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SOCIOECONOMIC BENEFITS OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE DELIVERY SYSTEM IN NIGERIA

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ABSTRACT

Rapid advances in AI research and the resources being provided by governments and industry make it highly likely that AI will be used extensively in healthcare delivery and there is huge potential for cost-saving as well as service quality improvement. AI has enormous potential and can undoubtedly bring new efficiencies and quality to healthcare outcomes in Nigeria. This paper aims at reviewing the socio-economic benefits of integrating AI into the healthcare delivery system in Nigeria. The benefits were divided into subcategories: benefits related to the medical domain, and the benefits related to economic and social lives domain. The paper identified the challenges to Implementing AI in healthcare delivery to include: bias, Missteps and accident, privacy and data availability. The paper recommended AI adoption, paradigm shift from care to prevention, skill acquisition and training for an AI enabled healthcare delivery system in Nigeria.

Keywords- Artificial Intelligence, Machine Learning, Personalised Healthcare, Healthcare Delivery

INTRODUCTION

Today's healthcare industry is changing quickly as many nations experience a paradigm shift from a human-centered to a technology-driven era (Abdulkareem, & Petersen, 2021). Nigeria, the largest country in Africa, shouldn't be left out in any manner because we need to acknowledge the crucial responsibilities that technology—specifically, artificial intelligence—plays in enhancing patient outcomes and bettering overall health. According to Kim, Jeong, and Kim's report from 2021, the introduction of artificial intelligence (AI) into healthcare has been revolutionary, revolutionizing how patients are diagnosed, treated, and monitored. By enabling more individualized therapies and delivering more precise diagnoses, this technology is significantly enhancing healthcare research and outcomes. Automation-based artificial intelligence (AI) has the potential to transform healthcare and help solve some of the most pressing problems. The ability of a computer program to carry out operations or think through problems is known as artificial intelligence (AI). AI has the potential to boost healthcare delivery productivity and efficiency, as well as patient outcomes (Shaheen, 2021). The use of machine learning (ML) algorithms and other cognitive technologies in healthcare is referred to as artificial intelligence (AI). Artificial intelligence (AI) was described by Carter, Rogers, and Win

(2021) as the replication of human intelligence in robots that are often programmed to mimic human behavior. It is an interdisciplinary science with several machine learning methods used in the technology sector.

The rise of artificial intelligence (AI) in healthcare has been revolutionary, transforming how we diagnose, treat, and monitor patients, according to Seyyed-Kalantari, Zhang, and McDermott (2021). By enabling more individualized therapies and delivering more precise diagnoses, this technology is significantly enhancing healthcare research and outcomes. According to Yakar, Ongena, and Kwee (2021), one industry where artificial intelligence (AI) has become a game-changing technology is healthcare. Artificial intelligence has the potential to drastically improve patient outcomes and transform Nigeria's healthcare system.

With a vast range of applications and promise in the medical, pharmaceutical, and a wide range of other sub-sectors under healthcare, artificial intelligence has the ability to significantly improve the delivery of healthcare in Nigeria. Unfortunately, the general consensus in Nigeria is that artificial intelligence would drastically change the healthcare industry, potentially leading to job losses or displacements (Robinson, 2020). Unexpectedly, research has shown that when technology enters the healthcare industry, productivity, yield, and production often rise.

This development is anticipated to lead to higher output, lower healthcare spending, and improved patient and health outcomes. To improve the healthcare delivery system in Nigeria, it is important to look at the socioeconomic advantages of AI in healthcare and make the results available to policymakers, healthcare providers, and stakeholders.

Statement of the Problem

The widespread adoption of artificial intelligence (AI) technology in healthcare has already started to revolutionize Nigeria's healthcare delivery system. However, in Nigeria, the adoption of artificial intelligence is still very much in its infancy due to a number of issues, including a lack of suitable infrastructure and socioeconomic and cultural hurdles. A public discussion on the possible benefits and drawbacks of artificial intelligence has resulted from the advent of economic, ethical, legal, and societal concerns related to their use. The essential advantages of artificial intelligence have not yet been felt in the Nigerian healthcare sector. This explains why the industry has encountered numerous obstacles to delivering healthcare effectively. To explore and optimize the enormous potential of AI in Nigeria's healthcare delivery system, however, leaders of the country's healthcare sector will need to build strong legislative frameworks as that future draws closer. Therefore, the goal of this review paper is to analyze the socioeconomic advantages of AI in Nigeria's healthcare delivery system.

History of AI

John McCarthy, an American computer scientist, first used the phrase artificial intelligence (AI) in 1956 at the Dartmouth Conference (Kovarik, 2020). Currently, it serves as a catch-all phrase for everything from true robotics to robotic process automation. AI is described as the capacity of a computer or other machine to carry out tasks that are believed to require intelligence in the American Heritage Science Dictionary (2020). The behaviours include reasoning, inference, inventiveness, the capacity to draw conclusions based on prior knowledge or incomplete or conflicting information, and language comprehension.

AI is currently defined as "a science and a set of computational technologies that are inspired by, but typically operate quite differently from, the ways people use their nervous systems and bodies to sense, learn, reason, and take action" (Davenport and Kalakota, 2020). This definition comes from Stanford University's 100 Year Study on AI. AI, to put it simply, is the creation of computer systems that can carry out activities that would normally need human intelligence. An interdisciplinary concept, artificial intelligence (AI) combines Logic/Mathematics, Computation, Psychology, Neuroscience, and Evolution.

The early philosophers who endeavored to understand the nature of human thought laid the foundations for contemporary artificial intelligence (Chincholkar and Sarkar, n.d.). In the 1940s, the programmable digital computer was created because of this work. Scientists began to think about the prospect of developing an electronic brain after discovering this technology and the thoughts that went along with it. British mathematician Alan Turing posed the topic of whether machines can think in a paper he wrote in 1950 titled *Computing Machinery and Intelligence* (Turing, 1950). To test his theory, he devised a straightforward experiment: could a computer converse with a suspicious human and provide answers that would make the human believe the computer was a real person? The "Turing test" that resulted is still in use today.

Incorporating AI in Healthcare Delivery

It is becoming more and more clear that AI techniques have applications in both the delivery of healthcare and medical research (Agah, 2017). The effectiveness and promise of AI-enabled health applications have been emphasized in studies. Governments and technology corporations are currently making large investments in the use of artificial intelligence (AI) in healthcare (Millard, 2018), actively assisting the release of AI-enabled medical products on the market. The four domains of healthcare administration, clinical decision support, patient monitoring, and healthcare treatments where AI-enabled healthcare delivery is most likely to have an impact can be seen in Figure 1.

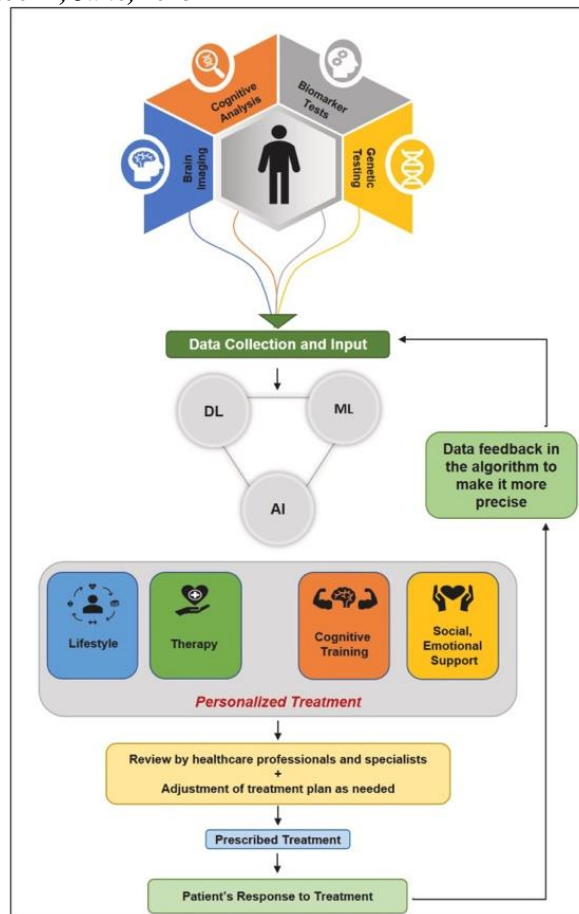


Figure 1. An AI-enabled healthcare system (Gupta, N. S., & Kumar, P., 2023)

Healthcare Administration

Due to administrative costs and resource limitations, the business of providing healthcare has grown more complex (Braunstein, 2022). As a result, healthcare infrastructure in many nations is being strained to its limit. Data mining and artificial intelligence (AI) tools have been cited as two of the most promising ways to support healthcare administration by enhancing clinical care and reducing administrative burdens on clinicians (Wells, 2018). These tools have been shown to lessen the burden on health services.

AI can give doctors more time to serve patients with direct care by automating repetitive and routine processes like patient data input and reviewing laboratory data and imaging results (Derrington, 2018). Clinical staff and administrators may benefit from retrieving precise and pertinent patient data by connecting machine learning algorithms to electronic health records (Xiao, Choi, and Sun, 2018).

Clinical decision support

Clinical decision support systems are computer programs that employ clinical information and knowledge to assist healthcare practitioners in making decisions (Musen, 2018). Clinical decision

support systems can decrease medical errors and improve consistency and efficiency in healthcare, and there are growing initiatives to integrate these tools into everyday practice. Since the early 1970s, expert systems and other healthcare decision support systems have employed AI approaches. To help doctors and patients with chronic obstructive pulmonary disease get the right diagnosis and care, machine learning algorithms are currently being applied (Anakal and Sandhya, 2017).

Patient monitoring

The adoption of electronic health records, as well as the growth of smartphones and fitness trackers, have opened previously unheard-of access to digital data and the opportunity to use AI approaches for patient monitoring (Dubey & Tiwari, 2023). We now have information on patient sleep habits, blood pressure, heart rate, and other measurements in ways we never did previously. We have seen improvements not only in these settings but also in others. Through the interpretation of vital signs, AI-enabled software can be utilized in intensive care units to monitor the cardiovascular and respiratory systems (Reddy, Fox, & Purohit 2019).

Healthcare interventions

The development of AI has made it possible to customize health therapies for specific people or population subgroups. Electronic health records that have machine learning programs connected with them can analyze the biometric and other medical data of specific patients and make treatment recommendations based on up-to-date clinical recommendations (Paul, 2020). Waiting times in overcrowded emergency departments can be decreased by AI systems connected to hospital servers that are capable of analyzing recorded patient data and posing patient enquiries. Medication administration can be performed by AI programs built using fuzzy logic, a type of many-valued logic. For instance, vasodilators have been administered to postoperative patients using fuzzy controllers (Shaheen, 2021).

Robotics and computer vision have made significant strides in recent years, promising quicker and less expensive diagnostic and therapeutic services. In recent years, computer vision has been used to automatically analyze 3D medical photos (Leetaru, 2018), but it is also currently being used to analyze a patient's facial expressions to determine their health (Lehne, Sass, Essenwanger, Schepers, and Thun, 2019). The four topics covered in this paper are by no means all the AI advancements that have been made in the field of healthcare delivery. Applications of AI are not limited to these spheres of healthcare delivery and drug development and market entry have been sped up using machine learning (Huang, Jennings, and Fox, 2018). AI has been utilized for syndromic surveillance to identify disease outbreaks as they occur and to forecast patient outcomes for cancer patients and those who are severely ill (Leventhal, 2017). AI has also been used to cut back on and, in some cases, remove tests, lowering the expense of healthcare.

Benefits of applying AI to healthcare delivery System.

In the contemporary, digitalized healthcare environment, the accuracy and accessibility of the underlying data are essential for sound decision-making. Data that is unavailable or too large to investigate, information that is overlooked, or ideas that are ignored can all lead to complex decisions in healthcare going wrong. AI can be used to tailor treatment programs, increase the precision of diagnoses, and anticipate future healthcare requirements. Although AI is still in its infancy, it has the potential to completely transform the healthcare sector.

Better Data-driven Decision to Improve the Healthcare System

The steps in the decision-making process include deciding what to decide, gathering information,

and assessing potential solutions. You can make more thoughtful decisions by using a phased decision-making process to gather crucial information and identify options.

The correctness and accessibility of the underlying data are crucial for good decision-making in the modern, digitalized healthcare setting (Madsen, 2014). Smart data inclusion can make a substantial contribution and help to improve the quality of decision-making in the healthcare industry, where clinical decision-makers face numerous obstacles and issues along the patient pathway. Complex decisions in healthcare may go wrong due to data being unavailable or too massive to investigate, information being overlooked, or suggestions being disregarded, leading to ineffective and expensive procedures and poor clinical outcomes (Guo, Chonghui, and Chen, 2020).

Surgery Assistance

Numerous applications of artificial intelligence are available in the fields of medicine and dentistry. Surgery is now more precise and predictable thanks to surgical robots. Many surgical specialties, including oral and maxillofacial surgery, make substantial use of robotic surgery. Other uses include radiography, spine imaging, diabetic retinopathy, bioprinting, and radiology (Hashimoto, Ward, and Meireles, 2020; Zhou, Shen, and Yang, 2019). over the other hand, augmented reality overlays a computer-generated image over a patient's perception of the physical world to produce a consolidated perspective of the operating room.

Supports mental health

As patients want simplicity and quick feedback, artificial intelligence (AI) is becoming more and more popular in the field of mental health therapy (Luxton, 2016). Psychiatric professionals have historically relied on therapeutic discourse and patient narrative to measure mental health since language is the primary means through which we communicate our emotional and mental well-being. Recent developments in AI have opened new vistas for the area by enabling technology to infer emotional meaning from a larger variety of data sources (Lovejoy, 2019; Habermann, 2021b;).

Researchers have developed algorithms that can decipher written text to understand human emotions (Le Glaz, Haralambous, Kim-Dufor, Lenca, Billot, Ryan, Marsh, Devylder, Walter and Berrouguet, 2021). These AI implementations provide extensive information on a patient's emotional and psychological health by utilizing Natural language processing and sentiment analysis combo (Habermann, 2021a).

Economic and Social Benefits: Cost and Energy Saving

There is strong evidence that AI can help manage healthcare costs in a variety of ways, even though we are not quite at the point where autonomous robots perform every task.

Elimination of Expenditures Associated with Post-treatment Problems

Nowadays, being able to harness the power of data enables more effective decision-making effectively and precisely across practically all industries. There is no exception in healthcare. As healthcare providers move toward a consistent framework for recording patient outcomes, massive amounts of data will become available for analysis by AI-powered systems. These technologies will be able to examine post-treatment result patterns and identify the best remedies based on patient profiles.

AI enables clinical decision-making as a result, ensuring that each patient receives the proper interventions and therapies, leading to a more personalised approach to care. The immediate impact will be a sharp improvement in results, which will eliminate expenses related to post-treatment issues, one of the key cost drivers in most healthcare ecosystems worldwide (Le Nguyen & Do, 2019).

Cutting Cost through Early Diagnostics

AI-enabled technologies can perform repetitive, simple tasks more accurately, such as processing CT scans and other tests, reducing physician errors and promoting prompt diagnosis and action before significant issues arise. AI has demonstrated more accuracy and speed than humans in the analysis and interpretation of mammograms, enabling far earlier detection of breast cancer than humans. The cost of treating conditions like osteoporosis to health services can be greatly reduced by recognizing vertebral fractures, an early symptom of the disease that is typically overlooked by human diagnosis.

Cost minimization with enhanced clinical trials

AI has the potential to speed up the development of potentially life-saving medications, saving the health care systems billions of dollars in costs. Saving money and, most importantly, lives is the goal of an AI-powered algorithm that simulates and evaluates millions of potential treatments to predict their effectiveness against the Ebola virus. AI can optimize drug development in clinical trials by utilizing biomarker monitoring frameworks (biomarkers allow for gene-level disease detection) and a large volume of patient data points, which can be analyzed in seconds from a sample of blood using at-home devices (Beck et al., 2020).

Patient empowerment

In fact, artificial intelligence has the potential to empower us as individuals to make wiser choices regarding our health. People across the world are already using wearable devices to gather common data like heart rate and sleep patterns. People who are at risk of contracting certain diseases could be warned well in advance of them becoming serious by using machine learning to assess this data. The usage of smartphone apps that offer granular-level patient profile information may help patients with certain chronic diseases better manage their conditions and lead healthier lives. A healthier population and fewer overall expenditures are possible outcomes of all of this (Ichikawa et al., 2016; Vollmer et al., 2020).

Challenges

While AI has a lot of potential benefits, it also has several drawbacks.

Bias

Prejudice and inequality are risks in health-care AI. AI systems can pick up biases from the data they are given and learn from it. For instance, if a provider belongs to a race or gender that is underrepresented in the training data, speech-recognition AI systems may perform worse when used to transcribe encounter notes.

Although this recommendation is based on institutional bias rather than biological reality, an AI system learning from medical records may eventually learn to propose lower painkiller doses to African-American patients (Lee, 2021). Allocating limited resources to patients who are viewed by health systems as less attractive or lucrative for a variety of reasons could exacerbate inequality.

Missteps and accidents.

The most obvious risk is that occasionally inaccurate AI systems can cause patient harm or other problems with healthcare. An AI system might harm a patient by prescribing the incorrect medication, failing to spot a tumor on a radiological test, or choosing one patient over another for a medical bed because it predicted the wrong patient would benefit more. Even without the use of AI, a lot of injuries occur in the modern healthcare system as a result of medical mistakes.

Concerns about privacy.

When it comes to privacy, there are additional risks to be aware of. Developers are encouraged to collect data from a lot of patients because there is a high demand for large datasets. Since data sharing between large health institutions and AI startups has led to lawsuits, some people may be concerned that this data collecting would violate their right to privacy.

According to Marwan, Kartit, and Ouahmane (2018), AI may violate privacy by foretelling patient personal information even when that information hasn't been provided to the algorithm. For instance, even if a person has never told anybody else (or is unaware), an AI system might be able to detect Parkinson's disease based just on the movement of a computer mouse. Particularly if the AI system's findings are disclosed to outside parties like banks or life insurance companies, patients may perceive this as an invasion of their privacy (van der Schaar et al., 2021).

Data accessibility

To train AI algorithms, a lot of data is required from sources like electronic health records, pharmacy records, insurance claim paperwork, or consumer-generated data like activity trackers or purchase histories. Health statistics might be hard to find, though. Frequently, data is scattered across various platforms. In addition to the variety, patients frequently switch doctors and insurance providers, which fragments data across many systems and formats. This fragmentation limits the kinds of organizations that could successfully develop health-care AI by increasing the risk of inaccuracy, reducing the comprehensiveness of datasets, and increasing the cost of data collecting (Hu, Perer, and Wang, 2015).

Recommendation

Nigeria's health institutions would need to make significant expenditures in several sectors to include AI and digitalization. Nigeria may need to alter its IT systems in their present care delivery processes to properly benefit from the integration of AI in healthcare.

1. Create and maintain a well-balanced regulatory framework that promotes future technological innovation and evolution and is based on the appropriate regulations that are now in place.
2. Create data rules and infrastructure to provide easy access, connectivity, and sharing of high-quality, standardised data (in line with the European Health Data Space project).
3. Adaptation to digitalization. Healthcare providers must modify their clinical paths as healthcare systems move toward a more digital environment. Before AI fully realizes its efficiency, this will place a load on implementation. Naturally, if AI

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technologies are affordable, they will be embraced more quickly.

4. Technologies. AI-related technologies are not free. Despite the benefits AI technologies offer, the current pricing and reimbursement structures may not be adequate to finance their use. To evaluate the value of integrating AI into their care pathways, some centers of excellence are already undertaking cost-benefit analyses. However, it is not done regularly throughout Europe.
5. Training and skills. Hospital operating paradigms will change when AI applications are introduced. The usage of these cutting-edge technology will require training for healthcare professionals. To train and find people with the ideal combination of IT and medical abilities, new job profiles must be developed concurrently.
6. Change the focus from care to prevention. AI has the capacity to enhance illness early diagnosis and prevention. This necessitates a change in the way care is organized and how the effort is distributed among the many healthcare specialities.

Conclusion

To further the present discussion on the role AI may and should play in health, it is essential to examine the socioeconomic effects of AI on Nigeria's healthcare systems. In addition to helping with the creation of valuable drugs, artificial intelligence can boost the effectiveness of already existing ones. Though the use of AI in healthcare is currently limited, the financial and medical advantages are too tremendous to ignore. The research concludes that AI provides a wide range of medical and socioeconomic advantages that can enhance healthcare at a low cost and with increased accessibility to remote areas. As a result, AI will be crucial to the development of Nigeria's healthcare system.

Acknowledgement

Figure 1 Reprinted from Perspective of artificial intelligence in healthcare data management: A journey towards precision medicine, 162, Nancy Sanjay Gupta and Pravir Kumar, 107051, Copyright (2023), with permission from Elsevier

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