1999 to 2017. 2) To determine the benefits and prospects of e-health and

telemedicine practice in Nigeria in from 1999 to 2017. 3) To investigate the barriers/challenges of e-health and telemedicine practice in Nigeria from 1999 to 2017.

METHODOLOGY

Relevant literatures were reviewed from medical journals, textbooks, scientific publications, library search and internet using search engines like Google, Yahoo and PubMed. Key words or their combinations like; e-health, telemedicine, electronic health records, health information systems; benefits, challenges and prospects of e-health were used to guide the search.

Inclusion and Exclusion Criteria: All topics or literatures related to the key words or their combinations were included for the search and analyzed. All topics or literatures not related to the key words or their combinations and / or not written in English language were excluded for the search. About 57 articles were collected and analyzed, and out of these 34 of them were selected based on their relevance. The analyses of the later revealed the historical development and present status of e-health and telemedicine in Nigeria, the current benefits and challenges of the practice across the country. The implications of the findings could be used to guide future research in this field.

Results on the Extent of E-Health & Telemedicine Initiatives and Practice in Nigeria from 1999 to 2017

The actual practice of e-health in Nigeria can be traced back to 1999; although efforts to develop telemedicine and e-Health in Nigeria started in 1994. Federal Government of Nigeria (FGN), first showed commitment to the use of ICT to deliver health services as explained in the National Economic Empowerment and Development Strategic (NEEDS) document (e-Health seen as a component of e-Government). The Department of Planning, Research and Statistics of Federal Ministry of Health (FMOH) tried to produce necessary documents for e-Health development and deployment in 1996. However, available information have shown that until 1999, ICT use in Nigeria was next to nothing until development of ICT policies for the telecommunication sector in 2000 and the establishment of the National Information Technology Development Agency (NITDA) to formulate a national policy for ICT in Nigeria in 2003.[11]

It was not until April, 2005 when a group of professionals from diverse background founded the Society for Telemedicine and e-Health in Nigeria, that the e-health and telemedicine gradually came to the limelight. [12] The Society for Telemedicine and e-health in Nigeria (SFTeHIN) is an affiliate of the International Society for Telemedicine and E-health; and the former resumed a prominent role and pushed on the agenda for implementing telemedicine and e-health in Nigeria. At that time not much was known about this aspect of health, and people did not understand what this is all about or how it works. The SFTeHIN took the first challenge and responsibility of providing advocacy and communication, building momentum and increasing awareness on e-health technology to the public, private sector and government. The sustained efforts of this association culminated to the hosting of the first national stakeholders meeting on telemedicine and e-health on October 27, 2005 during President Olusegun Obasanjo's regime.[12]

Borne out of the recognition for the opportunities that ICT presents to support health system strengthening and the achievement of health system goals, the Nigerian Federal Ministry of Health (FMOH) and Federal Ministry of Communication Technology (FMCT) led the multi-sectoral and stakeholders' development of the National Health Information and Communication Technology (Health ICT) Strategic Framework between late 2014 and the first half of 2015. The draft framework, which incorporates the effort and inputs of over 150 public and private health and technology sector stakeholders, is a three part document that articulates the collective vision and necessary actions of stakeholders involved in the health system in Nigeria. The framework was fashioned after the WHO-ITU e-Health Strategy toolkit,

which was adopted as the guide through the development process. The framework draft followed assessments of the current state of Nigeria's e-health enabling environment to identify gaps in policy, legislation, governance, regulatory, standards, infrastructure and capacity. It is designed to position Health ICT within the current context of the health system. This means addressing and delivering universal health coverage (UHC), which is a major national health priority of the Federal Government of Nigeria by 2020.[12, 13] Drawing from the recommendations for Health ICT vision to support the achievement of UHC and other health system goals and activities, an action plan was developed. The action plan activities which are to be executed over a five year period and segmented into three phases would be supervised by the National Council of Health (NCH), as owner of the Health ICT vision. The NCH would be guided and supported by the Health ICT Steering Committee, Project Management Office and Technical Working Group. [13]

The report, assessing the enabling environment for ICTs for Health in Nigeria, also, identified the need for a coordinated Health ICT Strategy. The reason was that the rapid growth of ICTs in the country has ushered in a proliferation of technology applications in every sector of our lives, including the health sector without appropriate guidance and coordination; and such development if allowed unchecked could weaken the health system, through duplication of efforts, resultant wastage and inefficient use of lean resources. It was in recognition of the above facts that the draft document of Nigerian National e-Health Strategy was ratified and approved on the 10th of March 2016 at the 58th session of national council on health meeting held from the 7th to 11th of March, 2016 in Sokoto, SokotoState. [12] Nigeria's National Health strategic Framework 2015 – 2020 (aka e-Health Strategy) is now the roadmap for strategic adoption and application of ICT in health for health impact in Nigeria. The approval of framework is widely seen as the turning point for Health ICT and perhaps Health in Nigeria. The National e-health Strategic Framework provides a vision and guide for alignment of current investments in technology within the health sector towards a digitized health system that will help Nigeria achieve Universal Health Coverage by 2020.[14]

The National e-Health strategy provides an over-arching guide to harmonizing and focusing ICT interventions – in health – along government priorities and towards the achievement of these priorities. The benefits of this strategy include ease of coordination of e-Health activities by government and stakeholders in the sector to reduce duplication of efforts; and it would make the implementation of standardized registries for health information exchange easy. The Strategic Plan would enable the Nigerian Health sector also identified the need for the deployment of ICT to healthcare delivery in urban and remote parts of the country; and would focus on the creation of a national health information systems (a national medical web portal), a telemedicine programme, practitioners' data exchange, public awareness in disease prevention and human capital development using ICT/Online education. [12] The e-Health Steering Committee was also inaugurated in Abuja on 14th September, 2016 to address some of the challenges bedevilling the Nigeria's health sector, ranging from data collection and management to those of human resources and issues of universal health coverage. The aim is to guide and monitor e-Health implementations, by setting rules, policies, guidelines and standards to guide stakeholders and to improve quality of care and access; and also, to increase availability of healthcare services to the teeming population of Nigerians especially in remote and rural areas. [15]

The initial entry of telemedicine into Nigeria was through mobile units or vehicles equipped with satellite receivers and operated by the Federal Ministry of Health. However, since 2001 when the global system for mobile telecommunications (GSM) found its way into Nigeria, a lot of achievements had been recorded in the ICT sector; and services that are technologically-driven have been delivered via GSM networks. It was in 2007, when National Space Research and Development Agency (NASRDA) and the Federal Ministry of Health (FMOH) inaugurated its pilot project

on telemedicine in two teaching hospitals and six federal medical centres in the six geopolitical zones of the country. The teaching hospitals were the University College Hospital, Ibadan and the University Teaching Hospital, Maiduguri. The Federal Medical Centres included those in Owo, Gombe, Makurdi, Yenagoa, Birnin-Kebbi and Owerri. Apart from the public institutions, private organizations such as the Lagoon Hospital, Lagos and the Igbinedion University Teaching Hospital, Benin also embraced the use of the technology. In addition, a pilot project implementation that involved mobile-units or vehicles equipped with satellite receivers was unveiled. [14] In 2010, a telecommunications service provider pioneered the Mobile Doctor concept, whereby customers could speak with a qualified health personnel or medical doctor at the rate of N100 (about 68 cents) per minute. This service so far, has not been widely utilized due to the huge costs involved. [15] Today, telemedicine systems are supported by State of the Art Technologies like interactive video, high resolution monitors, high speed computer networks and switching systems, and telecommunications superhighways including fibre optics, satellites and cellular telephony. ` The use of telemedicine has spread rapidly and is now becoming integrated into the ongoing operations of hospitals, specialty departments, home health agencies, private physician offices as well as consumer's homes and work places. [16]

Although, several pilot e- health initiatives have been carried out throughout the country by the federal government, partners and the private sector since 2006; their implementation have been largely piecemeal and uncoordinated, and existing pilots were rarely scaled- up. [17] Quite few assessments had been conducted in terms of measuring exactly where we are in terms of adoption and practice of e-health since 2005. Some of the findings indicate that Nigeria is gradually moving towards a matured ICT environment. [17] However, the general conception is that e-health is still at its experimental phase in Nigeria where we are trying to see how we can tap into its potentials. In other words Nigeria is transiting from experimentation and early adoption to developing and building up. It will be necessary therefore to think of accelerating the implementation of the Health ICT Strategic Framework in order to advance the enabling environment and support scale-up of initiatives. However there are hopes that with the development of entrepreneurship around the problems of health informatics bedevilling the country today, the case note may be pushed into the museum of modern medicine where it belongs just like the bucket latrines and anaesthesia-less surgeries.

Most of the e-Health initiatives witnessed in Nigeria is driven by the private sector and the story has hardly changed even after the approval of Nigeria's National e-Health Strategy in 2016. Nigeria began to witness e-Health initiatives in areas like mobile drug authentication and blood donations among others. The use of mobile phone has also helped in the fight against drug counterfeiting. With an SMS enabled technology driven by Sproxil, a global brand protection specialist, consumers can determine if a drug is fake or not by just sending an SMS via their mobile phones. Recently, a group of software developers in Nigeria came to solve the problem of access to safe-blood, developed an application called Life bank that makes it easy to give and receive blood in Nigeria. In Ondo State, the state government's Abiye Safe Motherhood project which provides a mobile phone for each registered pregnant woman free of charge, and with a toll free prepaid by government to access and ensures information flow with health practitioners, has drastically reduced the maternal and infant mortality rate in the state. [18]

The adoption of electronic medical record system has been occurring at a very slow pace throughout the country. It is quite appalling to note that about less than 1 % of healthcare organizations in Nigeria today make use of e-health technology (particularly EHR) for service delivery. [19] It has been observed that no public hospital either at State or Federal level in Nigeria has fully utilize the electronic medical record; and while some hospitals use it for some aspects of documentation (like registration of patients, billing and stock taking), there is zero usage for real consultation. It has been

observed that most hospitals in the country still do more of paper work and talk more about electronic medical record system than putting it into practice. Despite such setbacks, it is impressive to note that some private hospitals like Abuja Clinics and the Nigerian National Petroleum Corporation (NNPC) hospital have achieved almost 100 percent adoption of electronic medical record services. [20] The Federal Medical Centre, Keffi, has gone a little bit far in the use of electronic medical records, more than any other public hospital so far in the area of patients' registration, consultation, laboratory investigation, pharmacy, stock and billing including inpatient consulting services; are all electronic. [21] The story are different with the National Hospital, Abuja; the Maitama District Hospital, Federal Medical Centre, Nguru and University of Maiduguri Teaching Hospital which among others only use electronic medical records for documentation, which is in registering patients. [20]

The e-health project in Lagos State started as far back as the 5th of January, 2009 and is being implemented in phases to involve teaching hospitals, all the 25 secondary and about 60 primary health care facilities in the state. With their Hospital Management Information System (HMIS) brand, any patient coming to the Hospital is registered on a Central Database and the doctors managing the patient will have access to update the medical records (including investigations and treatment) of the patient. Currently only 5 modules: Electronic health records; Consultation, Nursing, Pharmacy and Physiotherapy is being utilized. [20]

Some other e-Health initiatives or projects in Nigeria include: [22] Intel telemedicine/e-Health project between Federal Medical Centre, Bida, and the National Hospital, Abuja, for critical paediatric care as well as surgical cases; FCT e-Health pilot (the FCT e-Health web Portal Initiative) – an online portal that seeks to manage patient data/statistics and to close any existing gap between primary and secondary health systems by linking data across health facilities; mHealth project with the National Primary Health Care Development Agency (NPHCDA) used in the Midwives Service Scheme (MSS); Mobile Community Based Surveillance (mCBS) project designed to give traditional birth attendants the ability to report vital MCH events in real time using mobile phones; India Pan African e-Health Network project at the Universities of Ibadan and Lagos Teaching Hospitals to help provide trans-border tele consultation and training of workforce; A pilot project initiated by National e-Government Strategies Ltd in 2006 to provide tele consulting in cardiology with the use of video conferencing equipment and digitalized electrocardiography machine to Abuja communities; Adoption of District Health Information System (DHIS) as a national tool for reporting aggregate data from the lowest to the highest level; Establishment of a national e-Health data/documentation centres to provide central coordination for national health data/information for all health programmes of FMoH; UNICEF supported mHealth initiative which involves the use of Rapid SMS to track the supply of malaria bed nets as well as using Rapid SMS to pilot a child nutrition monitoring system; Saving One Million Lives (SOML) The Federal Government in January 2013 also launched an initiative called 'ICT for Saving One Million Lives' (SOML) to promote a result based approach to tackling the challenges Nigeria face in delivering health care services. [15]

Some health companies driving some of the e-health initiatives in Nigeria are briefly highlighted below. The list here is in no way exhaustive but players in this field are quite few and it can barely be said that an ecosystem exists today. [19]

E-Health Africa: Is an international organization founded by Evelyn Castle and Adam Thompson. It is based in Germany but has operations in Liberia, Sierra-Leone and in Northern Nigeria. It has been able to successfully deploy low-cost, low-power equipment to one health facility in Kano and has been active in disease surveillance and notification for Polio and Ebola in the region through the use of open MRS software.

E-Health Nigeria: e-Health is based in Kano, Nigeria and Santa Ana, CA. This organization provides health management information system to hospitals and private health clinics in both urban and rural parts of Nigeria. It implements an electronic medical records system (MRS) using the Open MRS platform. E-Health Nigeria has six major active projects viz.: e-Health Institute of Human Virology, Nigeria (IHVN), in the design, development, and deployment of a Clinical Information System, based-on Open MRS, for 27 health facilities in Nasarawa State, Nigeria. Similarly, in January 2011, e-Health Nigeria developed the mCBS platform, based on Rapid SMS. The mCBS platform collects SMS reports from traditional birth attendants, community health extension workers, and community midwives, about vital events related to maternal and newborn health. Vital events reports are forwarded to a community response team of health professionals based at Ahmadu Bello University Teaching Hospital in Zaria, Nigeria for emergency response and follow-up care.

One Medical: This is a strictly EHR company based in Lagos which aims to make it possible for Nigerian healthcare institutions to go digital using their simple, instant and free platform.

Swift Practice EMR: Based in Abuja, has been able to serve a number of centres within the Abuja metropolis and environs.

Curacel: A Nigerian start-up that has built an affordable and easy to use electronic health information management system for clinics in developing countries.

The All Purpose Medical Information System (APMIS) is Nigeria's connected healthcare platform. It handles electronic health records (EHR) system or hospital management software (HMS) for various health institutions. They are arguably the biggest players in the field today. APMIS is currently implementing in Nigeria largest and most complex health Institution, University College Hospital (UCH) Ibadan, a 955 bed hospital with 750 physicians, 250+ consultants, 33 clinical departments, 4200 work staff with an annual patient load of over 165,000 outpatients and over 14,000 inpatient admission. It has over 45 wards and over 10 outpatient clinics, as well as, other healthcare facilities across the country. [23]

Results on the Benefits and Prospects of E-Health & Telemedicine Practice in Nigeria from 1999 to 2017

E-health has been defined as an amalgamation of healthcare system and Information Communication Technology (ICT) to enable better health and healthcare delivery [24]. According to Silber, e-Health is an application of information and communication technologies (ICT) across the whole range of functions that affect health. [25] It has been rightly argued that the National Bureau of Statistics can only put straight the country health indicators including maternal, infant and under five mortality figures if there is complete adoption of *e-health* in the country where readily available accurate data are channelled into a central pool system from across the hospitals in the country. [18] The followings have been listed as some of the benefits of e-health deployment in Nigeria: [18]

The use of electronic medical records (EMR) to securely keep a digitized record of patient medical history. b) The existence of EMR allows prompt communication of patients with their doctor, transfer of records among specialists and reducing the number of repeated tests. c) Patients are also able to educate themselves on preventive remedies or lifestyle changes that will help improve their outcomes to disease. d) *E-health* really allows the doctor to practice medicine more safely and efficiently. The availability of electronic records reduces medical errors, gives the doctor concise and accurate medical histories of patients and allows for prompt referral to specialist colleague if that is necessitated. e) *E-health* would allow policy makers in government the ability to gather, collate and analyze data retrospectively and in real time to allow for efficient budgetary allocation of scarce funds. f) On the economic front, the full adoption of *e-health* will create a new

vibrant economy in Nigeria which will generate good paying jobs for IT professionals, software developers and researchers; health economists and insurers who will significantly contribute to our GDP, expand our middle class and help reduce our dependence on oil.

Several Other Benefits Derivable From Deploying E-Health/Telemedicine in Nigeria Include

Access to Quality Medical Care in Hard-To-Reach Areas: Patients in rural areas and other remote places may benefit from telemedicine by way of getting the medical services they need as if they are physically present in a clinic or medical facility. Telemedicine allows rural residents to receive expert diagnosis and treatment from distant medical centres. Through video conferencing for example, patients may report their concerns with their doctors even if they are in remote areas. The patient's location is basically not a hindrance to avail of medical services when telemedicine is available or implemented. Thus, patients in remote locations have equal access to quality medical healthcare as those in the urban areas.

Better and Faster Care For Patients: Telemedicine also enables medical practitioners to easily and quickly communicate with other specialists and caregivers regarding a patient's condition without the need for leaving the hospital. With the availability of electronic devices, exchanging medical information is made faster and easier. With telemedicine, doctors will be able to respond quickly to patients needs and more options will be available for them to give the best care. Telemedicine helps doctors in distant and remote areas to avail themselves of timely consultations with specialists without going through long hours of travel across geographical divides.

Improved Knowledge and Skills: Telemedicine can help different categories of health workers, primary care physicians, providers, specialists and patients to update their knowledge and skills when they interact amongst themselves and share vital information, current health practices and experiences. With regular communication with other medical practitioners (specialists) for example, their knowledge and information regarding medical cases will also improve and therefore translate to enhanced skills and improved services to patients.

Wide Choice of Consultation and Referrals: A patient's medical records can be viewed by several doctors so as to clearly identify the problem. This enables patients to consult with any physician throughout the world before deciding to go to their offices for assistance. It enables more informed decision making and enhanced quality of care. Nevertheless, the benefits of e-health may take some time to be noticed as the hospital workers may need time to familiarize themselves with the new technology. Also, the store and forward system captures patient provisional diagnosis and the necessary tests conducted in one hospital; which can be forwarded to the referral doctor in another hospital. This doctor can then re-examine the test results and propose treatment to be sent via the same route. [20]

Benefit of Prompt Treatment and Management Plan: The instant or easy access to medical information provided by telemedicine makes it easier for any medical team to provide the appropriate treatment and management plan for patients. With telemedicine, patient treatments may be commenced immediately with the result of improving patient's overall health and/or recovery from disease.

Reduction of Health Care Costs: The practice of telemedicine also helps lower medical costs for patients and healthcare providers. It creates more efficient, convenient and potentially more cost effective delivery of care. On the patient side, unnecessary trips to the doctor's clinic or healthcare facilities are avoided or efficiently scheduled with telemedicine services like video conferencing or basic email-sending for example. For healthcare providers, the costs of unnecessary transfers to other facilities may also be avoided if there is proper exchange of medical information via telemedicine platforms.

Telemedicine has been shown to reduce the cost of healthcare and increase efficiency through better management of chronic diseases, shared health professional staffing, reduced travel times, and fewer or shorter hospital stays. [20] The deployment of EHR systems in health care delivery could save billions of dollars; in fact, one such study indicated the systems could save up to $81 billion in healthcare costs annually, as well as improve healthcare quality. [5]

Increase Access to Patients' Medical Records: A great advantage of e-health is that it enables better access of patients' medical records. It eliminates the requirement of digging through different file rooms so as to locate a certain file. Through e-health, all the necessary files are placed in a central database and thus doctors can look at whichever medical records they need, particularly during emergencies. This helps the patients also as they no longer require getting their records from one hospital to another when they are seeing new doctors. The doctor can log into the database, thereby being able of accessing all the records. Electronic filing systems that are done using computers are also more efficient than the traditional paper filing systems.

Performance of Advanced Procedures: With e-health, doctors are capable of guiding each other through difficult procedures so as to prevent medical errors. During a high risk surgery, a surgeon can do the procedure while the other surgeon (probably more experienced in the procedure) provides him or her instructions via a webcam, supervising the whole procedure to make certain that nothing wrong happens. The attending doctor may even ask some questions during the procedure, enabling them to ensure that the procedure is going on well.

Real Time Update of Medical Records: Electronic medical records stored in the computer or data base is always available to users in different locations, such as doctor in clinic, nurse in ward or radiologist in x-ray department and so forth. At every visit, patients' clinical reports and laboratory test results are updated and added to patient's record as soon as it is ready and can be made available to other doctors or any healthcare providers at any other time or location.

Facilitation of Medical Teaching, Learning and Research: Telemedicine can be used as a teaching tool, by which experienced medical staff can observe, show and instruct medical staff in another location, a more effective or faster examination techniques. [21] E-health helps bring together the views of leading researchers and biomedical professionals, practitioners from around the globe from a series of high level discussions and workshops using web cams, video conferencing and teleconferencing and other ICTs.

Real Time Monitoring of Patients Health: Some e-health real-time monitoring devices can be used to monitor patients and provide early warning of patients' health deterioration. For instance, a multi-parameter patient's monitoring system can be used to continuously monitor the vital signs of acutely ill patients, to provide early warning signals of biomedical deteriorations which can then trigger the intervention of a medical emergency or critical outreach team. Mobile phone based tele-health can also be used as tracking device and to monitor and improve the management of patients chronic conditions like diabetes, asthma, and hypertension. Telemedicine enhances senior wellness and preventative care through telemedicine and remote in-home monitoring.

Promotion of Universal Health Coverage: e-Health plays a vital role in promoting universal health coverage in a variety of ways. For instance, it helps provide services to remote populations and underserved communities through tele-Health or mHealth. It facilitates the training of the health workforce through the use of eLearning; and makes education more widely accessible especially for those who are isolated. It enhances diagnosis and treatment by providing accurate and timely patient information through electronic health records. Through the strategic use of ICT too, it improves the operations and financial efficiency of health care systems. e-Health has a crucial role to play in the diagnosis and

management of Important causes of morbidity and mortality in Nigeria like malaria, TB, malnutrition, HIV/AIDS, parasitic infestations, typhoid fever, pneumonia, complications of pregnancies and deliveries, hypertension and diabetes mellitus. Others include strokes, cancers, sickle cell disease and accidents, coronary artery disease and pulmonary arterial embolism, amongst other conditions and related complications.

Reduction of Medical Tourism Abroad: Full deployment of e-health care services across the country will bring about great reduction of cases of medical tourism abroad. The country loses more than N81 billion annually to medical tourism. [5] In essence, large sums of money spent by the government officials and some wealthy individuals on medical tourism abroad can be reduced to a minimum when doctors and / or patients in Nigeria can consult with specialist doctors outsides the country and across other continents of the world using tele-health technology. The essence of telemedicine is to provide specialist medical care where there is no specialist.

Results on Barriers / Challenges of E-Health & Telemedicine Practice in Nigeria from 1999 to 2017; and Conclusion & Recommendations

The practice of e-health and telemedicine has not been widespread in Nigeria. Although several factors are involved; the main reasons can be summarized to include the following: high cost of installation and maintenance of equipment; inconsistent electricity supply; low levels of awareness of the advantages of EHR; reluctance of the health workers themselves to change their method of operations; and the abysmally low government funding of healthcare among others. The main challenges hindering full adoption and practice of e-health in Nigeria include: Low levels of awareness of the advantages of e-health especially among people at the very remotest parts of Nigeria who have no access to e-health. Similarly, many hospitals in Nigeria are yet to fully embrace e-health. The only way forward is advocacy and communications. Also the high prevalence of cyber-crimes (privacy violation, identity theft & fake websites): create vulnerability of patients' privacy and confidentiality and this is another ethical challenge in using e-health services, due to unprotected accessibility and potential abuse of confidential medical information via information technology.[26] A lot of diagnostic websites are fake and unreliable, and wrong information obtained can lead to incorrect diagnosis and cause false complacency or anxiety. Inadequate human resource capacity is another **barrier**: the Federal Government has called for enhanced man-power and capacity building to overcome the numerous challenges to adopting e-Health system in Nigeria. During the 10th Nigeria Conference on Telemedicine and e-Health, the government identified low capacity of health workers as major challenges in adopting e-Health in Nigeria. The improvement of healthcare system through effective use of telemedicine and ICT supports can only be achieved when e-health is properly deployed and operated by sufficiently trained professionals. Many Health professionals such as pharmacist, medical doctor, nurse, medical laboratory scientist, etc; have not acquired adequate trainings or requisite skills to effectively run e-health services in the country. If staff of medical health care fail to acquire the skill or may be resistant or fearful of using ICT in hospitals it will be difficult to be current and access vital information for the betterment of the patient, and also difficult to inculcate the knowledge into potential scientists (students).[19] Furthermore, epileptic electric power supply remains a big challenge facing full adoption and sustainability of e-health and telemedicine processes in the country. The power supply in both urban and rural areas of the country is grossly inadequate, epileptic and frustrating in terms of supporting critical e-health devices, applications, equipment and infrastructures. Therefore, battling challenges like unavailability of electricity and network services are crucial if Nigeria hopes to deliver efficient ICT enhanced healthcare service to its citizen nationwide especially the hard-to-reach areas. Again, resistance to change the old way of doing things: Some of the factors mitigating against the implementation of electronic medical records in Nigeria include the poor political (management) will to do it and poor

attitudinal change of the attending doctors.[27] There is usually that strong inertia or reluctance by the top ranking, old generation department heads or managers to change their old way of doing things. The change from the paper based medical records to the electronic health record system may be touching on some nerves, and a pursuing over some herculean tasks. There is therefore the urgent need to create attitudinal change among all cadres of health workers whether low or high profile as this is key for proper adoption and success of EHRs implementation. Moreover slow implementation of national e-health strategy and policy: Mid-way into the 5years Nigerian National e-Health Strategic Framework (2015-2020) plan to deploy ICT tools to achieve UHC in the country, only a few public health institutions have actually and partly commenced electronic health records and the national budgetary allocation to e-health still very poor. Although, the assessments of e-health adoption in the country described it as transiting from 'experimentation and early adoption stage to developing and building up stage' there is virtually not much on ground to show for it in terms of reaping the huge benefits of fully deploying ICT to support or impact on health of Nigerian citizens.[28] Most of e-health initiatives are funded in ways that may threaten their sustainability/scalability.[27] For instance the 2017 budgetary allocation for healthcare by the Nigeria government was about 50billion Naira which is about $150million; and that is less than $1 per individual.[19] There is also poor stakeholders' involvement: Most of the e-health projects lacked adequate stakeholders' involvement in all phases from conception to implementation. It has reported that most chief medical directors of hospitals sometimes introduce the method without involving other relevant stakeholders. The doctors and other clinicians need to be brought into the picture right from the planning stage and down to the implementation and evaluation stages. The involvements of all stakeholders especially the doctors are key to the success of any EHRs project; considering the fact that 80 percent of documentation or writing for patients at hospitals are done by doctors and they attend to about 50 patients daily on the average.[26] Ethical and litigation issues also present their own challenges: Some ethical requirements in EMR usage may inadvertently lead to issues of litigations whether to health care providers or the patients. It is quite unfortunate that up till now electronic evidence are not admissible in most Nigerian courts.[26] It would therefore be imperative to advocate to the National Assembly the need to pass a law to incorporate electronic evidence.

Low Internet Connectivity: There exists little or no internet connectivity in rural and remote communities. To enhance the application of telemedicine or e-health care services, there should be access to fast and reliable internet connectivity to all parts of the country. Such fast and reliable internet connection is not available in most rural and remote communities in Nigeria.

In Addition, Costs of E-Health & Telemedicine in Nigeria: Gans D, et al. had enlisted the high cost of e-health systems and most clinicians' inability to use the new system as the top barriers preventing the full adoption of the technology. [29] Cost of telemedicine is still beyond the rich of many Nigerians. Although, telemedicine is to reduce the cost of medical services, the cost of telemedicine itself is still not affordable to people, especially those in rural and remote communities in Nigeria, and even in the urban areas. Similarly the cost of providing some critical e-health infrastructures is huge. For instance the cost of providing electronic health record for 20 people cost about 15 million to put the infrastructure on ground, and cost more where users in a hospital are up to 50 to 100 people. [30] There is therefore the need for increased and adequate budgetary allocation and funding to e-health projects in the country. Inadequate ICT infrastructure: Lorenzo Moreno has noted that incorporating EHRs into clinical practice will require large investments in technology, in addition to changes in existing systems and processes. [27] The non-availability or inadequacy of ICTs infrastructure remains a big challenge to effective utilization of e-health services in the country. Information and Communication Technology facilities particularly the internet installation, maintenance and repair services are important in

accessing and utilization of valuable information. However, unequal access to these facilities to all Nigerians is a serious problem because computers, telephone lines, satellite dishes, etc; necessary for internet connectivity are still not available or affordable in most parts of Nigeria districts.

Lack of Doctors' Healing Touch: Most e-health services and channels of communication between doctors and patients; like the use e-mails, audio - visuals and real time capabilities such as teleconferencing precludes sensory modalities such as sense of smell and touch, which can be vital in the assessment of patients. Most importantly, it erodes the humanistic nature of the doctor-patient interaction and deprives patients of the physician's healing touch, which can only be delivered through a person to person interaction.[31]

No Integration or Interoperability of E-Health Services: The multiple and wide variety of health information systems produced in the country are yet to be integrated. E-health projects implemented so far in the country have merely created small-scale applications of e-Health that are unable to effectively communicate or share information with other health systems or across geographies, technologies or programs. [22] One common reason often cited for not achieving e-health scale up is the fragmented organization and culture of healthcare, which hinders standardization and interoperability. Interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged. Interoperability in e-health is so complex that cuts across the legal, organizational, semantic and technical issues.[27] To achieve interoperability, there must be a legal framework and wider policies in place which allow for and encourage the exchange of information between e-health providers, and this, the Nigerian legal framework is lacking in many respects. Although, the National Health Act 2014 permits Health Care Providers (HCPs) to disseminate information on the organization of their health services and to disclose patient healthcare records to other HCPs and third parties in the interest of the patient; the HCPs have not demonstrated serous obligation to this end. This is practiced to some extent at facility level, which means there is no clear obligation to provide information to another HCP operating in another facility or a third party in the interests of interoperability. [27]

CONCLUSIONS

From the above review, it can be said that the country still has a long way to go in terms of fully deploying ICT in the health care system and deriving full benefits of e-health applications. The President of the NMA Dr. Osahon Enabulele opined that "Nigeria is yet to enthrone a full utilization of *e-health* in a way to maximize its alluring and undeniable benefits especially in strengthening Nigeria's healthcare system; improving access of Nigerians to healthcare services in the face of limited resources and shortage of medical/health manpower, improving medical education and research and improving the quality and efficiency of healthcare services; all of which would have translates to improving the health and development indices of Nigeria." He decried the backseat arena where Nigeria has found itself in the application of this technology to solve most of her health needs and to reduce medical tourism; whereas overwhelming evidence abound that developing countries like India, Rwanda, Kenya and Uganda have greatly explored the potentials of *e-health* in transforming their health systems and economies. [17]

RECOMMENDATIONS

In view of the afore-mentioned findings on e-health practice in Nigeria, it would be of immense benefit if the following measures are taken to improve its establishment, utilization and sustainability in the country: 1. The Government should provide adequate and constant power supply (electricity generation and distribution) in all regions, districts, urban and rural communities in order to maximize the benefits of e-health adoption in the country. 2. The poor network services must

be remedied if Nigeria hopes to deliver efficient ICT enhanced healthcare service to its citizen nationwide especially in remote areas. Just like Uganda, Nigeria can also invest on the use of mobile devices (mhealth) in delivering healthcare services, as it has one the highest rate of mobile phone penetration in the continent. According to Price Waterhouse Coopers (PwC), mobile health (mHealth) applications such as text messages could save 147,000 Nigerian lives lost annually to HIV/AIDS, tuberculosis (TB), malaria and pregnancy-related conditions.[5] 3. Human capacity development on the use of e-health applications should be provided for Health care providers and health workers. It would be of great value if all health staff at all levels of health care delivery should be trained periodically on computer appreciation and e-health applications for proper adoption and implementation of e-health technology in the country's health care system. The government should invest massively in ICT infrastructure in hospitals, healthcare centres and tertiary institutions (Universities, Polytechnics, and Colleges of Education) for effective skill acquisition in the area of e-health technology. 4. Electronic Health Card system should be adopted and commenced throughout the country as one efficient and effective way of introducing the electronic health records (EHR) system. This can be started as a pilot scheme in one or two geopolitical regions of the country and gradually extended to other regions in phases just like the e-banking scheme introduced in the country. 5. Policies must be formulated for proper management and monitoring. Government must establish monitoring and supervision agency to ensure data validity and communication to the Ministry of Health. Another effective approach is to manage the utilization of ICT in medicine through the use of legislative and regulatory measures, and by looking into legal reforms to enhance the privacy of health information. Other security measures involve the integration of privacy settings into hardware and the use of biometrics. [25] The legal implication in EMR usage is that in case there are litigations electronic evidence are not admissible in most Nigerian courts. It is therefore expedient that the National Assembly pass a law to incorporate electronic evidence to be used in all forms of court litigations. 6. Finally, experts are of the opinion that telemedicine and e-health should be integrated into the curriculum of medical / health training institutions in the country. They also believed that the federal government should promote advocacy to get the three tiers of government involved in the implementation of e-health strategy, with active participation of all major stakeholders – private sectors, academia / universities, NGOs in health, development partners, professional bodies and associations, etc.

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