Review

Leveraging Technology to Enhance Healthcare Delivery and Reduce Brain Drain in Nigeria

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Abstract

Background: Nigeria's healthcare system faces challenges, including brain drain, outdated facilities, and medicine shortages, leading to poor quality care. The migration of healthcare workers worsens the issue, resulting in increased morbidity and mortality. To address this, Nigeria must find solutions to retain healthcare professionals and improve the system. This review examines the potential of technology to mitigate the healthcare workforce shortage, focusing on sustaining quality care and minimizing the impact of brain drain.

Method: This study combines literature review, case studies, and policy analysis to understand how technological advancements can enhance healthcare delivery and mitigate brain drain.

Results: Electronic medical records (EMRs) improve access to patient information. AI-assisted diagnosis and robotic surgery enhance predictive analytics and surgical precision. Wearable devices monitor vital signs, enabling proactive health management. Telemedicine expands access to healthcare through remote consultations, reducing the need for in-person visits and increasing access to global specialists. These technologies help leverage specialist expertise, improving health outcomes and reducing patients' period of recovery.

Conclusion: Technological advances can significantly reduce the impact of brain drain in developing nations like Nigeria. Adopting these techniques is essential to prevent increased mortality and poor knowledge transfer in healthcare systems. The government and healthcare organizations must urgently incorporate these technologies into Nigeria's healthcare system, as the migration of highly qualified professionals is unlikely to decrease soon. Integrating technology into healthcare is crucial for maintaining an effective and sustainable healthcare system.

Keywords: Healthcare system, Technological advancements, Brain Drain, developing nation.

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Introduction

Technology has shown to be quite helpful in a number of areas of the global economy, and it is anticipated that using computers and other technology will greatly increase productivity, efficiency, coverage, and the provision of high-quality healthcare at a lower cost.[1]

The global healthcare landscape is undergoing a transformative shift, propelled by rapid advancements in technology. From telemedicine and electronic health records to artificial intelligence and wearable devices, technological innovations are reshaping how healthcare is delivered and experienced.[2] This evolution is particularly crucial in addressing the dual challenges of enhancing healthcare delivery and mitigating brain drain in the medical profession.[1,3,4]

Brain drain, the emigration of highly trained and skilled professionals from their home countries to more developed regions, poses a significant threat to the healthcare systems of developing nations.[4] These countries often invest substantial resources in training healthcare professionals, only to lose them to regions offering better opportunities, facilities, and working conditions.[5,6] This migration exacerbates the already strained healthcare infrastructure in less developed regions, leading to inadequate medical care, longer wait times, and increased mortality rates.[4,7]

Nigeria faces significant challenges in its healthcare sector, including a shortage of skilled healthcare professionals, inadequate infrastructure, and limited access to quality healthcare services. The brain drain of healthcare professionals from Nigeria to other countries worsens these challenges. Leveraging technology can help enhance healthcare delivery and reduce brain drain in Nigeria. Technology can improve access to healthcare services, enhance the quality of care, and provide opportunities for professional development and collaboration. By investing in health technology, Nigeria can improve its healthcare outcomes, reduce the brain drain of healthcare professionals, and build a more sustainable healthcare system.

Using technology becomes a practical way to keep skilled workers in their home countries while also improving the standard and accessibility of healthcare. By integrating cutting-edge technologies, healthcare systems can offer improved diagnostic tools, efficient patient management, and innovative treatment options.[8] These developments may lessen the motivation for experts to relocate by improving the local healthcare environments.[3,4]

This review examines the various ways that technology is changing healthcare delivery and tackling the brain drain problem. It looks at how different technology solutions might be used to raise the standard of treatment, better the working conditions for medical staff, and build a more resilient and sustainable healthcare system. By investigating case studies, current trends, and future projections, this study aims to provide a comprehensive understanding of how technology can be harnessed to build a robust and equitable global healthcare system.

Method

This study investigates how digital technology affects patient outcomes and healthcare delivery using a methodical literature review technique. Articles that were relevant were identified using search terms and keywords from databases like Google Scholar and PubMed. "ICT in healthcare," "telemedicine," "Electronic medical records," "mobile health applications," "brain drain," "patient outcomes," "Information communication technology (ICT)," "Telemedicine," "EMR," "Healthcare delivery," "Healthcare system" were among the keywords that were used.

To guarantee the accuracy and timeliness of the information, only articles that were released in the past 20 years were chosen. Non-English publications and duplicate records were not included.

From the chosen publications, important details about how digital technologies affect patient outcomes, healthcare delivery, and brain drain were taken from the study design, sample size, findings, and conclusions. The results were combined to give a thorough picture of how digital technologies are changing patient outcomes, healthcare delivery, and brain drain.

Results

Table 1: Advantages of the effective use of technology in the healthcare sector

Advantages	Relevant Studies	Country of study
Information technology links patients and health care providers through support networks	Adebayo et al 2021(1) McLean et al 2011(9)	Nigeria United Kingdom
Technology provides adequate storage of patient's record	Alawiye 2024 Adebayo and Ofoegbu 2014(10) Akaowo et al 2022(11)	United Kingdom Nigeria Nigeria
Monitoring of patient's health conditions is made easier through ICT	Fitzpatrick 2009 (12) Alawiye 2024 (2)	England United Kingdom
Computer-aided equipment saves time, resources and aid referral system	Adebayo et al 2021 Gambo and Soriyan 2017 (13)	Nigeria
ICT use allows for even distribution of healthcare	Gambo and Soriyan 2017	Nigeria
Technology devices ensure reduction in medication error rates	Olorode and Oladunni 2011(14)	Nigeria

Table 2: Overview of ICT applications in healthcare and their associated challenges

ICT Application in Healthcare	Description	Challenges	Sources	Method
Electronic Medical Records (EMRs)	Digital storage of patient health data	Data privacy and security concerns; interoperability issues; high implementation costs	Alawiye 2024(2) Akwaowo 2022(11)	Review of literature Quantitative research
Telemedicine	Remote consultation and diagnosis via video or phone	Limited access in rural areas; technical literacy barriers; regulatory constraints	Alawiye 2024(2) Alenoghena 2023 (15)	Review of literature Review of literature
Health Information Systems (HIS)	Integrated systems to manage patient, financial, and operational data	Complexity in integration; high initial cost; maintenance issues	Adebayo 2014(10) Adebayo et al 2021 (1) Khalifa 2017(16)	Review of literature Review of literature Review of literature Quantitative survey
Wearable Devices	Devices for monitoring vital signs and fitness metrics	Data accuracy concerns; privacy issues; high cost for advanced devices	Alkhudairi 2014 (17) Alawiye 2024(2)	Interview and review of literature Review of literature
Artificial Intelligence (AI)	AI for diagnostics, treatment planning, and predictive analytics	Bias in AI algorithms; lack of trust; legal and ethical concerns	Alawiye 2024(2) Alkhudairi 2014 (17)	Review of literature Interview and review of literature
Mobile Health (mHealth)	Health apps and SMS-based health services	Poor internet connectivity; inconsistent app quality; regulatory approval	Alkhudairi 2014 (17)	Interview and review of literature

ICT Application in Healthcare	Description	Challenges	Sources	Method
			Gagnon et al 2016(18)	Review of literature
Big Data Analytics	Analysis of large datasets for trends and decision-making	Data integration challenges; high storage and processing costs; privacy risks	Hillestad 2005(19)	Survey and review of literature
Blockchain in Healthcare	Securing patient records and enabling transparent transactions	High energy consumption; lack of standardization; complex implementation	Adebayo et al 2021 (1) Akwaowo 2022(11)	Review of literature Quantitative research
Internet of Medical Things (IoMT)	Network of connected medical devices for real-time monitoring	Cybersecurity risks; data overload; interoperability issues	Adebayo et al 2021 (1)	Review of literature
Cloud Computing	Storing and accessing health data through the cloud	Data breaches; compliance with data protection laws; dependency on internet	Khalifa 2017(16)	Quantitative survey

Discussion

Electronic medical records (EMRs)

In developing countries like Nigeria, electronic medical recording system is gradually being appreciated. Same with some developed nation like Australia, where the shift from paper to electronic health records has been gradual but unavoidable.[20] Healthcare systems' access to, management of, and storage of patient data have been completely transformed by electronic medical records, or EMRs. EMRs provide a number of benefits that improve the effectiveness, accuracy, and quality of healthcare delivery by digitizing patient records. EMRs improve access to patient information and overall healthcare in different ways.

EMRs provide healthcare professionals with instant access to a patient's complete medical history, including past diagnoses, treatments, medications and lab results. This comprehensive data accessibility is vital in making informed clinical decisions, especially in emergency situations where time is much critical.[16] Unlike traditional paper records, which can be incomplete or misplaced, EMRs ensure that all relevant patient information is available at the point of care.[19]

Medical record digitalization reduces the time and effort needed to handle patient information by streamlining administrative processes. EMRs automate a number of tasks, freeing up healthcare personnel to concentrate more on patient care and less on paperwork, including insurance claims processing, billing, and appointment scheduling.[20] This increased efficiency can lead to shorter wait times for patients and quicker turnaround for lab results and referrals. EMRs enhance coordination among healthcare providers by ensuring that each has access to up-to-date patient information, reducing redundant tests, conflicting treatments, and medication errors. This interconnected approach promotes a holistic view of patient care, resulting in more accurate diagnoses and effective treatment plans.[11,16]

EMRs incorporate clinical decision support systems (CDSS) that provide alerts and reminders for critical patient information, such as potential drug interactions, allergies, and preventive care measures. These features help healthcare providers avoid errors and ensure that patients receive appropriate and timely care. Furthermore, EMRs enable the implementation of evidence-based practices by providing access to the latest clinical guidelines and research findings.[19]

Many EMR systems include patient portals that allow individuals to access their own medical records, laboratory results and treatment plans. This transparency empowers patients to take an active role in managing their health, improving adherence to treatment regimens and fostering better communication between patients and providers. Patients can also update their personal information and track their health progress, leading to more personalized and proactive care.

Studies have suggested that the Nigerian health care delivery system is readily disposed to adopting EMR.[11,21] However, there are still a number of obstacles standing

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in the way of the effective adoption and application of EMR, and therefore in comparable settings in developing nations. A quantitative study which collected responses from a large sample across four states in Nigeria found that infrastructure unavailability, such as inadequate or nonexistent internet connectivity and an irregular electrical supply, were not considered as barriers to the successful adoption and deployment of an EMR system.[11] Frequent power outages and the absence of user-friendly websites are major problems for Nigerian hospitals, particularly in outlying locations, hindering the regular use of EMR, this is evident in a study which found that 96.7% of respondents believed that improved power supply would help the effectiveness of EMR.[21] These challenges lead to medical personnel being overworked thereby resulting in their migration to countries where they could get better work conditions.[7,22]

Telemedicine

Telemedicine refers to the remote diagnosis and treatment of patients through telecommunications technology. It encompasses various services, including virtual consultations, remote monitoring, and telehealth education.[2,15]

Telemedicine has significant potential to reduce brain drain in Nigeria by improving working conditions for healthcare professionals and enhancing access to medical care for patients.[23,24] By leveraging telemedicine, Nigerian doctors and specialists can provide consultations and treatments remotely, reducing the need for physical presence in underserved or rural areas.[2,25] This flexibility can make healthcare jobs more attractive, encouraging professionals to remain in the country.

Furthermore, telemedicine enables continuous professional development and collaboration with international experts, fostering a supportive and enriching work environment. This access to global medical knowledge and networks can help mitigate the isolation that often drives healthcare workers to seek opportunities abroad. By improving both job satisfaction and patient outcomes, telemedicine can play a crucial role in retaining skilled healthcare professionals in Nigeria.

A nationwide telemedicine network was created in Ghana to improve the delivery of healthcare and address differences in access to care between urban and rural areas.[26] Telemedicine hubs equipped with video conferencing, diagnostic tools, and high-speed internet were established in various regions, enabling general practitioners in remote areas to consult with urban specialists. This setup allowed for timely diagnosis and management of complex cases, teleradiology consultations, and enhanced healthcare professional skills through training programs.[26,27]

In Nigeria, medical consultations are performed in hospitals and other facilities, which contributes to a rise in mortality rates because it takes longer time for some patients to get to these facilities and telemedicine is a fundamental solution to this, according to experts.[23]

Telemedicine significantly benefits the Nigeria's healthcare system, especially during emergencies, by compensating for the lack of modern resources. Its essential role necessitates various measures to ensure its sustainability as a vital healthcare resource in the country.[23] Infrastructure for information and communication, the capacity to use it, a reasonably steady electrical supply, and personnel to support and maintain the infrastructure are all necessary for telemedicine. In Africa, just 6.7% of homes have access to the Internet at home, 16.3% of individuals utilize it, and 0.3% of homes have fixed broadband penetration.[25] Due to weak infrastructure and expensive connectivity costs, telemedicine is least likely to be available in rural areas, where the poorest of the poor most need it. In addition, there is a lack of government support for telemedicine and a low level of knowledge of it among patients and healthcare professionals.[1,3]

Mobile health (mHealth)

Mobile health (mHealth) applications are digital tools for smartphones and tablets that support health and wellness by offering services like appointment scheduling, medication reminders, fitness tracking, and telehealth consultations.[2,28] These apps enhance healthcare accessibility and convenience for users.

The use of mobile health (mHealth) devices improves healthcare delivery by increasing accessibility, efficiency, and patient engagement. These devices enable healthcare professionals to monitor patients remotely, provide timely interventions, and manage appointments and medication adherence more effectively.[29] This not only enhances the quality of care but also reduces the workload and stress on healthcare workers.[30]

By streamlining administrative tasks and facilitating remote consultations, mHealth devices create a more flexible and supportive work environment for health professionals. This improved work-life balance and

access to modern technology can help retain skilled workers in developing countries, thereby reducing brain drain. Additionally, continuous professional development and collaboration opportunities offered through mHealth platforms can further motivate healthcare workers to stay in their home countries.[29]

A study on mobile health technology to enhance healthcare delivery in developing nation[31] noted that in order to reduce the number of unnecessary follow-up appointments, mobile applications are designed to manage patients' adherence to medication refill timing and manage patients' reminders of physician appointments. The blood sugar level test is an example of mHealth application and help enhance care delivery by allowing patients whose health conditions show improvement or stability to be temporarily removed from the follow-up appointment list. This will allow the healthcare center to treat more patients in a shorter amount of time. Another study assessed the acceptance of a diabetes management application on a mobile device among Saudi Arabian diabetic experts.[17] The study specifically looked at whether using mHealth apps would help with diabetes management. The study used surveys and interviews with chosen participants and medical professionals to investigate the viability and difficulties of utilizing the smartphone application Glucose Buddy in the Saudi Arabian environment. According to the study, with the right incentives and training, smartphone apps like Glucose Buddy might be successfully adopted in Saudi Arabia.[17]

The role of mobile health technology in the mitigation of brain drain in the healthcare sector is multifaceted. Technological advancements can improve working conditions, reduce workload, and increase job satisfaction among healthcare professionals. They also provide opportunities for continuous professional development, enabling healthcare professionals to acquire new skills and stay updated with the latest medical knowledge.[5,13] Furthermore, telemedicine and digital health platforms reduce the need for physical relocation, while facilitating collaboration and networking among healthcare professionals across borders, ultimately mitigating brain drain.[2,5]

Mobile health technology has played an important role in the control of pandemics by raising awareness and disseminating information, preventing disease such as the COVID-19 virus from spreading from person to person, tracking infected individuals, minimizing in-person contact, conducting virtual screenings, and remotely monitoring patients.[32] A study in a public secondary health facility in Lagos[33] noted that while nurses mostly used treatment compliance and appointment reminder services, majority of doctors only used patient monitoring/surveillance and mobile telemedicine. The majority said they would use more mHealth services if their hospital offered them. The study concluded that knowledge, awareness, and use of mHealth services were low, so doctors and nurses should be trained on their use, mHealth services should be made available in hospitals, and the use of smartphones should be encouraged for better adaptability.[33]

Implications of the findings of this review
Policy Implication
The government should invest in digital health infrastructure, including telemedicine platforms, electronic health records, and mobile health applications. This investment will improve access to healthcare services, especially in rural and underserved areas. Additionally, policies and guidelines should be developed to regulate the use of technology in healthcare, ensuring data privacy, security, and standardization. Incentives, such as training opportunities, equipment, and internet connectivity, should also be provided to healthcare professionals to encourage the adoption of technology. By implementing these policies, Nigeria can leverage technology to enhance healthcare delivery and reduce brain drain.

Practice Implications
The adoption of telemedicine platforms can increase access to healthcare services, particularly in rural and underserved areas. Additionally, electronic health records can improve the accuracy and completeness of patient data, enabling better decision-making. Furthermore, mobile health applications can be developed and used to promote health education, disease prevention, and management, ultimately leading to better health outcomes for Nigerians.

Educational Implication
Digital health should be incorporated into healthcare education to equip healthcare professionals with the necessary skills to effectively use technology. Additionally, training programs should be developed to enhance healthcare professionals' skills in using digital health technologies. Furthermore, digital literacy programs should be established to educate patients on the effective use of digital health technologies, ultimately empowering them to take a more active role in their healthcare.

Research Implication

To fully harness the potential of digital health in Nigeria, further research is necessary to explore its impact on healthcare outcomes, patient satisfaction, and healthcare professionals' job satisfaction. Evaluating existing digital health initiatives is also crucial to identify best practices, challenges, and areas for improvement. Moreover, developing context-specific digital health solutions is essential to address the unique healthcare challenges facing Nigeria. This includes leveraging electronic medical records (EMRs) to improve quality of care and patient outcomes, as seen in studies on EMR adoption in developing countries.

Strengths and Limitations of the review

This review possesses several strengths. It provides a comprehensive overview of the current state of healthcare delivery in Nigeria and the potential of technology to enhance it. The review is based on relevant literature, including academic articles, reports, and policy documents, and has clear objectives. The content is well-structured, making it easy to follow, and provides implications for policy and practice, including investment in digital health infrastructure, policy development, and training for healthcare professionals.

The narrow focus on Nigeria in this review restricts its applicability to other countries. Furthermore, the limited number of studies, particularly on the impact of health technology on brain drain, may not accurately represent the broader literature. The reliance on secondary data may also constrain the depth of analysis, and the absence of a detailed methodology description undermines the reliability of the findings.

Conclusion

This study emphasizes the vital role of technology in transforming Nigeria's healthcare landscape, reducing brain drain, and enhancing healthcare delivery. The adoption of modern technologies such as electronic medical records, telemedicine, and mobile health devices can significantly improve patient care, streamline administrative processes, and create a more supportive work environment for healthcare workers. To harness the full potential of technology, we recommend that developing countries invest in the widespread adoption of these technologies, accompanied by comprehensive training programs for healthcare workers. Robust infrastructure, including reliable power supply and internet access, is also crucial. Furthermore, sustaining these advancements and enhancing healthcare delivery will necessitate fostering global partnerships and securing government support. By implementing these strategies, Nigeria can build a more resilient and sustainable healthcare system, ultimately improving health outcomes and reducing the migration of skilled healthcare professionals.

Declarations

Ethical Consideration: Ethical approval of this study was obtained from the University of Port Harcourt teaching Hospital ethical committee.

Authors' Contribution

Conceptualization
Nwafor CE and Ogomegbunam MO conceived the idea of leveraging technology to enhance healthcare delivery and reduce brain drain in Nigeria. Both authors contributed to the development of the research question, objectives, and methodology.
Development
Nwafor CE led the literature review and development of the theoretical framework, while Ogomegbunam MO focused on the technology aspects and potential solutions for healthcare delivery in Nigeria.
Conduct
Both authors collected and analyzed data, with Nwafor CE focusing on the healthcare delivery aspects and Ogomegbunam MO on the technology integration aspects.
Reporting
Nwafor CE and Ogomegbunam MO shared responsibilities for writing and editing the manuscript. Nwafor CE led the writing of the introduction, literature review, and discussion, while Ogomegbunam MO focused on the methodology, results, and conclusion.
Authors' Approval
Both authors have read, approved, and contributed significantly to the final version of the manuscript. They acknowledge responsibility for the entire work.

Conflict of interest: Authors declared they have no conflicts of interest

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