The Role of Artificial Intelligence in Health Promotion in the Contemporary Society

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Abstract

Artificial Intelligence (AI) is increasingly becoming a transformative force in health promotion efforts worldwide. Artificial Intelligence is increasingly utilized in health promotion to enhance personalized interventions and improve outcomes. It is transforming the healthcare industry in profound ways, including revolutionizing patient care, evolving the patient experience, improving operational efficiencies, and assisting in medical research. Research indicates that AI-driven devices can converse, provide reminders, and inspire those aiming to adopt healthier habits. These devices can also monitor personal data in real time and analyze it. This capability enables customized feedback, insights, and personalized recommendations to motivate individuals toward positive and enduring behavioral changes. Nevertheless, all round successful implementation of AI in healthcare requires collaboration among the technologists, healthcare workers and clients to control some breaches. Such breaches as protecting the confidentiality and security of sensitive health information is crucial; ethical issues related to AI in healthcare, such as bias in algorithms and obtaining informed consent, need careful consideration; the essentiality of ensuring that AI-based treatments are accessible to everyone, irrespective of their socioeconomic status etc. Summarily, integration of AI in healthcare will be an added advantage in promoting the health of the public if government, technologists and health agencies will collaborate to address the challenges.

Keywords: Artificial Intelligence, health promotion, contemporary society, algorithms, public health education.

Introduction

Artificial intelligence is a rapidly evolving tool revolutionizing many aspects of healthcare. Artificial Intelligence is increasingly being leveraged in health promotion to enhance strategies aimed at improving public health and individual well-being. According to World Health Organization (WHO, 2024), prioritizing AI for health is crucial, given its potential to enhance healthcare and address global health challenges, including the achievement of sustainable. The AI accelerates and improves core areas of interaction between patients, providers, and solution entities to facilitate personalization, improve patient outcomes, and enhance the overall quality of healthcare services through data-driven decision-making (Le'Rhone, 2024).

The increasing intricacies of health conditions coupled with the rapid expansion of data have made the integration of AI in healthcare a crucial step to meet the demand for improved precision, effectiveness, and individually tailored medical attention (Leewayhertz, 2024). AI is bringing in a revolutionary era in the healthcare industry, shifting the paradigm from a one-size-fits-all approach to medicine to a more nuanced, predictive, personalized, and preventive holistic care model as remarked by Witt (2023).

Research has shown that AI powered devices can engage in conversations, offer reminders and motivate individuals seeking to adopt healthier habits. The AI-enabled devices can track real time personal data. This allows for tailored and personalized feedback, insights and individual recommendations to encourage individuals to make positive and sustained changes in their behaviors (Mogles et al., 2024). The explosion of generative AI tools for natural language generation, data processing, image generation and many other uses is rapidly changing the landscape for content development in the areas of health education and patient engagement, both of which are critical to promote healthy behaviors and address persistent health disparities among vulnerable groups (Garfield, 2023).

Driven by major advances in computers algorithms and 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. The AI-based medical devices, algorithms, and other new industries have shown great potential in surveillance, prevention, diagnosis, and health management, which provide important support for this global fight against the epidemic (Kanade, 2022).

Artificial Intelligence

Artificial Intelligence 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. The 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 (Amanawa & Vanessa, 2024).

Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience (Copeland, 2024).

According to Kanade (2022), there are different components of AI which need to work in conjunction with each other. They are:

- Machine learning: Machine learning is an AI application that automatically learns and improves from previous sets of experiences without the requirement for explicit programming.
- Deep learning: Deep learning is a subset of ML that learns by processing data with the help of artificial neural networks.
- Neural network: Neural networks are computer systems that are loosely modeled on neural connections in the human brain and enable deep learning.
- Cognitive computing: Cognitive computing aims to recreate the human thought process in a computer model. It seeks to imitate and improve the interaction between humans and machines by understanding human language and the meaning of images.
- Natural language processing (NLP): NLP is a tool that allows computers to comprehend, recognize, interpret, and produce human language and speech.
- Computer vision: Computer vision employs deep learning and pattern identification to interpret image content (graphs, tables, PDF pictures, and videos).

An AI system accepts data input in the form of speech, text, image, etc. The system then processes data by applying various rules and algorithms, interpreting, predicting, and acting on the input data. Upon processing, the system provides an outcome, i.e., success or failure, on data input. The result is then assessed through analysis, discovery, and feedback. Lastly, the system uses its assessments to adjust input data, rules and algorithms, and target outcomes. This loop continues until the desired result is achieved (Kanade, 2022).

Brief History of Artificial Intelligence in Public Health

The 1960s saw the beginning of artificial intelligence (AI) research, which first aimed to create systems that could mimic human intelligence. Expert systems, which utilized knowledge from human specialists to give decision assistance for medical diagnosis and treatment planning, were the main focus of early AI applications in healthcare. Expert systems were still the main focus of AI research in the healthcare sector in the 1980s and 1990s, but machine learning and natural language processing were also being investigated. Researchers were able to begin exploring the potential of AI in domains such as medical diagnosis, drug discovery, and public health surveillance as a result of the availability of enormous databases of medical information and sophisticated computer systems (Olawade et al., 2023).

The 2000s saw advancements in computer vision, natural language processing, and machine learning that made it possible for researchers to create increasingly complex AI systems that could evaluate vast amounts of data and anticipate future outcomes. Due to this, AI-based diagnostic systems were created, such as those that analyze medical images and help with the identification of diseases like cancer. Additionally, improvements in text mining and natural language processing methods allowed academics to use AI to evaluate vast amounts of unstructured data, such as electronic health records, and derive insightful conclusions (Zeng et al., 2020).

Recent years have seen a rise in interest in the use of AI within public health, notably in the fields of predictive modeling and public health surveillance. AI algorithms, for instance, have been used to forecast the spread of infectious diseases like COVID-19 or influenza, enabling public health officials to take preventive measures. They have also been used to analyze vast amounts of data from social media and other sources to spot potential outbreaks and monitor the spread of diseases (Zeng et al., 2020). Furthermore, the application of AI in public health has grown to include new fields like drug development and personalized treatment due to the increased accessibility of massive data and sophisticated computing resources. In general, there has been a growth in the history of AI in public health from primitive expert systems to more advanced systems that can examine vast volumes of data and make predictions (Olaoye et al., 2024).

Artificial Intelligence in Nigerian Health Care System

Nigeria, with its large population and significant disease burden, offers a vast opportunity for AI in healthcare. Many healthcare institutions in the country have started adopting AI-driven solutions to enhance healthcare services. Lagos University Teaching Hospital has developed an AI-based system for diagnosing breast cancer. The system utilizes machine learning algorithms to analyze mammograms and identify early signs of the disease. Wellvis, a Nigerian startup, developed an AI-driven telemedicine platform that enables patients to remotely consult with healthcare providers (Upadhyay, 2024). This enhances access to healthcare services, especially in rural areas with limited medical infrastructure. The growing

availability of AI-based solutions, along with heightened investment from both government and private sectors in advancing artificial intelligence in healthcare, is expected to drive the adoption of AI in Nigeria in the years ahead. The Nigerian Communications Commission (NCC) has launched a research grant program aimed at fostering the development of innovative and impactful technologies, such as artificial intelligence (AI) in healthcare (Health Strategy and Delivery Foundation, 2024).

There some constraints that need to be addressed. A major challenge is the insufficient medical infrastructure, especially in rural areas with limited healthcare resources. Additionally, low digital literacy among patients and healthcare workers could hinder the adoption of AI-based solutions. The use of AI entails handling sensitive patient data, making data privacy and security a major concern. Additionally, the lack of comprehensive regulatory frameworks for AI in healthcare poses a significant challenge, as it is crucial for ensuring the safe and effective implementation of AI technologies in Nigeria (Upadhyay, 2024).

Health Promotion

Good health is the best resource for personal, economic, and social progress. The World Health Organization indicates that Health Promotion constitutes a global, political, and social process that encompasses actions aimed at both strengthen the abilities and capacities of individuals and communities, and, even more important, modifying social, environmental, and economic conditions in order to favor its positive impact on individual and collective health (Pan American Health Organization [PAHO] & WHO, 2019). The authors emphasized that health promotion develops people's health potential while putting into consideration the available assets and social/cultural conditions that could affect their health.

According to WHO (Ottawa Charter in 1986), Health promotion is the process of enabling people to increase control over, and to improve, their health. It moves beyond a focus on individual behaviour towards a wide range of social and environmental interventions (WHO, 2024). Public Health Ontario (2024), defined Health promotion as the process of implementing a range of social and environmental interventions that enable people and communities to increase control over and to improve their health. Other authors opined that health promotion seems to be the art and science of helping people, enhancing their motivation to seek better health, and supporting them in changing their behavior to reach optimal health (Spevan et al., 2022).

A Brief History of Health Promotion

The first International Conference on Health Promotion was held in Ottawa in 1986, and was primarily a response to growing expectations for a new public health movement around the world. It launched a series of actions among international organizations, national governments and local communities to achieve the goal of "Health for All" by the year 2000 and beyond. The basic strategies for health promotion identified in the Ottawa Charter were: advocate (to boost the factors which encourage health), enable (allowing all people to achieve health equity) and mediate (through collaboration across all sectors).

Since then, the WHO Global Health Promotion Conferences have established and developed the global principles and action areas for health promotion. Most recently, the 9th global conference (WHO, 2016), titled ‘Promoting health in the Sustainable Development Goals: Health for all and all for health, highlighted the critical links between promoting health and the 2030 Agenda for Sustainable Development.

Contemporary Society

Contemporary society refers to the current social, cultural, and political conditions and values that exist in the present time. This contemporary society characterized by technological innovation and increasing human interconnection and globalization. The advances in technology in this era cut-across different sectors including health care system and others, which consequently have led to profound changes in the way we live, work, and interact (Khadar, 2023).

As technology advances, artificial intelligence (AI) has become a significant force, altering our lifestyles and work dynamics in this contemporary time. It plays a transformative role in shaping daily activities, from how we engage with technology to how businesses operate. The AI's impact extends across various facets of society, influencing not only individual experiences but also the broader interactions within our communities and workplaces. Artificial intelligence as a universal field is relevant to all intellectual tasks that tries not only to understand, but also to build intelligent entities (Spalevic et al., 2023).

The Needs of AI in Health Promotion

Integration of artificial intelligence into healthcare services can be very useful in health promotion strategies. It can be helpful in many ways such as:

- Disease surveillance and prevention: Disease surveillance in public health aims to detect early and reliable signals of health anomalies and epidemic outbreaks from the diverse collection of data sources. Data sourcing and analysis are two major challenges for public health surveillance (Barros et al., 2020). The AI-based ubiquitous social media, online newswires, and other internet-based data streams effectively leverage various open data beyond traditional public health surveillance systems through its powerful surveillance capabilities, which expand and facilitate data sourcing. Traditional data analysis is primarily achieved through statistical methods that focus primarily on macro-level conclusions (Zeng et al., 2020). The AI-based analytics methods such as natural language processing and image processing converted unstructured data into structured items through semantic labeling and auto-population of features, which in turn enhances traditional statistics-based data analysis. In practice, multiple AI products, such as infrared thermal imaging and face recognition, contribute to monitoring and controlling the source of infection. These products expressly identify people with abnormal body temperature and close contact to determine the source of the disease in the case of dense crowds and a rapid flow of people (Wang et al., 2023).
- Intelligent diagnosis: The most obvious manifestation of AI in public health is intelligent diagnosis. Intelligent diagnosis requires relevant personnel in medical institutions to collect and analyze a large amount of data and information by using modern information technology. Machine learning algorithms are then used to quickly identify the database of the cases to facilitate professionals making highly accurate diagnostic decisions (Wang et al, 2023). The application of artificial intelligence (AI) in the assessment of medical images has led to accurate evaluations being performed automatically, which in turn has reduced the workload of physicians, decreased errors and times in diagnosis, and improved performance in the prediction and detection of various diseases (Nia et al., 2023).
- Health administration: Artificial Intelligence technology can also improve the efficiency and quality of health management in various ways such as AI-assisted decision-making systems, medical record quality control, and pathological assistance

systems. Health protection and promotion inseparable from AI. With advances in AI, personalized predictions and prevention are possible. Up to now, multiple disease prediction models had been developed and improved to provide targeted and personalized health advice. (Wang et al., 2023). Furthermore, AI can automate administrative tasks in healthcare settings, freeing up healthcare professionals to focus more on patient care. This includes scheduling appointments, managing medical records, and processing insurance claims (Olaoye et al., 2024).

- Personalized Interventions: Artificial Intelligence can analyze large datasets from diverse sources, including genetic information, medical histories, and behavioral data, to identify patterns that may not be evident to human researchers. By understanding these patterns, AI can help tailor interventions to meet the specific needs of individual patients and also offer personalized health advice (Kevin, 2024). According to United Kingdom (2023), the goal of personalzed intervention is to provide treatments that are more effective, minimise side effects, and optimise outcomes based on each patients unique genetic makeup, medical history, and lifestyle. The author further explained that wearable devices and sensors equipped with AI algorithms enable continuous real time health monitoring.
- Early Detection: Artificial Intelligence powered systems can detect patterns in health data that humans might miss, enabling earlier detection of diseases or health risks (Leewayhertz, 2024). For example, AI algorithms can analyze medical images to detect abnormalities or predict diseases based on symptoms. According to United Kingdom (2023), AI models can predict disease onset by analysing patient data and recognising early warning signs. This allows for proactive interventions, lifestyle adjustments, and preventive measures.
- Behavioral Insights: Artificial Intelligence can analyze behavioral patterns from data collected through wearables, smartphones, and health apps to provide insights into lifestyle choices and habits. This information can guide individuals towards healthier behaviours (Shajari et al., 2023). According to research, early mechanistic views held that human behavior is based on fixed rules, which could allow for simulation via artificial intelligence (Bucher et al., 2024). The authors further explained that AI approaches such as natural language processing (NLP) have the potential to enable the ingestion and digestion of large quantities of disparate data related to people's health and behaviors and then support behaviour change by facilitating personalized recommendations and experiences. Examples of AI powered devices that can be used for behavioural interventions were highlighted by Mogles et al. (2024), such as AI-powered Chatbots and Virtual Assistants which can provide personalized health advice, answer questions and offer support and coaching for behavior change. Other wearable devices, such as fitness trackers and smartwatches, can collect data on physical activity, sleep patterns, and other health-related metrics, and interpret this data.
- Remote Monitoring: Artificial Intelligence - enabled devices and sensors can continuously monitor patients remotely, providing real-time feedback and alerts to healthcare providers if any anomalies are detected (Pulimamidi, 2023). This is particularly useful for managing chronic conditions. The traditional methods of monitoring often involve regular clinic visits, which can be burdensome. However, remote patient monitoring using AI has gained signifcant attention in recent years due to various medical, economic, and social factors. With an aging population and growing prevalence of chronic diseases, there is an increasing demand for cost-effective solutions to provide continuous quality care for patients (Ranjibar et al.,

2024). Further, through predictive analytics, AI algorithms can analyze patient data, including demographic information, laboratory results, and vital signs, and improving health outcomes.

- Health Education: Artificial Intelligence can deliver personalized health education content to individuals based on their health status and needs. This can include recommendations for diet, exercise, medication adherence, and preventive care (Luga, 2024). Further, AI's potential to integrate social determinants of health could enhance population health outcomes. It provides a clinical-community linkage that is crucial for effective health education and management. By considering factors such as socioeconomic status, lifestyle and environment, AI can offer more holistic and individualized educational interventions for patients. According to Garfield (2023), personalized health content generation has been constrained by high production costs, long timelines for development (largely due to significant review) but AI models, which are trained on large data sets and able to respond in human-like ways to prompts.
- Healthcare Resource Allocation: Research has revealed that AI can analyze population health data to identify trends, predict outbreaks, thereby furnishing public health authorities with comprehensive situational awareness by consolidating and presenting relevant data coherently and optimize resource allocation in healthcare systems (Olaoye et al., 2024). This helps lead to more efficient distribution of services and better response to public health emergencies. Also empowers decision-makers to make well-informed choices swiftly. As explained by PAHO & WHO (2024), AI-driven dashboards and visualizations provide a clear overview of disease trends, enabling authorities to allocate resources effectively and implement appropriate preventive measures, such as quarantine protocols, travel restrictions, and vaccination campaigns.

Implications of Ai in Public Health Education

The implications of Artificial Intelligence (AI) in public health education are profound, offering both transformative opportunities and challenges. AI can significantly impact how health information is disseminated, learned, and applied to improve public health outcomes. Below are key implications of AI in public health education according to Wang, et al. (2023) and Wang & Li (2024).

1. Personalized learning and education: AI can deliver tailored education to individuals based on their specific needs, health status, and learning preferences. This personalized approach helps in: providing customized educational content, especially for individuals with chronic conditions, disabilities, or specific cultural backgrounds; using predictive analytics to identify people at risk and offering proactive health education to them; and enhancing health literacy by offering materials in various formats (videos, texts, quizzes) to cater to different learning styles.

2. Data-driven decision-making and insights: AI can analyze vast amounts of data to identify trends, predict health crises, and assess the effectiveness of health interventions. This allows for creating evidence-based health education programs that are aligned with real-time data and emerging health threats (e.g., pandemics, outbreaks). Using AI to monitor population health trends and adapt educational materials to address the most pressing health issues in a given area.

3. Scalability and reach: AI-powered tools, such as chatbots, virtual assistants, and online platforms, can scale health education programs to reach large, geographically dispersed populations. This is particularly important for reaching underserved or rural populations who

may have limited access to traditional educational resources. Also offering continuous learning opportunities that can be accessed 24/7, making education more accessible and flexible.

4. Interactive and engaging learning experiences: AI can create dynamic, interactive learning environments that engage users more effectively than traditional methods. For example: simulations and virtual reality (VR) scenarios can help learners understand complex health concepts in a more immersive way. AI-driven chatbots or virtual assistants can provide real-time feedback, answer questions, and guide learners through health education content.

5. Improved public health campaigns: AI can enhance the effectiveness of public health campaigns by analyzing audience data to create targeted campaigns that speak directly to the needs of specific demographic groups, such as communities with low vaccination rates. Monitoring the reach and impact of campaigns in real-time, allowing for adjustments to be made as needed.

6. Behavioral insights and intervention: AI can be used to analyze individuals' health behaviors and identify the most effective strategies to promote healthy lifestyle changes. This could involve predicting health behaviors based on past data and offering tailored advice and educational content to encourage healthier choices (e.g., reducing smoking, improving diet). Designing nudges or reminders that help individuals adopt and maintain healthier behaviors, such as taking medications or attending regular screenings.

Challenges of Ai In Health Care System

Artificial intelligence though very useful in healthcare system yet have some challenges. Such challenges as outlined by khan et al, (2023) include:

- Data Privacy: Ensuring the privacy and security of sensitive health data is paramount. There are several data security risks, including data breaches where hackers or malicious individuals gain unauthorized access to patient information, such as medical records or insurance details, which could result in severe financial and reputational harm to healthcare providers. Insufficient data encryption, whether stored or transmitted, can also make patient data susceptible to unauthorized access or exploitation.
- Ethical Concerns: Ethical considerations around the use of AI in healthcare must be addressed, including bias in AI algorithms and informed consent. Bias and discrimination can emerge in artificial intelligence algorithms when the data used for training reflects the biases of the data collectors or contains inherent biases. This can cause the algorithms to make decisions that produce unfair outcomes for specific individuals or groups. Additionally, if a certain class of patient data is underrepresented in the training dataset, AI algorithms may demonstrate reduced accuracy.
- Accessibility: Ensuring that AI-driven treatments are accessible to all individuals, regardless of socioeconomic status, is crucial. Accessibility in the context of AI refers to the ability of all individuals regardless of their socio-economic background, geographical location, physical ability, or technological literacy to access and benefit from AI-driven health solutions. Access to the internet and advanced technologies is not uniformly distributed across the globe.
- Collaboration: Successful implementation of AI in some aspects of care such as autism treatment requires collaboration between technologists, healthcare providers, researchers, and families. However, it presents several challenges when it comes to

aligning various stakeholders, including healthcare providers, technology developers, policymakers, and communities.

Conclusion

The integration of AI in healthcare represents a pivotal advancement that has the potential to reshape the landscape of medical practices. With the ability to evaluate vast amounts of data, AI offers invaluable insights that aid in timely and accurate diagnoses, personalized treatment strategies, and efficient disease management. This technology not only enhances the capabilities of healthcare professionals but also empowers patients through personalized care, early disease detection, and improved treatment outcomes.

Recommendations

- Governments and health agencies should promote universal access to these innovations and prevent them from becoming another driver for inequity.
- There should be ethical guidelines for the development and deployment of AI technologies in healthcare to ensure patient safety, privacy, and fairness.
- Strengthen data privacy laws and security measures to protect sensitive health information collected and processed by AI systems, promoting trust and compliance with regulatory standards etc.

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