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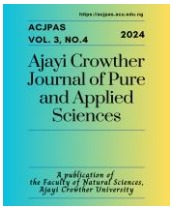

Mini Review

Enhancing Health Care Delivery Services through the Application of Information and Communication Technology (ICT) in Nigeria

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Abstract

The whole world has turned to the use of Information and Communication Technologies to enhance the social, economic, political, educational and health deliveries of their people. The success recorded in almost every aspect of human life has been a result of the use and application of these technologies. The advent of the e-strategies such as e-voting, e-commerce, e-governance, e-learning, e-banking, e-shopping, e-medicine, and e-health was as a result of the evolution in the field. However, despite these improvements in the ICT, Nigeria is yet to fully tap from these enormous benefits accruable from these technologies. In this paper, the areas of focus would be the management of health information, infrastructure, and health delivery services. The problems often encountered in the system would also be examined, discussed and solutions proffered.

Keywords: Health Information, health deliveries, e-health, health care infrastructure.

1. Introduction

Information and Communication Technology (ICT) has remained the major driver of technological innovations and advancement in all areas of human requirements and needs to enhance their social, economic and educational life. The success recorded in almost every aspect of human life has largely been attributed to the use and application of these technologies. Nigeria has a population of over two-hundred million people and a vast expanse of land, without the application of ICT, an effective health care delivery service may not be achievable or become an uphill task to the government. Re [1] concluded in his work that, ICT has assisted in driving down healthcare costs; and improved the delivery and effectiveness of healthcare services through disease management, improved patient safety and decision support for practitioners [2].

Medical Informatics and Health Informatics are two words often used interchangeably to describe the application and use of ICT tools and wares to process, store, analyze, communicate and develop systems for medical (health) related institutions (hospitals). In the early '60s, these tasks are often performed manually which implicitly means incorrect patients' records and absence of sufficient data for government to effectively plan the yearly budget for the health sector. Peter et al. in [3], defined health informatics as the application of information systems that allow collection, updating, storing, analysis and management of health-related data in order to enhance health care delivery.

2. Related Works

Okpalla *et al.* [4] carried out their research on the role of ICT in healthcare Management for efficient healthcare delivery in Nigeria and affirmed that "Information and communication technologies (ICT) are being widely used in healthcare management systems" ([4]. As a result of their research, it was discovered that the records of patients in Nigerian hospitals were not well managed due to paper based approach of keeping medical records [4]. Consequently, a centralized database system was developed for storing health related information for all Nigerians [4]. To illustrate data integration and information exchange among medical practitioners, operational data from communications, blood banks, and patients' medical information systems were connected using data mining techniques [4].

Peter *et al.,* in [3] worked on Health informatics deployment in Nigeria and discussed "ICT in Nigeria with focus on three common ICT indicators: Internet, computing and telephony. We review the past and present state of health informatics in Nigeria, in comparison to the United Kingdom as examples of less developed and developed nations" [3]. In their work, problems facing successful implementation of health informatics in Nigeria were highlighted and possible solutions suggested [3].

A study on the Impact and challenges of Information and Communication Technology on Health Care Delivery in Nigeria was undertaken by Adesoji *et al.,* in [5] adopting doctrinal method of research which involves the use of primary and secondary sources of materials such as statutes, online publications, text books, articles, online dissertation and so on. It was observed that the present state of the application of ICT in Nigeria hospitals and health centers is very low and the need to improve on this is crucial to effective health care delivery in Nigeria. Adesoji *et al.* in [5] highlighted some of the benefits accruable from the application of ICT to healthcare delivery system in Nigeria.

Bari dam Barile and Govender in [6] carried out a "study to examine the critical issues linked to healthcare delivery within the Niger Delta of Nigeria, in relation to the application of ICT within a health-ICT policy" [6]. Some of the issues examined are "staffing, personnel attitude and training, ICT infrastructure and policy management, funding, e-health solution policy, and policy acceptance" [6]. In the course of their work, "several tests were performed on the parameters (which are the issues examined); descriptive statistics, and where necessary, the Pearson correlation coefficient were introduced to check relationships between variables. Results obtained indicated low-level adoption rates of "ICT application in healthcare delivery and a need for an enabling policy. The result of the study confirmed the low levels of healthcare delivery in the region and the importance of an ICT policy in the healthcare sector to improve efficiency" [6].

3. Research Approach

This study's methodology consists of the descriptive method of research and the utilization of primary and secondary sources, including but not limited to text books, online publications, journal articles, and other pertinent data sources. The application areas given consideration in this work are; Health Sector (PHC, Hospitals, Specialist Hospitals, Teaching Hospitals, Dispensaries, Maternity Canters), Management of Patients and Patients' Records, Medical Assistance system (AI Based Systems, Robotics etc.) and e-health.

4. Information and Communication Technology Tools

Several authors have defined Information and Communication Technology (ICT) using various forms of approaches appropriate and corresponding to their research direction and the investigation being carried out. Ratheeswari in [7] defined ICT as an umbrella term that includes any communication device or application, encompassing: radio, television, phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them. Therefore, it could be empathetically stated that ICT is technology that supports activities involving information. These include gathering, processing, storing and presenting data and involve collaboration and communication. In today's global technological village, the advancement in ICT has turned the world into a highly sophisticated technological-driven entity with ICT creating a huge impact on Health care and Health care deliveries. Accessibility to information has been simplified using

ICT tools and also people find themselves more relaxed while availing themselves of healthcare services.

In developing nations of the world, such as Nigeria, the major challenges faced by the Healthcare sectors are summarized as follows; storage and retrieval of patients' medical records, maintenance of Hospital Information System, maintenance of medical equipment, medication and diagnosis error, and training of personnel on some specific ICT driven equipment. In Nigeria, unlike the urban centers with accessible medical facilities (though inadequate equipment), the rural areas are at disadvantage because of lack of proper healthcare, awareness and information. The transportation problems, (bad roads, ambulances) which often impede timely evacuation of patients with serious health to the nearby hospitals at the urban centers.

In the ICT driven world of today, the whole process of the healthcare sector is being rejuvenated and the rural areas given unfettered access to quality healthcare, drugs are also more accessible than the pre-ICT era reducing the gap between the urban–rural disparities. It is a fact that with the right provision of ICT enabled channel and tools; a doctor can easily deliver treatment and care for a given patient independent of the location [8]. In addition, the monitoring of the patient's records could be easily carried out along with the tracking of the patient's recovery process.

5. Nigeria's Healthcare System and ICT Applications

There are four identified categories for the application of ICT for healthcare and management as listed below [8]:

5.1 Health and Education

There are available opportunities for unhindered access to seek, learn and communicate with patients, health officials and medical and paramedical personnel whenever and wherever there exist the need to do so. This is vital during outbreak of diseases such as cholera, covid-19, communicable diseases for training on preventative measures, health status and current diagnostic and procedures.

5.2 Hospital Management System

Information and Communication Technology helps in improving the management processes of patients' safety and records and avail them of the latest Health Tech development. Statistics on the needs of the health institutions to improve their planning and budgeting system for the local population will be improved through the application of ICT.

5.3 Health Research

ICT Records have demonstrated to a great extent the enhancement of researches and remarkable successes recorded in that area with the application of ICT tools. The recent outbreak of Covid-19 is a great example of these success stories as results were easily disseminated through the use of ICT in finding the possible prevention measures to eradicate and reduce its spread. Also, the introduction of AI (Artificial Intelligence) has created technology that assists in diagnosis of diseases, surgery and medical robots has greatly impacted on health care system. This saves the lives of many individuals by providing treatment in advance. The emergence of ICT in the field of healthcare has taken it to new height as the traditional healthcare systems have given way with the formation of new models for effective quality service delivery and an improved health care.

5.4 Health Data Management

Patients' data handling procedure is being improved as the available ICT tools help in the storage and retrieval process with the near total elimination of the traditional manual filing system. The electronic storage of medical data with the use of ICT tools in Hospital facilitates the fast storage and data retrieval of patients' data equally improves the referral process as patient's gets to the referred hospital before

the patients. This will enhance the target hospital's level of preparedness for the arrival of the patient in case of an emergency.

6. Harnessing ICT Tools for Efficiency in the Healthcare Delivery Sector in Nigeria

According to Worldometer in [9], the current population of Nigeria is 216,421,519 as of Saturday, July 9, 2022, based on Worldometer elaboration of the latest United Nations data. The current statistics show that health institutions rendering healthcare delivery services in Nigeria are 33,303 general hospitals, 20,278 primary health centers and posts, and 59 teaching hospital and federal medical centers [10]. Of note however is the fact that 70% of the primary health centers are located in rural areas. All others are located in urban centers. The implication is that effective health care delivery services may be a nightmare which has resulted in high mortality rate in these rural areas because of the difficulty in accessing prompt HealthCare services. Based on the above stated figures, the Nigerian government should urgently prioritize the implementation of a national ICT policy on the use of ICT tools in all health institutions in Nigeria. This goes beyond the traditional record keeping and retrieval systems.

There has been considerable success recorded with use of ICT tools on the social media and other platforms. The educational, financial, economic, political, business, social, news and other aspect of human lives have recorded great successes which should be replicated in the healthcare sector with the use of ICT tools. Telemedicine (e-Health) which has turned out to be the norm in some advance countries of the world should be elaborately advocated in Nigeria. In view of the current dynamics in the health sector.

7. The New Paradigm Shift – Enhancing the Present System

A Country like Nigeria with a population of over 216 million and most of her citizens attend public hospitals and a teeming rural population needs an advanced way of providing healthcare services to its citizens. Two approaches using ICT are presented:

7.1 Telemedicine in the Healthcare Sector

Several industrialized and developing countries around the world, including China, Brazil, and India, have adopted telemedicine. The practice of providing remote medical care when the patient and the practitioner are not in the same physical location is known as telemedicine. Doctors can now use video conferencing to consult with patients thanks to modern technologies [11]. In order to improve the health of people and their communities, the World Health Organization (WHO) defines telemedicine as the provision of medical services by medical professionals while utilizing information and communication technologies (ICT) for the exchange of reliable data for disease and injury diagnosis, treatment, and prevention, research, and evaluation, as well as for health care providers' ongoing education [12]. The delivery of healthcare services remotely using telecommunications infrastructure (ICT), including examinations and consultations, is known as telemedicine, also known as telehealth or e-medicine [13]. Healthcare professionals can assess, diagnose, and treat patients via telemedicine without having to see them in person. Using a telehealth kiosk or their own personal device, patients can consult with doctors from the comfort of their own homes [13].

The technology of telemedicine consists of a computer system with custom medical software connected to essential medical diagnostic tools that enables visualization of digitized versions of patients' medical images and diagnostic details are dispatched to specialist doctors through the satellite-based communication link either in real time or scheduled remote consultation depending on the availability of the specialist medical personnel [14]. The information is received and examined to diagnose and suggest appropriate treatment through video-conferencing. With all of these services being offered, reaching the poor in the most remote places has become more of a possibility [14]. Ekanoye *et al.* in [15], asserted in their work that Telemedicine was successfully deployed in Nigeria (Lagos and Abuja) during the COVID-19 pandemic and the resultant restriction of movements encouraging remote

consultations with patients across many hospitals in urban centers like Lagos and Abuja [15]. The outbreak of COVID-19 and the resultant restriction of movement forced several developing and developed into the adoption of telemedicine. Indian with a population of about 400 million people was forced to adopt the technology that reduced the damaging effect of the COVID-19 pandemic.

The normative revolution forced by Covid-19 inspired the Brazilian government into revisiting the set aside regulation of the use of telemedicine by the healthcare institutions [15]. The regulation of telemedicine remained untouched until the beginning of 2020, when the Covid-19 pandemic compelled its use on a large scale. Faced with overcrowded hospitals, doctors on the front lines in the fight against the virus and the need for social isolation to prevent the spread of the disease, public authorities were quickly forced to regulate telemedicine, allowing remote medical care with no personal contact [16]. Telemedicine is a reality in the Brazilian territory and well received by the Brazilians. On the one hand it is widely used by health plans, hospitals and doctors; on the other, it is evaluated extremely favorably by patients in all corners of the country [16].

In response to the harsh realities of the COVID-19 Pandemic, Telemedicine became the only available option in most African countries due to shortage of medical personnel and the need to tackle the fast-spreading disease with a mind-boggling mortality rate [17]. Adenipekun in [12] stated his appraisal of the telemedicine approach to healthcare concluded that "the health sector could be improved upon to impact greatly on the health and well-being of the population by filling the gap in number of healthcare professionals in the country, reducing delay in accessing health care due to transit time to health facilities in urban cities like Lagos, and increasing access to quality health information and services in rural and hard-to-reach communities" [12]. Despite the beauty and positive results emanating from countries that have already embraced there are challenges developing countries have to resolve and could be classified into two; Provider and Patients' challenges. Provider challenges include inadequate infrastructural development, high cost of set up, and resistance to change [12].

Patients' challenges include lack of access to required gadgets and lack of affordability of telemedicine services [12]. However, these challenges are surmountable because Internet Connectivity in Nigeria presently is around 90% [18] and about 70% [19] coverage of the total population and area respectively, there are also gadgets such as i-Pad, Notebooks, Sophisticated and high-resolution cheap GSM devices (phones) government can procure for the citizens at rural designated centers.

7.2 Artificial Intelligence in the Health Care Sector

Artificial intelligence in healthcare is a term used to describe complex algorithms designed to perform certain tasks in an automated way., These newly built algorithms can review, interpret and even suggest solutions to complex medical problems based on data input into the computer by researchers, doctors and scientists [20]. In a collaborative paper with the European Union's EIT Health, the authors examine how artificial intelligence (AI) might enhance care results, patient experience, and access to healthcare services. AI has the potential to completely change the way healthcare is provided in Nigeria [21]. In their report, Angela et al. [21] confirmed the effectiveness of care delivery, enabling healthcare systems to treat more patients with greater quality while assisting AI in enhancing the experience of medical professionals, allowing them to spend more time directly caring for patients and preventing burnout. Once more, a sizable number of industrialized nations, including Finland, Germany, the United Kingdom, Israel, China, and the United States, have embraced AI and made significant investments in the field [21].

Codrin in [20] listed some of the technological applications of AI in healthcare but not limited to:

a. Medical diagnostics: Artificial Intelligence Software are being developed to diagnose patients with specific diseases such as; malaria, Typhoid, Cholera.
b. Drug discovery: Some health and pharma companies currently leverage Artificial Intelligence to help with drug discovery and usage.
c. Clinical Trials: AI is being used to manage and track Clinical Trials in research centers. They provide integrated solutions that can track progress, data gathering and drug trial outcomes.

d. Pain management: By leveraging virtual reality combined with artificial intelligence, one can create simulated realities that can distract patients from the current source of their pain and even help with the opioid crisis.
e. Improving patient outcomes: Artificial intelligence driven variety of strategies and outcomes can be used to improve Patients outcomes.

Although AI in healthcare could be described as having an amazing future with huge potential; however, as most developments in the technological space (ICT) for instance, there are a number of known current limitations. There are bound to be teething problems following initial adoption, resistance to change, Data Privacy and compliance to regulations. All these would disappear with the massive implementation and investment in the healthcare sector by private and public concerns. Nigeria could definitely benefit from these technological discoveries and improve the healthcare delivery system to cover all the nooks and crannies of the country.

8. Conclusions

The current state of health care delivery in Nigeria is not encouraging due to the obsolete method in use. The ICT in most health institutions are mostly for data storage and retrieval and therefore there is the need for the Federal Government of Nigeria to key-in into the new technology (ICT) as presented in this paper. This will save lives and reduce mortality rate in our health centers and enhance service deliveries throughout the country Nigeria.

9. Recommendation

Based on the devastating effect of the Covid-19 outbreak and the resultant thousands of death recorded throughout the whole world, predominantly in the advance countries, it is hereby recommended that Nigeria re-strategize the health sector for an improved performance with the use of Information and Communication Technology for a prompt service delivery.

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Both authors contributed equally to the article.

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