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Enhancing Infectious Disease Management in Nigeria: The Role of Artificial Intelligence in Diagnosis and Treatment

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Abstract

Infectious diseases present major obstacles to global public health systems, especially in resource-poor areas like Nigeria. Artificial Intelligence (AI) methods for disease detection, medication development, and patient risk assessment are widely used in healthcare. In the low-resource setting like what Nigeria represents, the benefits of AI in offsetting major systemic and resource constraints cannot be overemphasized. In light of the recent strides by the Nigerian government to support local AI adoption and talent development, we present an overview of how public and private health management and delivery practitioners should being to think about adopting AI technologies to improve health services delivery within the country, especially towards managing infectious diseases. Our overview is based on a mixture of on-the ground experience and literature studies. With the evidence in literature showing that AI shows great promise for enhancing clinical laboratory testing, disease diagnosis, and treatment selection, we have argued that by prioritizing AI integration into health systems in Nigeria, there will be higher accuracy in diagnoses, lower costs of service provision, and time savings to ensure the understaffed health systems can reach more people.

Keywords: Infectious disease; Nigeria; Machine learning; Artificial intelligence

Introduction

Africa, including Nigeria, naturally, has one of the highest rates of infectious disease burdens worldwide [1]. Remarkably, most of the estimated 10 million annual deaths attributed to infectious diseases take place in Africa [2], with Nigeria accounting for a sizeable portion of these deaths. Accordingly, research has shown that infectious diseases negatively affect Nigeria's health and the economy of the continent [3]. Infectious diseases cause about 227 million years of lost health life and over $800 billion in lost output annually [4].

Although Nigeria puts a lot of effort into fighting these infectious diseases, the SARS-CoV-2 pandemic interrupted Africa's flimsy attempts to stop infectious diseases including HIV/AIDS, malaria, and tuberculosis. In relation to this, it has been estimated that between 2020 and 2025, the COVID-19 pandemic will probably result in an additional 6.3 million TB cases and 1.4 million TB fatalities [5]. Despite the dire situation brought about by infectious diseases on the continent, artificial intelligence has also opened up a whole new world of possibilities.

In a recent move indicative of political alignment, the Nigerian government has signaled its commitment to nurturing the country's capabilities in AI. With the unveiling of the Nigeria Artificial Intelligence Research Scheme in October 2023, the government has initiated growth in the local AI ecosystem. This initiative promises to channel resources, expertise, and collaborative opportunities to stakeholders within the AI domain. A focal point of this scheme is the healthcare sector, where the application of AI holds considerable promise, particularly in the realm of infectious disease management. This overview serves as a foundational analysis, aiming to guide potential trajectories of influence that AI could have within this critical area of public health.

The goal of the quickly developing computer science subject of Artificial Intelligence (AI) is to build machines that are capable of activities that normally require human intelligence. Artificial intelligence encompasses a range of methodologies, including Natural Language Processing, deep learning, and machine learning (NLP). Large Language Models (LLMs) are a class of Artificial

Intelligence (AI) algorithms that comprehend, summarize, produce, and forecast new text-based material using deep learning methods and extraordinarily large data sets [6]. Artificial Intelligence (AI) has been used in research to examine massive datasets and find patterns that would be hard for humans to find; this has produced breakthroughs in areas like drug development and genomics. AI has been applied to healthcare settings to create individualized treatment programs and diagnostic tools. It is essential to make sure that AI is created ethically and for the good of mankind as it continues to advance [7]. Artificial Intelligence (AI) is developing at a rapid pace, which opens up possibilities for its use in clinical settings and might completely transform healthcare delivery. In order to give healthcare professionals, the information and resources they need to successfully apply AI in patient care, it is critical to record and distribute information about the technology's application in clinical settings.

It's interesting to note that research has shown various uses of artificial intelligence in the health sector in low- and middle-income nations. A few instances of these are the use of natural language processing models to expert systems to assist doctors in medical diagnosis and the use of these models in epidemiological surveillance and disease prediction [8]. Also, AI-based chatbots and telehealth platforms have been proposed to address the shortage of health professionals in Africa [9]. In light of Africa's high malaria load and the correspondingly high child mortality rate [10], a novel deep-learning model was recently investigated to determine whether it may speed up malaria detection and support efforts to control the disease there. The study's emerging findings point to considerable promise [11]. Other studies have assessed the potential applications of artificial intelligence in Africa including its use in health insurance plans [9], diagnosis of colorectal cancer [12], and the process of drug discovery and development [13].

Although there is evidence from throughout the world that artificial intelligence and machine learning have great potential for improving healthcare in poor nations, little is known about healthcare providers' perceptions and expertise of these technologies in Nigeria. This study therefore aimed at giving a mini-overview on how AI can support infectious disease diagnosis and treatment with Nigeria as case study.

Artificial Intelligence in Disease Diagnosis

Despite all of the advancements in medicine, accurate disease detection is still seen as a difficulty globally since artificial intelligence is still not fully applied to medical diagnosis. Because of the complexity of the many disease mechanisms and the underlying symptoms, developing early diagnostic tools is a continuous problem in Nigeria and even globally. Thus, AI has the potential to transform a number of areas of healthcare, including diagnostics, particularly through machine learning. Machine learning is a branch of artificial intelligence that employs data as an input resource. It can overcome some of the difficulties and complexity of diagnosis, and its accuracy depends heavily on the quantity and quality of the data entered [14]. In summary, machine learning can help with decision-making, workflow management, and timely and economical task automation. Additionally, layers were added via deep learning using data mining and Convolutional Neural Networks (CNN) to assist find patterns in the data. These are quite useful for finding important patterns in large datasets that indicate the presence of disease. In healthcare systems, these instruments are very useful for identifying, forecasting, or categorizing illnesses [15].

For example, a South Korean study found that AI-powered diagnosis was 90% more sensitive than radiologists to identify breast cancer with a mass, *vs*. 78%, respectively. Additionally, 91% of AI detected early breast cancer, compared to 74% of radiologists [16]. According to a different study, radiologists identify pneumonia from chest radiography with sensitivity and specificity of 50% and 73%, respectively, while deep learning algorithms identify the illness with 96% and 64%, respectively [17]. Comparably, 83.75% of cases were correctly predicted to have acute appendicitis using a variety of machine learning algorithms on a dataset of 625 cases. The accuracy, sensitivity, and specificity of the results were 84.11%, 81.08%, and 81.01%, respectively [18]. While there could be major baseline infrastructure differences between Nigeria and South Korea, health management authorities could look into examples of what is been tested in saner clines to set the standards for future AI-enabled improvements.

In addition, it is reasonable to assume that, in comparison to conventional diagnostic techniques utilized in Nigeria and other developing nations, AI technologies can increase accuracy, lower costs, and save time. AI can also deliver more accurate results faster and with less chance of human error. In the future, AI technology could be used to support medical decisions by providing clinicians with real-time assistance and insights [19]. Researchers are still investigating applications of AI in medical diagnosis and therapy, including the analysis of MRIs, CT scans, X-rays, and medical photographs. AI can also assist in identifying anomalies, detecting fractures, cancers, or other problems by utilizing ML approaches. It can also provide quantitative measurements for quicker and more precise medical diagnosis [7].

Artificial Intelligence in Treatment of Diseases

With its ability to analyze large, complicated datasets, forecast results, and improve treatment plans, Artificial Intelligence (AI) has shown itself to be a useful tool in the advancement of personalized medicine [20]. Personalized medicine, sometimes referred to as precision medicine or customized treatment, is a medical method that customizes care for individual patients according to their distinct attributes, including genetics, lifestyle, environment, and biomarkers [20]. With more focused, safe, and economical interventions, this customized strategy seeks to enhance patient outcomes. While customized care is a cutting-edge area that shows the potential of precision medicine on a broad basis [21]. However, the development of artificial intelligence systems that can foretell people who might need to take medications based on genomic information is necessary if real-time suggestions are to be made [21]. As a result, there is growing awareness for the potential uses of AI to support medical professionals in making treatment decisions, especially in predicting therapy response [21].

For instance, a study by Huang et al. [22] that used patient gene expression data to build a support machine learning system was successful in predicting the treatment response. The authors of this study used the gene-expression profiles of 175 cancer patients to predict how the patients will react to different standard-of-care chemotherapy treatments. Notably, the study had positive results, with over 80% prediction accuracy for a variety of medications. These results show how promising AI is for predicting therapy response [23].

AI algorithms continue to aid in the prediction of drug-drug interactions in the treatment of disease. These algorithms can discover possible medication interactions by analyzing huge patient data sets. This can lower the risk of adverse drug reactions, save costs, and enhance patient outcomes [24]. It can also help identify patients who are more likely to experience bad drug responses. Healthcare providers can proactively avoid adverse events before they occur by reviewing patient data and identifying relevant risk factors [25].

Final Remarks

The fight against infectious diseases in Nigeria and other African countries can benefit greatly from artificial intelligence. However, for the effective implementation of artificial intelligence in Nigeria, the government must demonstrate the requisite political will. Furthermore, initiatives to implement artificial intelligence in Africa ought to involve the commercial sector. AI's application in healthcare has the potential to completely transform patient outcomes and care. Predictive analytics powered by AI can improve clinical laboratory testing and illness detection in terms of precision, effectiveness, and cost-effectiveness. AI can also help with population health management and the creation of guidelines by optimizing pharmaceutical choices and delivering accurate, real-time information. In all, the population of the country who are users of the health services can benefit in terms of quicker turnaround times, wider access to infectious diseases treatment services through telehealth systems, and lower cost of service delivery.

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