The Application Of Artificial Intelligence (AI) In Medicine, With A Focus On Public Health Communication: Prospects For The Nigerian Health Sector

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Abstract: *The intelligent cognition stage of artificial intelligence (AI) development has started. A new age of computer-assisted support in medicine has begun with the advent of AI in education, bringing new opportunities for public health education instruction and learning. In time, medical research might be entirely transformed by artificial intelligence (AI), which can automate data processing, produce fresh perspectives, and advance knowledge. This exploratory research gathers the top areas where AI contributes to public health communication. In this study, we covered the strategic role of communication in public health promotion in Nigeria and the present state and limits of artificial intelligence (AI). We also provided an overview of the broad implementation of AI in public health practice. Given the speed at which technology is developing, we think artificial intelligence (AI) will transform public health education and facilitate handling public health emergencies.*

Keywords: **AI, Artificial Intelligence, Public Health, Medicine, Health Communication, Nigeria**

INTRODUCTION

Broadly, Artificial Intelligence (AI) refers to the process by which computers and machines simulate human behavior, including perception, learning, inferencing, analysis, and decision-making, to perform tasks through data processing and pattern recognition.[1] AI is also a software program that may mimic a context-sensitive response or a discussion (for example, in the form of a chat) with a human user in natural language via messaging services, websites, or mobile applications (apps).[2]

Machine learning, deep learning, neural networks, computer vision, and robotics are the five primary subfields of artificial intelligence (AI), while there are many other subsets and subfields within AI. AI frequently mentions two essential subfields: machine learning and deep learning.[3] Machine learning enables computers to learn autonomously by analyzing training data and experience without explicit programming. Furthermore, its performance improves with time. Machine learning algorithms include the supervised type that needs a training dataset containing input data and expected output and the unsupervised type that the data itself learns instead of the training datasets.[4] Recently, multiple complex problems in areas such as finance, health care, and manufacturing have been well addressed through machine learning.[5]

Deep learning has aroused much concern due to its remarkable success in computer vision, speech recognition, and self-driving cars. Deep learning is not only another subset of AI but also a subset of machine learning. It is a member of a group of machine learning algorithms that employ artificial neural networks with several layers as its architecture for learning data representations.[6] Several types of robotics systems have been developed to assist humans in difficult or dangerous tasks ranging from health care to national defense. All of these lay the foundation for further application and development of AI.

APPLICATION OF AI IN PUBLIC HEALTH

[1] Panch T, Szolovits P, Atun R. Artificial intelligence, machine learning and health systems. J Glob Health. (2018) 8:020303. doi: 10.7189/jogh.08.020303
[2] European Parliamentary Research Service; Artificial intelligence act. 2021. Available online: https://www.univiu.org/images/ aauniviu2017/GP/co-curr/Artificial_intelligence_act.pdf
[3] Hashimoto DA, Witkowski E, Gao L, Meireles O, Rosman G. Artificial intelligence in anaesthesiology: current techniques, clinical applications, and limitations. Anesthesiology. (2020) 132:379– 94. doi: 10.1097/ALN.0000000000002960
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[5] . Dogan A, Birant D. Machine learning and data mining in manufacturing. Expert Syst Appl. (2021) 166:114060. doi: 10.1016/j.eswa.2020.114060
[6] Albert D. The future of artificial intelligence-based remote monitoring devices and how they will transform the healthcare industry. Fut Cardiol. (2021) 18:89–90. doi: 10.2217/fca-2021-0073

Driven by significant advances in computer algorithms and the accumulation of big data over the decades, AI has entered an extraordinary stage of rapid development and widespread application. More recently, traditional AI research areas, including computer vision, speech recognition, and robotics, have also been found to be innovatively applicable in other real-world contexts, such as public health. In particular, the coronavirus pandemic outbreak at the end of 2019 plunged the world into a severe public health crisis. AI-based medical devices, algorithms, and other new industries have shown great potential in surveillance, prevention, diagnosis, and health management, which provides essential support for this global fight against the epidemic.

AI-based apps can enhance health education and promotion from a public health standpoint by providing easily accessible, economical, and engaging solutions.[7] AI can assist in managing chronic illnesses, including diabetes, hypertension, and asthma.[8] In addition, artificial intelligence (AI) systems can assist individuals in receiving automated or remote health services, tests, diagnosis, and therapy; tracking and monitoring health data, symptoms, and treatments (semi-automatically); and receiving emotional support for mental health concerns.[9]

AI applications have evidence-based public health implications, and their application in personalized health promotion, illness prevention, rehabilitation, and disease management shows promise.[10]

In medicine, artificial intelligence (AI) is emerging as a revolutionary force vital to many facets of health care, such as public health communication[11]. Here's a detailed review of the role of AI in the intersection of medicine and public health communication:

Diagnostics and Imaging

AI has revolutionized the field of medical diagnostics and imaging by leveraging advanced algorithms and machine-learning techniques to analyze complex medical data. AI algorithms are used to [12]analyze medical images, such as X-rays, MRIs, and CT scans, assisting in the early detection and diagnosis of diseases. This enhances the efficiency of health-care professionals and contributes to faster and more accurate diagnoses. AI aids pathologists in analyzing tissue samples and identifying abnormalities, facilitating quicker and more precise identification of diseases.

Here's a detailed review of the role of AI in diagnostics and medical imaging:

- Image Interpretation and Analysis: Efficiency Improvement: AI algorithms can process medical images, such as X-rays, MRIs, CT scans, and pathology slides, much faster than human counterparts. This expedites the diagnostic process, leading to quicker treatment decisions.
- Accurate Detection: AI excels in pattern recognition and can identify subtle abnormalities that might be challenging for human eyes. This enhances diagnostic accuracy, particularly in early disease detection.
- Disease Detection and Classification: AI algorithms aid in the early detection of various cancers by analyzing imaging data. For example, AI can identify potential tumors or anomalies in mammography, improving breast cancer screening accuracy.
- Neurological Disorders: AI is used in detecting and classifying neurological conditions, such as Alzheimer's disease and multiple sclerosis, by analyzing brain imaging data.
- Organ Segmentation: AI algorithms can automatically segment and identify different organs or structures within medical images. This assists radiologists in obtaining more detailed information for diagnosis and treatment planning.
- Lesion Detection: AI helps automatically identify and delineate lesions or abnormalities within images, aiding in precise localization for subsequent analysis.
- Integration with Electronic Health Records (EHR): AI tools integrated into diagnostic processes can streamline workflows by automatically associating imaging results with patient records. This improves the overall efficiency of healthcare systems.
- Quality Assurance (Image Quality Improvement): AI algorithms can enhance the quality of medical images, reducing noise and artifacts. This is particularly valuable in situations where low-quality images might impede accurate diagnosis. AI-driven quality control ensures consistency in image interpretation, reducing the likelihood of human errors and diagnosis variations.

[7] Giansanti, D. Artificial Intelligence in Public Health: Current Trends and Future Possibilities. Int. J. Environ. Res. Public Health 2022, 19, 11907.
[8] Piao, M.; Kim, J.; Ryu, H.; Lee, H. Development and Usability Evaluation of a Healthy Lifestyle Coaching Chatbot Using a Habit Formation Model. Healthc. Inf. Res. 2020, 26, 255–264. [CrossRef] [PubMed]
[9] Abd-Alrazaq, A.A.; Alajlani, M.; Alalwan, A.A.; Bewick, B.M.; Gardner, P.; Househ, M. An overview of the features of chatbots in mental health: A scoping review. Int. J. Med. Inform. 2019, 132, 103978. [CrossRef] [PubMed].
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[11] AI in Healthcare Administration – Soject. https://soject.com/tag/ai-in-healthcare-administration/
[12] AI in Healthcare—Innovative use cases & Applications - Urban Fugitive. http://urbanfugitive.com/ai-in-healthcare-innovative-use-cases-applications/

AI diagnostics and imaging have significantly transformed the medical field by enhancing accuracy, efficiency, and personalized treatment planning. To fully realize the advantages of AI in medical imaging, it will be crucial to solve issues with interpretability, data protection, and legislation as technology develops.

Treatment Personalization

AI helps tailor treatment plans based on individual patient characteristics, genetic makeup, and therapy response. [13] This individualized strategy can reduce side effects and enhance therapeutic results. AI accelerates drug discovery by analyzing vast datasets, predicting potential drug candidates, and optimizing the drug development process.

AI has made significant strides in treatment personalization, ushering in a new era of precision medicine. Here's a detailed review of the role of AI in tailoring treatment plans based on individual patient characteristics:

- *Genetic Profiling:* AI analyzes genomic data to identify genetic mutations and variations that may influence disease susceptibility and treatment response. This information is crucial for tailoring treatments to individual genetic profiles.
- *Pharmacogenomics:* AI assists in predicting how individuals will respond to specific medications based on their genetic makeup, minimizing adverse effects, and optimizing treatment efficacy.
- *Clinical Decision Support Systems (CDSS):* AI-enabled CDSS integrates diverse patient data, including electronic health records (EHR), laboratory results, and imaging data, to provide a comprehensive view of a patient's health status. These systems offer real-time treatment recommendations based on a patient's unique health profile, supporting clinicians in making informed decisions.
- *Drug Discovery and Development (Target Identification):* AI accelerates drug discovery by identifying potential drug targets through the analysis of biological data. This helps in developing medications that are more specific to individual patient needs.
- *Drug Repurposing:* AI analyzes existing drug data to identify potential new uses for existing medications. This may shorten the time and expense of medication development while also resulting in the identification of innovative therapeutic alternatives.
- *Treatment Response Prediction (Predictive Analytics):* AI models analyze patient data to predict how individuals are likely to respond to specific treatments. This enables health-care providers to choose interventions with higher probabilities of success.
- *Machine Learning Algorithms:* These algorithms continuously learn and adapt, improving their accuracy as they process more patient data and treatment outcomes.
- *Tumour Profiling:* AI helps analyze tumors' molecular and genetic characteristics to identify personalized cancer therapies. This includes targeted therapies and immunotherapies tailored to the specific molecular makeup of the patient's cancer.
- *Monitoring Treatment Resistance:* AI can predict and monitor the development of resistance to cancer treatments, allowing for timely adjustments to the therapeutic approach.
- *Diabetes Management:* AI assists in personalizing insulin dosages and treatment plans for diabetes patients based on continuous monitoring of glucose levels and other relevant factors.
- *Cardiovascular Diseases:* AI helps optimize treatment plans for cardiovascular diseases by considering individual risk factors, genetic predispositions, and lifestyle factors.
- *Remote Patient Monitoring (Wearable Technology):* AI integrates data from wearable devices to monitor patients remotely. This enables real-time adjustments to treatment plans based on the individual's health status and lifestyle.

AI supports personalized interventions for managing chronic conditions, ensuring that treatment plans evolve with changing health needs; AI has significantly advanced treatment personalization by leveraging patient data, genomic information, and advanced algorithms. To fully utilize AI's promise to transform personalized medicine, it will be necessary to overcome ethical issues and regulatory obstacles as the area develops.

Public Health Surveillance

AI is utilized to monitor and predict the spread of infectious diseases. Machine learning models can analyze data from various sources, including social media, to identify patterns and provide early warnings about potential outbreaks. AI helps create models that simulate the spread of diseases, allowing public health officials to plan and implement effective intervention strategies.

AI plays a pivotal role in public health surveillance, contributing to the monitoring, analyzing, and managing of health-related data on a population scale. Here's a detailed review of the role of AI in public health surveillance:

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[13] Top 10 Best Radiation Oncologist in Chennai | VS Hospitals. https://vshospitals.com/best-radiation-oncologist-in-chennai/

- *Early Detection of Outbreaks (Data Analysis and Pattern Recognition):* AI algorithms can analyze large datasets, including clinical records, social media, and environmental data, to identify patterns indicative of potential outbreaks.
- *Predictive Modelling:* Based on past data, machine learning algorithms can forecast the probability of disease outbreaks, assisting public health professionals in planning for preventative actions.
- *Simulation and Prediction:* AI-powered models simulate the spread of diseases, considering various factors such as population density, mobility patterns, and environmental conditions. This aids in predicting the progression of diseases and planning effective interventions.
- *Real-time Monitoring:* AI continuously analyzes incoming data to provide real-time updates on disease trends, allowing for timely response and resource allocation.
- *Automated Reporting:* AI streamlines the process of data collection and reporting, reducing the burden on public health agencies. Automated systems can collect and analyze information from various sources, including electronic health records and laboratory reports.
- *Syndromic Surveillance:* AI monitors patterns of symptoms reported by health-care facilities to detect potential outbreaks or unusual health events, providing an early warning system.
- *Social Media Monitoring and Sentiment Analysis:* AI tools can analyze social media content to detect mentions of symptoms, diseases, or clusters of illnesses. This provides additional data for surveillance and complements traditional methods.
- *Sentiment Analysis:* Contact Tracing Optimization: AI aids in the rapid identification of individuals who may have been exposed to a contagious disease, facilitating quicker and more targeted contact tracing efforts.
- *Network Analysis:* AI models can analyze social networks and identify potential transmission pathways, aiding in understanding and controlling the spread of infectious diseases.
- *Resource Allocation and Planning (Demand Prediction):* AI helps predict the demand for health-care resources, such as hospital beds, ventilators, and medical supplies, based on the projected spread of diseases. This assists in resource allocation and strategic planning.
- *Geospatial Analysis:* AI tools analyze geographical data to identify high-risk areas, enabling targeted interventions and resource deployment. AI algorithms gauge public sentiment, helping public health agencies understand public perceptions, concerns, and potential misinformation during health crises.
- *Vaccine Distribution and Campaigns:* AI supports the development of optimal vaccination strategies by analyzing demographic data, disease spread patterns, and vaccination coverage rates.
- *Communication Campaigns:* AI assists in designing targeted communication campaigns to increase public awareness about vaccination programs and address concerns.

Given that AI systems must abide by stringent privacy laws and ethical requirements, balancing the necessity of public health surveillance and individuals' right to privacy is a critical task. AI in public health surveillance can improve the efficacy and efficiency of disease monitoring and response initiatives. To maximize the advantages of AI in protecting public health, however, cooperation among stakeholders must be encouraged, ethical issues must be addressed, and data quality must be guaranteed.

Natural Language Processing (NLP) in Public Health Communication

AI-powered chatbots assist in disseminating information to the public, answering queries, and providing guidance on health-related matters. These tools enhance public engagement and ensure the delivery of accurate information. AI algorithms analyze social media and online content to gauge public sentiment regarding health-related issues. This information can guide public health communication strategies and address concerns in real time.

Natural language processing (NLP) allows computer programs to understand written and spoken human language. Natural language processing in health care enables organizations to extract vital document data quickly. It organizes uncategorized clinical information, gives valuable insights, and streamlines manual workflows.

When health-care professionals put medical documents into an NLP system, its algorithms try to understand the input. Natural language processing is designed to recognize characters and words in a document and comprehend what they mean. For instance, NLP can differentiate between a patient's name and a disease symptom. NLP algorithms can also recognize whether a medical document contains details of multiple patients. NLP employs a variety of artificial intelligence (AI) approaches to extract data from medical texts after it has analyzed and comprehended the input. NLP and AI can:

- Segment the details accurately if they are from a multi-patient medical document.
- Format the data into Electronic Health Record (EHR) systems.

Medical documents in random formats, such as scans, PDFs, and text, are unstructured data. That means the information is random and unorganized. Unstructured data is less valuable because it lacks meaningful context that EHR systems can use. For unstructured data to be usable and fit into health-care workflows, it must be converted to structured data. Structured data is formulaic and conforms to a preset template. In other words, you need patterns of data organized by category. That way, it's easy to analyze and record in health-care systems. Within health-care organizations, making unstructured data structured often means hospital staff manually reviewing physical medical records, PDFs, or images. Then, they sort the information before feeding it into the organization's system. This makes operations slower, inefficient, and time-consuming.

NLP for health-care is a faster and more efficient alternative. Instead of burdening already-busy hospital staff with manual documentation processes, hospitals can use NLP to:

- Identify and interpret unstructured data in documents
- Extract intelligence from unstructured documents and get usable insights
- Enter the structured data into EHR systems

In short, NLP for health care automates data extraction. As a result, clinicians and administrators get actionable insights from documents. And the process happens in less time so that they can make informed decisions quickly. Fast decisions translate to faster patient care.

Behavioral Analysis and Intervention

AI models analyze demographic and behavioral data to predict health-related behaviors and trends. This information can be used to design targeted interventions to promote healthier lifestyles and prevent the spread of diseases. AI supports monitoring patient adherence to treatment plans through data analysis, enabling better outcomes and reducing the risk of complications.

Telemedicine and Remote Monitoring

AI facilitates the remote monitoring of patients, collecting real-time health data, and alerting health-care providers to potential issues. This is particularly crucial for managing chronic conditions and ensuring timely interventions.

Artificial Intelligence (AI) has significantly impacted telemedicine and remote monitoring, transforming how health-care is delivered and managed remotely. The table below shows a detailed review of the role of AI in these areas:

ROLES	DESCRIPTION
REMOTE DIAGNOSTICS	**AI Imaging Analysis:** AI algorithms can analyze medical images remotely, aiding in diagnosing conditions through telemedicine, including the interpretation of X-rays, MRIs, CT scans, and pathology slides.
	Diagnostic Chatbots: AI-powered chatbots can collect and analyze patient symptoms and history, providing preliminary diagnostic information in telehealth.
TELECONSULTATIONS AND VIRTUAL HEALTH ASSISTANTS	**Virtual Consultations:** AI-driven virtual assistants facilitate teleconsultations, guiding patients through preliminary assessments, scheduling appointments, and providing information about medications and treatment plans.
	Voice and Text-based Communication: Natural Language Processing (NLP) enables AI to understand and respond to patient's questions and concerns, enhancing the communication experience during virtual consultations.
REMOTE PATIENT MONITORING (RPM)	**Wearable Devices:** AI integrates with wearable devices to remotely monitor patients' vital signs, activity levels, and other health metrics, particularly valuable for managing chronic conditions and postoperative care.
	Real-time Alerts: AI algorithms can analyze continuous patient data and generate real-time alerts for health-care providers when abnormalities or potential issues are detected, enabling timely interventions.
MEDICATION ADHERENCE	**Adherence Monitoring:** AI helps monitor and promote medication adherence by sending reminders, tracking consumption patterns, and analyzing patient behavior to identify potential adherence issues.
	Personalized Medication Plans: AI tailors medication plans based on individual patient characteristics, improving the likelihood of adherence.

DECISION SUPPORT SYSTEMS	**Clinical Decision Support:** AI provides real-time decision support to health-care professionals during teleconsultations, offering insights into diagnosis, treatment options, and personalized care plans.
	Remote Triage: AI-driven triage systems help prioritize patient needs, ensuring that individuals with urgent conditions receive timely attention.
TELEPSYCHIATRY AND MENTAL HEALTH SUPPORT	**Emotional Analysis:** AI can analyze facial expressions, voice tone, and text to assess patients' emotional well-being during virtual mental health consultations.
	Chatbots for Emotional Support: AI-powered chatbots offer immediate support for mental health concerns, providing coping strategies and resources.
DATA SECURITY AND PRIVACY	**Secure Communication:** AI contributes to developing specific telemedicine communication platforms, ensuring the confidentiality and privacy of patient data.
	Blockchain Technology: Blockchain technology is used by several telemedicine applications to improve the confidentiality and accuracy of medical data.
PREDICTIVE ANALYTICS AND PREVENTIVE CARE	**Predictive Health Monitoring:** AI models analyze historical and real-time patient data to predict potential health issues, allowing for proactive interventions and preventive care.
	Risk Stratification: AI helps stratify patients based on their risk profiles, guiding health-care providers in allocating resources more efficiently and focusing on high-risk individuals.

AI is essential to expanding the potential of telemedicine and remote monitoring and raising the effectiveness, accessibility, and standard of treatment provided from a distance. Addressing challenges and ensuring ethical use will be vital in maximizing their positive impact on health-care delivery as these technologies evolve.

HEALTH COMMUNICATION IN NIGERIA

Health communication is a broad term that means different things to different people. Scholars have defined and described health communication from different perspectives. This is because, like most concepts, there is no universal definition but rather perspectives that define health communication.

According to some scholars, health communication is the study and application of communication techniques to inform and sway public and individual decisions that improve health. It is essential to the total accomplishment of the goals and objectives of public health and includes illness prevention, treatment, and health promotion.[14] According to some, health communication studies how human and mediated communication affects the provision of health care and the advancement of health. He thinks it is problem-based and identifies serious communication issues that impede the quality and promotion of health care. He also suggests accurate health communication interventions, policies, and programs for improving the quality of health-care practices.[15]

The value of excellent health communication in the Nigerian health-care system cannot be overstated. The communication process in the health care system is essentially the dissemination of health information to individuals in the community. However, the goal of communication in general is to guarantee that persons considered beneficiaries have adequate access to cheap health care. Furthermore, the potential of a better and more effective health care delivery system in Nigeria and other emerging countries is dependent on the quality of the health information system.

In Nigeria, the Federal Ministry of Health & Social Welfare (FMoH&SW) is mandated to ensure high-quality health-care and vital services for a healthy Nigeria. It upholds global standards of excellence, striving for a prosperous nation through effective programs and assistance. Per this mandate, they are tasked with creating and implementing policies and programs as well as carrying out other essential tasks that will fortify the national health system and enable it to provide effective, efficient, and reasonably priced health-care services that improve the health status of Nigerians and act as the catalyst for the goal of faster economic growth and long-term development. The ultimate vision of all these moves is to reduce the morbidity and mortality due to infectious diseases to the bare minimum, having minimal prevalence of non-communicable diseases, fulfill the worldwide aim for illness elimination and eradication, and considerably boost Nigerians' life expectancy and quality of life.

The key documents backing the Public Health sector in Nigeria are as follows:

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[14] Sixsmith, J., Doyle, P., D'Eath, M., & Barry, M. (2014). Health communication and its role in the prevention and control of communicable diseases in Europe: Current evidence, practice and future developments. Stockholm: ECDC.
[15] Kreps, G. L. (2015). Health communication inquiry and health promotion: A state of the art review. Journal of nature and science, 1-12.

- National Mental Health Act.
- National Policy and Strategic Framework for Community Health 2021.
- Diabetic Retinopathy Guidelines.
- National Guidelines for the Prevention, Control and Management of Diabetes Mellitus in Nigeria.
- Eye on Covid: A National Guideline and Standard Operating Procedure for Eye Care During COVID-19 Pandemic.
- Global Fund Nigeria Malaria Grant: Report of LMIS-HMIS Data Triangulation Exercise – 2020.

Mental health issues are prevalent in many African countries, yet they rarely receive the care they need. In most African nations, stigma is a common issue that discourages people from seeking mental health treatment. Nigeria, Africa's most populous country, passed its first mental health law, the Lunacy Ordinance. This legislative structure was updated in 1958, under the name Lunacy Act, to provide magistrates and medical practitioners the right to imprison people with mental illnesses.[16]

Nigeria's first mental health strategy was created in 1991, and it had the following components: advocacy, promotion, treatment, prevention, and rehabilitation. A mental health bill was presented to the Nigerian National Assembly in 2003 to rectify the numerous flaws in the 1958 legislation. These flaws stemmed from a lack of awareness regarding mental health concerns and the limited and ineffectiveness of the treatments that were available at the time. Nevertheless, the bill was withdrawn in April 2009. The measure was reintroduced in 2013 but failed to pass because of a lack of support.[17]

In addition to the fact that stigma and discrimination are widespread, services are understaffed, people who suffer from mental health concerns are frequently mistreated, and Nigeria's health and development policy agenda has historically ignored mental health. Family members are commonly tasked with providing treatment for people with mental health concerns since primary health-care providers have a poor grasp of mental health diseases.

About 80% of persons with significant mental health needs are not receiving the care they require due to a lack of mental health professionals (there are only 300 psychiatrists for over 200 million people in Nigeria), poor infrastructure, and unfavorable public opinions of mental health issues.[18]

Lack of public knowledge on mental health has resulted in a lot of myths and misconceptions as well as a low level of acceptance of those who struggle with mental health concerns. Furthermore, the recovery process of individuals with mental health illnesses is significantly impacted by cultural and religious prejudices[19].

Nigeria underwent a significant transition when the 65-year-old Lunacy Act was replaced with the Mental Health Bill 2021, which was signed into law by the president of Nigeria on 5 January 2023. Nigeria's National Mental Health Act 2021 indicates the political intent of the country recognizing the need to enhance mental health treatment, but its goals can only be realized with successful implementation. One of the most important things for a successful implementation is funding. Other concerns should also be addressed, such as raising the amount allotted for mental health treatments relative to the cost of health-care. For the legislative framework to be correctly implemented, the Nigerian government must commit to providing the necessary financial, material, and human resources.[20]

The National Health Policy (NHP) 2016 acknowledges Nigeria's significant communicable and non-communicable diseases (NCDs) burden. This is compounded by low health literacy, poor sanitation, and insufficient focus on essential topics and social determinants of health. The NHPP (2019) aimed to fulfill Nigeria's promise to provide preventative, motivating, protecting, restorative, and rehabilitative health-care to all citizens.[21]

Globalization and other factors have led to significant changes in the country's alcohol, food, and tobacco use. Cancer, diabetes, and hypertension are becoming increasingly prevalent, causing disease patterns to shift. The prevalence of mental health issues, road traffic accidents, domestic violence, unsafe sex, and lack of physical activity is also increasing. Nigeria faces several risks, including instability, floods, Lassa disease, Ebola, Cholera, Polio, and Avian Influenza.

Over time, Nigeria's health sector expenditure has fallen short of the 15 percent target outlined in the 2001 Abuja Declaration, which committed member states of the African Union to dedicate at least 15 percent of their yearly national budgets to health. The existing health disparities reflect the relationships between people's health, social circumstances, and economic standing throughout Nigerian states. This contributes to nearly all political, economic, and socially motivated causes of disease and death, making it more difficult

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[16] Inter-Agency Standing Committee. Response to the humanitarian crisis in Haiti following the 12 January 2010 earthquake. July 14, 2010. https://reliefweb.int/report/haiti/responsehumanitarian-crisis-haiti-following-12january-2010-earthquake-achievements
[17] Saied, AbdulRahman A. "Nigeria's National Mental Health Act 2021: Any Challenges Ahead?" The Lancet, 2023, https://doi.org/10.1016/s0140-6736(23)00345-8.
[18] Miller, J. Medical Equipment Graveyards. May 20, 2021. https://medaid.co.uk/medicalequipment-graveyards
[19] The Mind of Christ – paint-and-pen.com. https://paint-and-pen.com/tag/the-mind-of-christ/
[20] AbdulRahman A. S. (2023) Nigeria's National Mental Health Act 2021: any challenges ahead?. National Food Safety Authority, Aswan Branch, Aswan, Egypt; Ministry of Tourism and Antiquities, Aswan Office, Aswan 81511, Egypt.
[21] National Health Promotion Policy. Federal Ministry of Health, Nigeria (Revised 2019).

for the government to address the social determinants of health effectively. In light of this, health promotion becomes extremely important.

Nigerian health promotion has changed dramatically from a mostly health education-focused approach to a more inclusive and comprehensive approach to promoting health and avoiding illness. Nigeria needs a dynamic, strong, and long-lasting health promotion system as it goes through a demographic shift that puts more strain on its already precarious health-care system. Integrating health interventions within a multi-sectoral framework, addressing the broader determinants of health, encouraging healthy lifestyles, and inspiring people, families, communities, and the entire population to take action in support of their health are all deliberate endeavors.

The updated Nigeria Health Information System (HIS) policy establishes an integrated framework for collecting, analyzing, storing, disseminating, and using health-related data and information. The policy influenced the preparation of the HIS Strategic Plan from 2014 to 2018.

The country's Health Information System (HIS) remains ineffective. The HIS system is divided into donor-driven vertical programs that operate independently.

Despite earlier expenditures in enhancing the nation's HIS, the sub-sector still faces challenges owing to multiple data-gathering technologies and a lack of reporting capabilities. The DHIS 2 platform collects data from 38,500 private primary and secondary facilities. In 2017, the reporting rate averaged 72%, but the timeliness was just 63%. The data reported was much lower than national estimates from other sources, reducing its usefulness value. The private sector provides 60% of health-care services in the country, yet their data is not fully captured in the HMIS. Tertiary health institutions do not report to LGAs within their domain; hence, their data is not captured in DHIS 2. Other data subsystems, including vital statistics, surveys, and health research, are not optimal. Poor data quality remains at all levels. There is no structured mechanism for analyzing HMIS data and providing feedback to health facilities. The utilization of HMIS data as a management tool for health planning and improvement has been hampered by this deficiency. Other difficulties include a deficient system for coordinating M&E across all levels, inadequate human resource capacity, a shortage of material resources, particularly at the subnational level, and the HIS policy's failure to consider data quality concerns.[22]

ETHICAL CONSIDERATIONS AND CHALLENGES

There are several ethical issues and difficulties when artificial intelligence (AI) is used in the medical industry. Here are some essential things to think about:

Data Privacy: The use of AI in health-care raises concerns about the privacy and security of patient data.[23] Striking a balance between innovation and protecting individuals' sensitive health information is a significant challenge.[24] Handling large amounts of sensitive medical imaging data requires robust privacy measures to protect patient confidentiality. Data breaches provide a substantial danger. It is critical to protect against unwanted access and implement robust cybersecurity procedures.

Bias and Fairness: AI models may inherit biases in training data, potentially leading to disparities in health-care delivery. Addressing these biases is essential to ensure fair and equitable outcomes.

Interpretability: The "black-box" nature of some AI algorithms challenges understanding how they arrive at specific diagnoses. Ensuring transparency is crucial for gaining trust among health-care professionals.

Culpability for Errors: Establishing culpability becomes difficult when AI systems make mistakes or provide incorrect results. Establishing accountability frameworks is critical for addressing AI failures.

Validation and Regulation: Rigorous testing and validation are necessary to ensure the reliability of AI algorithms in clinical settings. Regulatory frameworks must be in place to govern the deployment of these technologies in health-care.

Algorithmic Fairness: Ensuring fairness in AI algorithms, particularly in health-care, is crucial for avoiding prejudice and promoting equal health-care results.

Informed Consent: Patient consent for sharing and using personal health data is crucial. Clear communication about how AI is being used and ensuring patient understanding is essential.

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[22] Second National Strategic Health Development Plan (Nshdp Ii) 2018-2022

[23] Artificial Intelligence in Healthcare: Revolutionizing Diagnosis & Treatment - Education-Load. https://education-load.com/artificial-intelligence-in-healthcare-revolutionizing-diagnosis-treatment/

[24] Regulations for AI to Ensure Ethical and Fair Practices - Premier Workforce Solutions LLC. https://premierworkforcesolutionsllc.com/2023/07/13/regulations-for-ai-to-ensure-ethical-and-fair-practices/

Understanding AI Use: Patients may not completely understand the consequences of AI usage in health-care. Adequate informed consent mechanisms must be in place to ensure that patients understand how AI will be utilized in their diagnosis, treatment, or other medical procedures.

Physician Autonomy: AI should enhance, rather than replace, the work of health-care practitioners. Maintaining health-care practitioners' autonomy and ensuring that AI is utilized to help decision-making rather than dictate it is critical.

Equitable Access: Only some people or health-care organizations can access breakthrough AI technology. Equitable access to AI tools and benefits is critical to preventing worsening health-care inequities.

Compliance Challenges: Regulating organizations face difficulties with quickly advancing AI technology. Laws about the specifics of medical AI need to be developed and updated to ensure ethical use and protect patient interests.

Equitable Access: Ensuring that AI-powered telemedicine solutions are accessible to all populations, including those with limited technological resources, is essential to avoid exacerbating health-care disparities.

Regulatory Frameworks: Establishing robust regulatory frameworks is essential to ensure AI's safety, efficacy, and ethical use in treatment personalization.

Data Quality and Standardization: Ensuring data quality, accuracy, and standardization from various sources is crucial for reliable surveillance and analysis.

Interoperability: Establishing interoperability between health systems and data sources is essential for seamless information exchange and comprehensive surveillance.

Training for Health-care Professionals: Continuing education and training for health-care professionals is essential to integrating AI into medical practice. Ensuring practitioners are competent in applying AI tools ethically and efficiently is crucial.

Addressing these ethical concerns requires collaboration among researchers, health-care practitioners, politicians, and technology developers to create norms and standards promoting patient well-being, justice, and openness.

CONCLUSION

In summary, artificial intelligence (AI) has become a crucial component of contemporary healthcare, substantially impacting public health communication through the improvement of monitoring, personalization of therapies, diagnostic capabilities, and public outreach. To optimize the advantages of artificial intelligence (AI) in medicine while resolving ethical concerns and problems, collaboration between academics, engineers, and healthcare providers is essential as technology develops.

The need to improve the way staff are trained and to reform teaching techniques has arisen from the growing emphasis on public health education. It is imperative to build a new education system for the modern period that prioritizes intelligent and participatory learning methods. Nevertheless, given the current infrastructure, providing students with a tailored education at medical institutions is challenging. The lack of collaboration in education and the tension between intelligent and traditional teaching methods make it difficult to provide public health educators with the higher-quality educational materials society demands.

Artificial intelligence (AI) in education will provide fresh possibilities to raise the standard of instruction and learning significantly. AI helps students strengthen their areas of weakness and develop new abilities, which, on the one hand, makes learning plans and courses more personalized for each student and makes tutoring easier. Alternatively, intelligent technologies that support data gathering, evaluation, and better learning outcomes might benefit instructors.

AI has been incorporated into several educational disciplines, including radiography, ophthalmology, music, and physical education. It gained technological support and successfully pushed the field's development toward intelligence and humanity. Therefore, to better prepare public health practitioners for emergencies, we may redesign public health education and create a formal integrated AI curriculum at medical schools with the aid of the education department. AI-based public health education is anticipated soon to provide the public health system with previously unheard-of momentum, enhancing its capacity to handle crises.

If an appropriate health communication system is implemented, the use of AI in Nigeria's healthcare delivery system will take off successfully. However, planning and ensuring that the right kind of health staff are placed in place to ensure the adoption of health communication and AI strategy is necessary for the successful execution of health policy in Nigeria. New facilities and sophisticated communication systems must be installed for our health centers and other healthcare organizations to function correctly. This advancement will significantly contribute to ensuring that our AI health care services are helpful, pertinent, inexpensive, and available to everyone.

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