

Artificial Intelligence: A Lever To Achieve Universal Health Coverage In Sub-Saharan Africa

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Abstract

Artificial intelligence (AI) has strong potential to advance universal health coverage (UHC) in Sub-Saharan Africa by improving access, quality, and financial protection. The region faces structural challenges, including limited funding, low healthcare workforce density, fragile infrastructures, and geographic barriers, which constrain service delivery, especially in rural and underserved areas. AI applications, such as telemedicine, medical imaging, personalized medicine, pharmaceutical supply chain optimization, and therapeutic monitoring, can help overcome these gaps by enhancing diagnostic accuracy, care coordination, treatment adherence, and resource management. Locally adapted solutions demonstrate how technology can extend services to remote populations and strengthen health system efficiency. Successful adoption requires addressing digital connectivity, infrastructure, workforce training, and equitable access. Ethical, legal, and governance frameworks are essential to safeguard patient privacy, ensure fairness, and define accountability. With strategic planning, inclusive policies, and international cooperation, AI can serve as a transformative lever for strengthening health systems and advancing UHC in Sub-Saharan Africa.

Keywords : Artificial Intelligence, Digital Health, Health Systems, Sub-Saharan Africa, Universal Health Coverage

Introduction

Universal health coverage (UHC) ensures that all individuals can access the health services they need without facing financial hardship [1]. In Sub-Saharan Africa, achieving this goal remains challenging due to structural limitations, including insufficient funding, low healthcare workforce density, fragile infrastructures, and geographic barriers [2, 5]. For instance, in the Democratic Republic of Congo, the free maternity initiative launched in 2023 faced difficulties from resource and drug shortages [3] and physician density remains critically low at 2.08 per 10,000 inhabitants [4]. These constraints disproportionately affect rural and underserved populations, limiting equitable access to quality care.

Health systems in the region also contend with challenges such as inconsistent medical supply chains, high disease burdens, and limited adoption of digital technologies [5, 6]. The World Health Organization emphasizes that a minimum combined density of 2.3 health workers per 1,000 population—including physicians, nurses, and midwives—is required to provide essential services, a benchmark rarely met in Sub-Saharan Africa [4, 5].

Artificial intelligence (AI) offers a promising avenue to address these gaps by digitizing care processes, supporting remote consultations, optimizing resource management, and enabling faster, more accurate diagnostics [7, 8]. By extending services to remote areas, improving adherence to treatment, and facilitating personalized care, AI can

strengthen health systems and reduce out-of-pocket expenditures [9]. Successful adoption requires investment in digital infrastructure, training programs for healthcare workers, and policies to ensure equitable access [7, 9].

This commentary aims to explore how AI can serve as a transformative lever for advancing UHC in Sub-Saharan Africa. It examines key applications—including diagnostics, medical imaging, personalized medicine, pharmaceutical supply chains, and patient monitoring—while addressing ethical, legal, and governance considerations, highlighting how AI can improve healthcare delivery and outcomes for all populations, particularly the most vulnerable.

Challenges To Implementing UHC

A major challenge in Africa is the fragility of health systems, characterized by insufficient healthcare personnel and underdeveloped infrastructures. According to World Health Organization (WHO) data, the density of physicians (generalists and specialists) in sub-Saharan Africa remains very low, at approximately 4 physicians per 10,000 population, compared with much higher densities in other regions. The WHO does not recommend a minimum threshold for physicians alone but instead emphasizes the importance of an adequate combined health workforce, including physicians,

nurses, and midwives, to ensure essential service coverage. A commonly cited benchmark indicates that 2.3 health workers per 1,000 population are required to deliver basic health services. In sub-Saharan Africa, this threshold is rarely met, and the particularly low physician density continues to significantly limit access to care, especially in rural and underserved areas [4, 5].

Artificial intelligence (AI), as an advanced technology, could help reduce these disparities by facilitating remote consultations and optimizing the management of medical resources [7]. For instance, telemedicine and automated analysis of health data may partially compensate for shortages of medical personnel and the geographic barriers that often isolate rural populations [8].

Artificial Intelligence As A Potential Solution

AI is a promising tool to transform health systems in sub-Saharan Africa. It allows for faster and more accurate collection and analysis of health data. For example, mobile applications such as Babylon Health enable remote consultations based on patient symptom analysis, which is particularly useful in areas with few physicians [8]. Furthermore, AI can personalize treatments based on each patient's biological data, thereby improving care outcomes and chronic disease management [9].

However, integrating AI into African health systems presents several challenges. A primary obstacle is low connectivity. Limited internet access and digital illiteracy in certain regions hinder the adoption of AI-based technologies. Therefore, developing infrastructure and implementing training programs is key to ensuring effective AI use [7].

Applications Of AI In Health In Africa

AI-Assisted Medical Diagnosis

Telemedicine is one of the most promising AI applications, providing remote consultations that are essential in rural or isolated areas. In Africa, locally developed AI-enabled telemedicine solutions illustrate how technology can be adapted to regional needs. For example, LaFiya Telehealth in Nigeria integrates AI-powered vital signs monitoring and remote diagnostic tools, enabling patients to receive comprehensive virtual consultations even in underserved areas [10]. Similarly, Kenya's Zuri Health uses WhatsApp-based chatbots to facilitate 24/7 access to healthcare information, appointment bookings, and medication support, leveraging widely used mobile platforms to reach remote populations [11].

AI can also analyze diagnostic tests, such as blood smears, with accuracy often exceeding manual examinations [8]. By improving diagnostic accuracy and reducing delays in disease detection, AI-assisted diagnostic tools enhance service coverage and quality of care. Early diagnosis helps prevent unnecessary referrals and complications, thereby reducing out-of-pocket expenditures and strengthening financial protection, particularly for vulnerable populations.

AI-Assisted Medical Imaging And Analysis

AI-assisted medical imaging is another area where this technology can have a significant impact. AI can analyze medical images, such as X-rays and MRIs, to detect anomalies that may be invisible to the human eye. These tools are particularly valuable in regions with limited access to specialized equipment. AI algorithms can identify pathologies with increased accuracy, improving early diagnosis and treatment effectiveness [7]. AI-enabled telemedicine contributes directly to population coverage by extending healthcare services to geographically remote and underserved communities. By reducing travel costs and facilitating timely access to care, these technologies also enhance financial protection for patients.

Genetics And Personalized Medicine

AI supports advancements in genetics and personalized medicine by analyzing patients' genetic and biological data to identify disease risks and tailor treatments for each individual. This approach optimizes therapeutic outcomes and reduces treatment side effects [12]. By customizing therapies to individual biological and genetic profiles, AI-supported personalized medicine improves service coverage and the effectiveness of care. More targeted treatments may also reduce ineffective interventions and long-term healthcare costs, contributing to financial protection.

Optimization Of The Pharmaceutical Supply Chain

Optimizing the pharmaceutical supply chain is another domain where AI can be decisive. Companies such as Zipline use AI-powered autonomous drones to deliver medicines and blood products in hard-to-reach regions. This system has reduced drug delivery times and improved distribution efficiency in countries such as Rwanda and Ghana. AI can also manage stock and ensure drug traceability, reducing waste and shortages [13]. AI-driven optimization of pharmaceutical supply chains enhances population coverage by ensuring the availability of essential medicines in remote areas. By reducing stock-outs, waste, and emergency procurement, these systems also help lower costs for health systems and patients, reinforcing financial protection.

Therapeutic Monitoring And Improving Medication Adherence

Patient monitoring, particularly for chronic diseases, is another area where AI can play a key role. AI improves adherence through mobile applications that remind patients to take medications and monitor their health status. Connected devices can automatically detect whether a patient has taken their treatment, reducing non-adherence risks and enhancing long-term care effectiveness [14]. AI-based therapeutic monitoring improves service coverage by supporting continuity of care for patients with chronic diseases. Improved medication adherence helps prevent complications and

hospitalizations, thereby reducing healthcare expenditures and strengthening financial protection.

Ethical, Legal And Governance Considerations Of AI In Health

The integration of artificial intelligence into health systems raises important ethical, legal, and governance challenges. Key issues include:

1. Data protection and privacy: AI systems require access to large volumes of personal health data. Securing this information is essential to prevent privacy breaches and maintain patient trust.
2. Algorithmic bias and equity: Algorithms may reflect biases present in the data used for training, potentially leading to inequitable diagnoses or treatments, particularly among marginalized populations.
3. Responsibility and legal framework: It is necessary to clarify accountability in cases of AI-related medical errors, whether this responsibility lies with developers, healthcare providers, or health institutions.
4. Governance and regulation: A robust governance framework is critical to ensure ethical, transparent, and equitable use of AI in health. This includes regulating technologies, monitoring practices, and establishing standards for the safe deployment of AI.

In summary, while AI holds significant potential to advance universal health coverage, its adoption must be accompanied by clear regulatory and oversight mechanisms to protect patients and ensure responsible, equitable use of these technologies.

Perspectives And Challenges

Artificial intelligence holds considerable promise for improving healthcare access, quality, and efficiency in Sub-Saharan Africa [7, 13]. AI can extend services to remote areas, optimize resource allocation, and support healthcare professionals in decision-making. However, successful deployment requires addressing structural and systemic challenges, including limited infrastructure, unreliable electricity, insufficient digital connectivity, and shortages of trained personnel [4, 5, 7]. Enhancing digital literacy and providing targeted training for healthcare workers are essential to integrate AI effectively into clinical practice [7, 9].

International cooperation and knowledge sharing can further support technology transfer, best practices, and capacity-building [7, 13]. Governments must invest in infrastructure and develop policies that ensure AI solutions are accessible and equitable, particularly for vulnerable populations [1, 2, 5]. Ethical and regulatory frameworks are also crucial to safeguard patient privacy, data security, and algorithmic fairness [1, 7, 9].

In summary, AI can contribute significantly to universal health coverage in the region, if adoption is paired with strategic

investments, inclusive policies, and robust governance [1, 2, 5, 7]. A balanced approach combining innovation with planning and regulation is key to maximizing benefits while minimizing risks.

Conclusion

Artificial intelligence represents a unique opportunity to enhance UHC in sub-Saharan Africa. However, for this technology to be an effective lever, it is crucial to address challenges related to connectivity, training, and equitable access. Africa must adopt a comprehensive strategy to integrate AI into its health systems and ensure that this technology benefits all population segments, especially in rural and isolated areas. Overcoming these obstacles could transform healthcare in Africa, bringing the region closer to the goal of universal health coverage.

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Informed Consent

Not applicable. This study did not involve human participants or the use of data that could identify patients.

Ethical Approval

The research did not involve experimentation on humans or animals. The manuscript is entirely based on secondary data and publicly available information and adheres to all academic and publication ethical standards.

Data Availability

Data sharing is not applicable to this article, as no new datasets were generated or analyzed. All sources used are publicly available and fully cited in the reference list. Additional bibliographic materials may be obtained from the author upon reasonable request.

Statement

Use of AI and AI-assisted technologies : The author declares the use of an AI-assisted proofreading tool for the linguistic revision of the text.

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