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EMPOWERING THE NIGERIA HEALTH CARE SYSTEM THROUGH THE USE OF ARTIFICIAL INTELLIGENCE

Emmanuel 'Gbemisola.S, Ogunbanjo (CLN)
Polytechnic Library
Ogun State Polytechnic of Health and Allied Sciences,
Ilese-Ijebu, Nigeria
shmily.gbemisola@hotmail.com

Bukonla, Olu-Daniel
Department of General Studies,
Ogun State Polytechnic of Health and Allied Sciences,
Ilese-Ijebu, Nigeria
oludanielsbukonla75@gmail.com

Email address of corresponding author:
shmily.gbemisola@hotmail.com

ABSTRACT

The study examined the use of AI in Nigeria healthcare towards providing effective and efficient services using a systematic scoping review method. The study adopted secondary information sources from the internet which include the use of journal articles, e-books, databases and websites of organizations, healthcare systems, news, and others. Information obtained was analyzed using thematic analysis and whence findings are presented. The findings of this study show that AI can revolutionize personalized medicine, optimize medication dosages, enhance population health management, provide virtual health assistants, support mental health care, improve patient education, and others which could enhance healthcare service provision and outcomes in the Nigeria healthcare system. AI in Nigeria healthcare system is just a recent innovation, and only few such as CareAi, ZMP Inc., and others have been successfully deployed to enhance healthcare service delivery in the Nigeria healthcare system. Also, despite the benefits accruing to AI in the Nigeria healthcare, several challenges such as data privacy and quality, ethical and legal issues, patient safety and accuracy, low internet connectivity, electricity, and hardware issues affect the successful implementation and use of AI in the Nigeria healthcare system. The study recommends that governments, policy makers and medical professionals should endeavour to provide sensitization information and other working

mechanisms that enhance the propensity of the usefulness of AI towards ensuring a better healthcare provision in the Nigeria healthcare system.

Keywords: Artificial Intelligence, AI, Digital Health Innovation, Health Technology, Nigeria Health Care System, Nigeria

INTRODUCTION

Health is very paramount to the effectiveness of the productivity and wellbeing of the population; hence, providing a viable and effective health care system is very germane to ensure national development. However, the qualities of the health care services delivered are very poor and this has remained a very huge concern over the years (Aregbeshola, 2019). This is obvious from the range of mirage issues, which constitute both the supply and demand challenges combating the Nigeria health care system such as increasing rate of child and maternal mortality, poor coverage because most of the population, particularly those in the rural areas are at risks and are not able to access health care services, lack of infrastructure, and low level of technology deployment and utilization, among others (Aregbeshola, 2019; Abubakar, Dalglish, Angell, Sanuade, Abimbola, Adamu, Adetifa, et al., 2022).

In recent times, due to globalization, modernization, and development, couple with the revolutionary trend in the use of technology, several individual firms and sectors have continuously adopted various technologies to reposition them to better enhance their competitive advantage and also increase their performance, not just at the local level, but also at the regional and global levels. One of such trends in globalization, modernization, and development is the use of artificial intelligence to empower firm activities and provide effective services.

Artificial intelligence (AI) is a collection of technology, and it is a very powerful and disruptive technology, which possess the potential to transform firm activities and also provide effective services that could help in reducing the cost of production and service delivery towards increase maximum output for the organization (Davenport&Kalakota, 2019). Examples of AI are machine learning which include the neural networks and deep learning. Machine learning could be referred to as a statistical technique that fits models into data and also to ‘learn’ by the provision of training models. Hence, it could be divided into the supervised and unsupervised mode.

The supervised model is a type of machine learning which the algorithm learns to make predictions or decisions based on the labeled data and instruction provided, example is the

neutral networks, regression, object detection, and others (Banoula, 2024; Shinde, 2024). On the other hand, the unsupervised model may not need explicit instructions on what to do with the dataset provided hence, it tries to locate patterns, structures, or relationships in the data without the guidance towards making a prediction or decision, examples are image classification, heart disease prediction, and others through the use of K-means clustering, autoencoders, and others (Banoula, 2024; Shinde, 2024).

In the health care system, it AI could enhance the practice of healthcare service delivery to patients by reducing the increasing cost of healthcare, improving patient's experience during health care service delivery, better caregiver experience (Feeley, 2017; Bajwa, Munir, Nori&Williams, 2021). The use of AI could also be justified by the increasing population that need equal attention from the available medical practitioners within the health care system in Nigeria, and also the increase in the burden of several types of chronic diseases, couple with the increasing costs of providing and obtaining healthcare services (Bajwa et al., 2021). Examples of AI could be used in healthcare service provision include using it for medical image analysis, virtual assistants to assist medical practitioners to be able to manage the daily work of their clinic, predictions or forecasts about patient outcomes, Chatbots, AI-assisted diagnosis and treatment, AI-powered drug discovery, AI-powered robotics, and others.

The use of AI could be used to cushion and solve the supply and demand challenges and could vary from the increasing use of the multi-modal data (which cuts across the use of genomics, economic, demographic, clinical and phenotypic), the mobile technology innovations, internet of things (IoT), computing potential, and others are several through which AI could be used to transform the healthcare system (Davenport&Kalakota, 2019; Bajwa et al. , 2021). AI has the potential to perform, even better than humans, key healthcare tasks, such as diagnosing disease (Davenport&Kalakota, 2019).

The provision and adoption of integrated technological efforts, that is orchestrated by globalization and development to address health issues in Nigeria such as the provision and use of artificial intelligence to foster effective and viable health care service provision is very crucial to the country (Pongsiri, Gatzweiler, Bassi, Haines & Demassieux 2017; Abubakar et al., 2022). If the right policies are implemented towards the use of effective strategies and technologies such as artificial intelligence, Nigeria could be well re-strategize and positioned to becoming a global power due to its streams of health care medical practitioners (Institute for Security Studies

Power and influence in Africa: Algeria, Egypt, Ethiopia, Nigeria and South Africa, 2015; Abubakar et al., 2022). However, to be able to achieve this, it is important to articulate in a study, how the Nigeria health care system could be improved through the use of Artificial Intelligence. To this end, this present study focuses on examining how AI can empower and revolutionize the Nigeria health care system towards providing effective and efficient services to clients.

Research Objectives

The general objectives of this study are to examine how AI can be used to empower and revolutionize the Nigeria health care system towards providing effective and efficient services to clients.

Research Questions

The following research questions would be used to drive this study:

i. How could AI be used to empower and revolutionize the Nigeria health care system towards providing effective and efficient services?
ii. What are the possible AIs that could be used to empower and revolutionize the Nigeria health care system for effective and efficient health care services?
iii. What are the barriers to deploying and using AI for healthcare services

LITERATURE REVIEW

Studies have revealed that AI could empower and revolutionize health care system towards providing effective and efficient healthcare services to clients. Bajwa et al. (2021) defined AI as the science and engineering which focuses on making of intelligent machines, through several algorithms or set of rules, which such machines could follow to mimic human cognitive functions, which could include learning and solving of human related problem. They have several potentials that could be used to handle several problems or issues hence, they are being used in healthcare sector to solve health and administrative related issues (Bajwa et al., 2021). These could include learning and recognizing patterns and relationships from large multidimensional and multimodal datasets, which could cut across translating patient's medical record into a single number that represents a likely diagnosis, and others (Bajwa et al., 2021).

According to Philips Editorial Team (2022), AI could be used in improving precision in patient positioning and computer tomography (CT) image reconstruction, speed up image acquisition in magnetic resonance (MR) imaging, take the prevalence of complexity out of ultrasound measurements, help radiologists to read images faster and more accurately, support multidisciplinary collaboration, particularly in cancer care, guide medical practitioners during minimally invasive surgical procedures, detect early signs of patient deterioration in the general ward, minimize equipment downtime through predictive maintenance, and so on. This shows the wide potentials of AI use in healthcare system.

Davenport&Kalakota (2019) examined the potentials of artificial intelligence in healthcare, and stated that AI is increasingly prevalent and used in the healthcare system because of their potentials to provide transformation to many parts of providing care to patients, couple with its administrative potentials in handling several administrative issues and processes, particularly among healthcare providers, payers and pharmaceutical organizations. The findings of Davenport&Kalakota (2019) highlighted several examples of AI that can be used for the healthcare service, which are the natural language processing, expert systems, robots such as surgical robots, robotic process automation. Other AI could also include its use in diagnosis and treatment applications, patient engagement and adherence applications, administrative applications, and others.

Also, according to Daley (2024), AI has the potentials to enhance the patient experience in the healthcare system by streamlining processes and reducing delays. It also simplifies the workload of doctors and hospital administrators by performing the tasks that would otherwise require human effort – but in significantly less time. Daley further noted that AI could be applied to improve medical diagnosis, accelerate drug discovery, transform patient care, manage healthcare data, perform robotic surgery and more.

Also, The Foresee Medical (2024) examined AI in the healthcare sector, and noted that AI has drastically improved the healthcare outcomes for its tendency to produce a more accurate diagnosis and enable effective and efficient personalized treatments provided to clients. In addition, it possess the innate ability to help synthesize and analyze vast amounts of available clinical data, information and documentation which could immediately and also quickly assist medical professionals to better identify disease markers and the trends, and also make better informed decision towards effective healthcare outcome in the sector.

Despite the benefits and significance of the use of AI to enhance the healthcare service provision, several barriers have been noted to hinder the process in healthcare sector. Alowais *et al* (2023) highlighted few of these challenges:

i. The high and significant costs and risks in the use of AI in healthcare sector
ii. Safeguarding commercial interests of AI and data-driven healthcare technologies. For example, in the past, medical professionals are the only individuals that could measure some important health signs which could include blood pressure, glucose levels, heart rate, and others. But, in recent times, there are the provision of mobile applications that could be personally deployed for this purpose.
iii. Issues related to data privacy and confidentiality violations, couple with informed consent, and patient autonomy are also important issues in the use of AI in healthcare
iv. Protection legislation of robust data are also paramount towards safeguarding the privacy of individual. Although, in developed countries such as in the United States and Europe, Health Insurance Portability and Accountability Act (HIPAA) and the General Data Protection Regulation (GDPR) are provided respectively to protect the citizens' privacy. However, not much is done in developed countries such as Nigeria.
v. Cyber attacks could compromise patient data, and also disrupt critical healthcare operations, jeopardize patient safety, particularly in the use of AI in the healthcare system is

These challenges could inhibit the effective use and potentials of AI in healthcare, particularly in Nigeria. In addition, drawing from the works of Aregbeshola (2019) and Abubakar et al. (2022), these challenges could further make the healthcare system of Nigeria less effective thereby affecting development in the long run, and Nigeria may not be able to compete at the regional and global levels hence, there is need to refocus attention to understanding how AI could be used to empower the healthcare service in Nigeria and also highlight the several challenges that could limit the use of AI towards driving development in this sector. Also, from literature reviewed, it is obvious to note that, the use of AI in healthcare in Nigeria is still very low, and studies that are focusing on this aspect of enquiry are limited.

According to a report by Upadhyay (2024), Nigeria's Artificial Intelligence (AI) In Healthcare Market is projected to grow to $0.13Bn by 2030 from $0.01Bn in 2022, driven by the rising availability of AI-based solutions, couple with the growing investment by government and also

private companies in the development of AI in healthcare. This reveals that, investment in AI in Nigeria healthcare is probably a new trend hence, may have not been assimilated totally into the healthcare system in Nigeria, which demands the need for this study. Hence, this study focuses on examining how AI could be deployed and used to enhance the Nigeria health care service.

RESEARCH METHODS

The study adopted the systematic scoping review and focuses on the use of secondary sources which include journal articles, books, websites of organization, radio, television, database sources, online news and magazines, among others towards meeting the research objective of the study. The use of different secondary sources was initiated to be able to harness different aspects and forms of information and studies that could meet the subject matter of interest of this study.

The study also deployed the Cochrane review style towards informing the reviewing process. According to Chapman (2014), the Cochrane review style focuses on use of systematic review method to review studies towards achieving the objectives of a study. Various searches were initiated and the first search process was done on August 14, 2024, and another one was done on August 23, 2024, while another was done on September 02, 2024. This was done in order to gather relevant information and resources that could cater for achieving the objective of the study. Information and materials used for the study covers within the periods of 2015 and 2024. In addition, several components such as the evaluation of the appropriateness of study design used, the features of the methodology of the design deployed, the articles' author(s) and sources, how recent the information is, among others were inculcated in the materials appraisal process to enhance quality assurance of the outcome of the study. Moreover, data extraction was done and information obtained were analysis, through content and thematic analysis, and the outcomes were presented to better explain and achieve the research objective of the study.

RESULTS

This study examined the various AI that could be used to empower and revolutionize the Nigeria health care system towards providing effective and efficient services using a systematic scoping review method. In accordance with PRISMA-ScR guidance, a systematic scoping review was conducted by searching multiple databases (e.g., PubMed, Google Scholar, organizational websites) for English-language sources dated between 2015-2024, screened titles and abstracts

independently by two authors, extracted and thematically analyzed relevant data from included studies, and charted findings to map the current landscape and identify gaps.

This formulation clearly outlines the followings:

- Use of PRISMA-ScR (Preferred reporting items for systematic reviews and meta-analyses-scoping reviews) guidelines
- Multi-databases search, date and language limit
- Independent dual screening by two authors
- Thematic analysis and charting of results

Use of AI in Nigeria Healthcare System

Alowais, Alghamdi, Alsuhebany, et al. (2023), examined how the healthcare system could be revolutionized through the use of artificial intelligence in performing and providing clinical practices and services. AI offers increased accuracy, reduced costs, and time savings while minimizing human errors. It can revolutionize personalized medicine, optimize medication dosages, enhance population health management, establish guidelines, provide virtual health assistants, support mental health care, improve patient education, and influence patient-physician trust.

According to Digital Literacy Africa (2023), AI has been deployed in the Nigeria healthcare system for various purposes, which cuts across diseases diagnosis, supply chains management, fake drugs detection, and increasing education and awareness among health workers. Some of these AI applications that have been used in the Nigeria healthcare include (Digital Literacy Africa, 2023):

CareAi: This is an AI-powered computing system that focuses on diagnosing infectious diseases, which could include typhoid fever, malaria, tuberculosis, and others. This medical activity could be perform within seconds by the CareAi and could be achieved through the use of a finger-prick blood test and a Blockchain-based platform towards ensuring increase data security and privacy.

ZMP Inc. This is also an AI app that is based on MIT open-source software, and could be deployed in identifying fake drugs in Nigeria. It tends to use Smartphone camera to scan the barcode of a drug towards the verification of its authenticity with the help of AI algorithms.

The World health organization (2024) presented how Artificial Intelligence could be harnessed for health, and revealed that AI has been playing major roles in the diagnosis and clinical care, drug development, disease surveillance, outbreak response, and health systems management hence; the future of healthcare relies on the use of digital means to enhance service delivery hence, the need to promote the universal access and use of AI in their healthcare system.

Barth (2024) narrated how AI could be used to foster healthcare services, and stated that leveraging on the use of artificial intelligence in healthcare sector could provide smarter, faster, and more efficient services to millions of individuals. In addition, health professionals could make more informed decisions through the use of artificial intelligence in healthcare, particularly with respect to having access to accurate information that saves time, reduce costs, improves medical records management, and others

Examples of AIs in Nigeria Healthcare System

There are several AIs that could be deployed and used to enhance healthcare service delivery. Alowais, Alghamdi, Alsuhebany, *et al.* (2023), examined how the healthcare system could be revolutionized through the use of artificial intelligence in performing and providing clinical practices and services and presented several areas where AI could be leveraged towards informing effective healthcare service delivery. Alowais et al. (2023) and Barth (2024) presented some AI and how they could be deployed and used to foster healthcare services delivery. List of AI that could be deployed and used to enhance healthcare service delivery in Nigeria are provided below.

Medical Diagnosis and Treatment: The machine learning could possess certain significant reshaping potential on healthcare bee improving medical diagnosis and treatment. Through the processing of vast amounts of clinical data, the machine learning algorithms helps identify patterns and also predict medical outcomes with exceptional accuracy. Hence, machine learning could also aid in analyzing patient records, medical imaging, discovering new therapies, among others which could assist medical and healthcare professionals to make better decision and also provide improved treatments at reduce costs. It could also enable the diagnosis of disease precisely, customized treatments, and also being able to detect certain subtle changes in vital signs, which might not be possible to detect through the traditional means. It could also enhance precision medicine, among others hence, increasing the global

competitive advantage of medication and healthcare professionals in Nigeria, if well deployed and used.

Precision medicine and clinical decision support: AI has been deployed and used to enhance personalized treatment hence, it could offer the potential to better analyze complex datasets, couple with predicting outcomes, and also optimizing treatment strategies. In precision medicine or personalized medicine, medical care is provided to individual patients based on their personalized or unique characteristics, which could include genetics, lifestyle, environment, and others leading to improve patient outcomes. Also, applications of AI assist medical professionals in making effective treatment decisions, particularly with respect to predicting of therapy response.

Natural language processing (NLP): It is another form of AI that tends to help interpret and use human language, and could reshape the healthcare industry, including the Nigeria healthcare system. It could be used to improve patient care through enhanced diagnosis accuracy, clinical processes streamlining and providing personalized services with increasing patients' experience. It could accurately diagnose illnesses through the extraction of useful information from health data, identify relevant treatments and medications that could be administered to each patient or could even predict potential health risks drawing inferences from past health data. In could also help clinicians to manage large amounts of complex data, which may be too complex for the ordinary health service provider.

Expert Systems: Another type of AI that could be deployed and used to enhance healthcare service delivery is the use of expert systems. The expert system is based on variations of 'if-then' rules. Thus, revealing why many electronic health record systems provide a set of rules for software operation.

AI virtual healthcare assistance: The increasing demands of health care services and the available limited resources, has necessitate the need to find solutions to overcome several health challenges. A major example is the use of virtual health assistants. These are new innovative technologies that ten to transform the healthcare industry towards supporting the healthcare professionals. It assists to simulate human conversation to better offer personalized patient care based on the input that the patient provided. Examples are the use of AI-powered applications, Chatbots, sounds, interfaces, and others.

AI mental health support: AI also has the potential to create positive resonance effect on the provision of mental health support such as handling mental disorder, substance use disorder, and others through the provision of personalized and accessible care to different individuals. Examples are the use of Web-based or Internet-based cognitive-behavioral therapy (CBT) for psychotherapeutic intervention. Another example is the use of *Woebot* to support patients with substance use disorders and could reduce substance use, cravings, depression, and anxiety.

AI in Enhancing Patient Education: AI-powered Chatbots could be deployed and used for implementation in healthcare system, such as in the awareness of diet recommendations, smoking cessation, cognitive-behavioral therapy, and others. Patient education is paramount, particularly in achieving effective healthcare system hence, AI could enable individuals to possess a better awareness and understand of medical issues, diagnosis, treatment options, preventative measures, and so on.

AI in Mitigating Healthcare Provider Burnout: Also, when patients are aware and understand certain medical issues such as diagnosis, treatment options, preventative measures, and others, the level of task on medical professionals may be reduced which in the long run could assist in saving medical professionals burnout. For example, ChatGPT, an AI Chatbot which was founded by OpenAI, could assist patients with diabetes to understand their diagnosis and treatment options, and also help monitor their symptoms and drug adherence, and could also help in the provision of feedback and encouragement, and other responses that could answer the questions patients provided.

Barriers to Deploying and Using AI for Healthcare Services

Despite the benefits that AI brings to enriching the healthcare services, several issues have been identified to confront it. Foresee Medical (2024) presents several challenges confronting the use of AI in healthcare as provided below:

i. There are several ethical and regulatory issues that may make it very challenging to adopt for healthcare services. Examples of these are issues related to data privacy and security. The need for ensuring data privacy and security is premised on the notion that AI systems collect large amounts of personal health information, and such information could be misused if not handled correctly. Hence, there should be the need for proper security measures towards protecting sensitive patient data from being exploited, particularly for malicious purposes.

ii. Another important challenge is ensuring patient safety and accuracy.

iii. Patient safety and accuracy are very germane in the use of AI, particularly in healthcare.

iv. The issue and challenge of training algorithms to recognize patterns in medical data is germane hence, AI systems should be trained in effective recognizing of patterns in medical data, and to also understand the relationships between different diagnoses and treatments, and provide accurate recommendations that could be well tailored to individual patient.

v. Also, the integrating of AI with existing IT systems is important aspect to focus attention. This is because this process could introduce an additional and different type of complexity for medical providers due to the fact that it requires a deep understanding of how the existing technology works towards ensuring seamless operation.

vi. The probability of gaining physician acceptance and trust in using AI is also paramount in the effective use of AI in healthcare system. Thus, there is need for confidence in the use of AI that it could and would provide reliable advice and will not bring confusion.

vii. Another germane issue is ensuring compliance with rules and regulations. Compliance, particularly with federal regulations should be a must towards ensuring that AI system is used ethically and not putting patient safety at risk

The Digital Literacy Africa (2023) also outlined several challenges that are facing the use of AI or healthcare in Nigeria and include: data availability and quality, ethical and legal issues, human capital and infrastructure issues such as the low internet connectivity, electricity, and hardware.

CONCLUSION

The study examined how AI could be used in Nigeria healthcare towards providing effective and efficient services using a systematic scoping review method using a systematic scoping review method. The findings of this study show that AI offers increased accuracy, reduced costs, and time savings while minimizing human errors and can revolutionize personalized medicine, optimize medication dosages, enhance population health management, establish guidelines, provide virtual health assistants, support mental health care, improve patient education, and influence patient-physician trust which could reduce efforts and stress among medical professionals in the Nigeria healthcare system.

Although, the use of AI in Nigeria healthcare system is just a recent innovation, few AIs, such as CareAi, ZMP Inc., and others have been successfully deployed to enhance healthcare service delivery in the Nigeria healthcare system. It could also be used in medical diagnosis and treatment, precision medicine and clinical decision support,optimization of dose and monitoring of therapeutic drug, genomic medicine, virtual healthcare assistance, mental health support, enhancing patients' education and awareness, and others.

Despite these elastic benefits, several challenges such as data availability, privacy and quality, ethical and legal issues, patient safety and accuracy, human capital and infrastructure issues such as the low internet connectivity, electricity, and hardware are related issues that affect the successful implementation and use of AI in the Nigeria healthcare system.

RECOMMENDATIONS

Several recommendations were provided towards the effective and efficient use of AI in healthcare in Nigeria, and include:

i. Government, policy makers and medical professionals should endeavour to provide sensitization information that could provide relevant information to the public in the usefulness of AI towards ensuring a better healthcare provision.

ii. There would be need to establish and implement policy that focuses on achieving a comprehensive cyber-security strategies and robust security measures to better protect patient data and critical healthcare operations.

iii. The healthcare system should need to collaborate with AI researchers, and regulatory bodies towards establishing guidelines and standards for AI algorithms and uses in making clinical decision

iv. Governments, bodies, health organizations, and others should invest in research and development to better advance AI technologies that could be tailored towards addressing healthcare challenges, particularly in recent times of increasing healthcare challenges.

v. Also, in the use of AI for health care, healthcare leaders should put into consideration: ethical and responsible access to data, access to sufficient computing power to generate decisions in real time, electricity, internet connectivity, and research into implementation of AI in the Nigeria healthcare system.

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