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Artificial intelligence in healthcare systems in Africa: a scoping review of opportunities for universal health coverage

Abstract

Artificial Intelligence (AI) is increasingly recognized as a transformative tool for strengthening healthcare systems worldwide. In Africa, persistent challenges such as workforce shortages, weak infrastructure, and inequitable access to care continue to hinder progress toward Universal Health Coverage (UHC). AI offers innovative solutions to address these challenges by enhancing diagnostic accuracy, improving disease surveillance, and optimizing health system performance. This study presents a scoping review of AI applications in African healthcare systems, synthesizing evidence from peer-reviewed and grey literature published between 2015 and 2024. 78 studies were included. Findings indicate that AI applications are mainly concentrated in clinical diagnostics, public health surveillance, and system management. While these applications show significant promise, their large-scale implementation remains limited due to infrastructural, ethical, and governance challenges. Strategic investments in digital infrastructure, regulatory frameworks, and human capacity are critical to harness the full potential of AI for advancing UHC in Africa.

Keywords: artificial intelligence, Africa, healthcare systems, universal health coverage, digital health, scoping review

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Introduction

Artificial Intelligence is transforming healthcare systems by enabling data-driven decision-making, improving diagnostic precision, and supporting system-wide efficiency. Technologies such as machine learning, deep learning, and natural language processing allow for the analysis of large and complex datasets, generating insights that can enhance both clinical and public health interventions.[1] In many African countries, healthcare systems are constrained by limited human resources, inadequate infrastructure, fragmented information systems, and financial barriers to care. These challenges significantly impede progress toward Universal Health Coverage (UHC), which aims to ensure access to quality health services without financial hardship.[2] Against this backdrop, AI has emerged as a potential catalyst for health system transformation. By augmenting human capacity and improving efficiency, AI could help bridge critical gaps in service delivery. However, despite growing interest, evidence on the actual implementation and impact of AI in African healthcare systems remains fragmented. This study aims to synthesize existing evidence on AI applications in Africa and assess their implications for UHC.

Methods

Study design

This study adopted a scoping review methodology to map the existing body of knowledge on AI applications in healthcare in Africa. This approach is particularly suitable for emerging and interdisciplinary fields where evidence is heterogeneous and evolving.[3]

Data sources and search strategy

A comprehensive literature search was conducted across multiple databases:

i. PubMed
ii. Scopus
iii. Web of Science
iv. Google Scholar (for grey literature)

The search covered publications from January 2015 to December 2024. Keywords included combinations of:

i. "Artificial Intelligence" AND "healthcare" AND "Africa"
ii. "machine learning" AND "health systems" AND "LMICs"
iii. "digital health" AND "Africa"

Boolean operators and database-specific indexing terms were used to refine the search.

Inclusion criteria:

i. Studies addressing AI applications in healthcare
ii. Studies conducted in African countries or relevant to LMIC contexts
iii. Peer-reviewed articles, technical reports, and policy documents
iv. Studies reporting outcomes, implementation experiences, or system-level implications

Exclusion criteria:

i. Non-health-related AI studies
ii. Editorials without analytical content
iii. Non-English publications
iv. Studies lacking relevance to healthcare systems

Study selection and data extraction

After removing duplicates, titles and abstracts were screened, followed by full-text review. Data were extracted using a standardized template capturing:

i. Country and context
ii. Type of AI application
iii. Health domain
iv. Outcomes (e.g., accuracy, efficiency, access)
v. Implementation stage (pilot, scale-up)

Data analysis

A thematic analysis was conducted to categorize findings into three main domains:

1. Clinical applications
2. Public health applications
3. Health system management

Results

Study characteristics

A total of 78 studies met the inclusion criteria. The geographic distribution was uneven, with the majority conducted in South Africa, Kenya, Nigeria, and Rwanda. Over 70% of the studies were published after 2018, indicating a recent surge in AI-related research in Africa. Most studies were experimental or pilot-based, with limited large-scale implementation evidence.

Clinical applications

AI applications in clinical settings primarily focus on diagnostic support. Common use cases include:

i. Tuberculosis detection using chest X-rays
ii. Diabetic retinopathy screening
iii. Cancer detection (breast, cervical, skin)

These systems have demonstrated high levels of accuracy, sometimes comparable to human experts.[4,5] However, their impact on patient outcomes depends on broader system factors such as treatment availability and continuity of care.

Public health and surveillance

AI is increasingly used for disease surveillance and epidemic prediction. Applications include:

i. Real-time monitoring of infectious diseases
ii. Predictive modeling of outbreaks
iii. Risk mapping for targeted interventions

These tools enhance early warning systems and support timely public health responses.[6]

Health system management

AI supports health system management through:

i. Supply chain optimization
ii. Patient flow management
iii. Performance monitoring

These applications improve efficiency and resource utilization, which are critical in resource-limited settings.[7]

Contribution to universal health coverage

AI contributes to UHC through three key dimensions:

- Access: Expanding services to underserved populations
- Quality: Enhancing diagnostic accuracy and decision-making
- Efficiency: Improving resource allocation

Challenges identified

Key barriers include:

- Weak digital infrastructure
- Poor data quality and fragmentation
- Ethical concerns such as bias and privacy[8]
- Limited regulatory frameworks
- AI Ethics remains central to responsible AI deployment.

Discussion

This review highlights that AI in African healthcare systems is progressing but remains uneven and largely confined to pilot initiatives. The concentration of studies in a limited number of countries reflects disparities in digital readiness and research capacity. Clinical applications dominate the landscape due to their measurable outcomes and immediate relevance to workforce shortages.[9] However, improved diagnostic capacity alone does not guarantee better health outcomes if other components of the health system remain weak. This underscores the importance of integrating AI within broader system strengthening efforts. AI applications in surveillance offer significant potential for improving epidemic preparedness, particularly in regions prone to recurrent outbreaks. However, their effectiveness depends on the availability of high-quality, integrated data systems.

Health system management applications, though less prominent, may have the greatest long-term impact by addressing systemic inefficiencies. These include improving supply chains, reducing stock-outs, and optimizing resource allocation. From a UHC perspective, AI can enhance access, quality, and efficiency. However, there is a risk that AI may exacerbate existing inequalities if access to these technologies is limited to well-resourced settings. Ensuring equitable deployment is therefore critical.[10] Key barriers to scale-up include infrastructure limitations, human resource constraints, and weak governance frameworks. Ethical considerations, particularly regarding data privacy and algorithmic bias, must also be addressed to ensure trust and accountability. Overall, AI should be viewed as an enabler rather than a standalone solution. Its successful implementation requires alignment with national health priorities, investment in foundational systems, and strong governance mechanisms.

Limitations

This study is subject to several limitations:

i. Restriction to English-language publications
ii. Potential publication bias
iii. Limited availability of large-scale implementation data
iv. Heterogeneity of included studies

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Conclusion

Artificial Intelligence holds significant potential to strengthen healthcare systems and accelerate progress toward UHC in Africa. However, realizing this potential requires coordinated investments in infrastructure, governance, and human capacity. Future research should focus on implementation and real-world impact to guide sustainable integration.

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Conflicts of interest

The author declares that there are no conflicts of interest.

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