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Artificial Intelligence in Healthcare: A Narrative Review of Recent Clinical Applications, Implementation Strategies and Challenges in Zambia

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Abstract *Artificial intelligence (AI) is rapidly transforming healthcare delivery globally, offering significant potential to address critical health system challenges. The study employed a narrative literature review design guided by the narrative synthesis framework. with literature sourced from peer-reviewed databases and grey literature published between 2019 and 2026. A total of 68 publications met the inclusion criteria and were retained for synthesis. The review revealed that AI has been applied across diagnostic imaging, clinical decision support, public health surveillance, and telemedicine. Zambian studies have evaluated AI for tuberculosis diagnosis, breast cancer detection, and occupational lung disease. Implementation strategies emphasised governance, infrastructure, partnerships, and capacity building. Zambia has made notable progress through its National AI Strategy, SmartCare Pro initiative consolidating over 12 million patient records, Digital Health Data Governance Framework partnership with Finland, and Health AI Global Regulatory Network membership. However, significant challenges persist including unreliable infrastructure, nascent regulatory frameworks, workforce gaps, algorithmic bias, and financial constraints. Despite persistent challenges, substantial opportunities exist for AI to strengthen health service delivery, expand access to quality care, enhance efficiency, strengthen surveillance, and foster local innovation in Zambia. The National Telemedicine and AI Health Diagnostics Pilot and local innovations such as Larry RX AI demonstrate AI's potential. Recommendations include accelerating National AI Strategy operationalisation, developing a comprehensive regulatory framework, investing in resilient infrastructure, scaling workforce development, establishing sustainable financing, and aligning with continental frameworks.*

Keywords *Artificial Intelligence, Challenges, Clinical Applications, Digital Health, Healthcare, Implementation Strategies, Narrative Review, Zambia.*

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Introduction

Artificial intelligence (AI) has emerged as one of the most transformative technologies in modern healthcare, fundamentally changing the way diseases are diagnosed, treated, monitored, and prevented. AI refers to the ability of computer systems to perform tasks that traditionally require human intelligence, including learning from data, recognizing patterns, making predictions, understanding language, and supporting decision-making. In healthcare, AI technologies such as machine learning (ML), deep learning (DL), natural language processing (NLP), computer vision, and generative AI are increasingly being integrated into clinical workflows to improve diagnostic accuracy, optimize treatment planning, enhance administrative efficiency, and strengthen public health surveillance [1].

Globally, AI applications have expanded across nearly every area of clinical medicine. In diagnostic imaging, deep learning algorithms have achieved levels of accuracy comparable to expert radiologists in detecting conditions such as breast cancer, tuberculosis, diabetic retinopathy, pneumonia, and stroke from radiological images. AI-supported clinical decision support systems assist physicians by analysing laboratory results, patient histories, and clinical guidelines to recommend personalized treatment options. Furthermore, AI-powered predictive analytics enables healthcare providers to identify patients at high risk of deterioration, hospital readmission, or chronic disease complications, thereby facilitating preventive interventions. During infectious disease outbreaks, AI has also been used to strengthen epidemiological surveillance, disease forecasting, and contact tracing, demonstrating its value in supporting resilient healthcare systems [2].

The global COVID-19 pandemic significantly accelerated AI adoption in healthcare by exposing weaknesses in conventional healthcare delivery systems. AI tools were deployed to assist in outbreak prediction, vaccine development, medical image interpretation, clinical triage, telemedicine, and public health surveillance.

Most AI healthcare research, development, and implementation have occurred in North America, Europe, and parts of Asia, where strong digital infrastructure, comprehensive health information systems, substantial financial resources, and well-established regulatory frameworks support innovation. Conversely, many African countries continue to experience challenges related to limited digital infrastructure, inadequate internet connectivity, shortages of skilled AI professionals, fragmented health information systems, insufficient regulatory oversight, poor data quality, and financial constraints that limit large-scale AI adoption [3, 4].

Nevertheless, AI presents considerable opportunities for strengthening healthcare delivery in resource-constrained settings. In many LMICs, shortages of healthcare workers, limited specialist availability, and geographical barriers reduce access to quality healthcare services, particularly in rural areas. AI-supported telemedicine, automated diagnostic systems, mobile health applications, and decision support systems can help bridge these gaps by expanding access to specialized care while improving efficiency [5].

Within Africa, digital health transformation has accelerated over the past decade through investments in electronic medical records, health information systems, telemedicine, and mobile health technologies. AI is increasingly viewed as the next phase of this digital transformation. Several African countries have begun exploring AI for disease surveillance, maternal and child health, pathology, radiology, and predictive analytics [6].

In Zambia, the healthcare system continues to face significant challenges, including shortages of skilled healthcare personnel, unequal distribution of healthcare services between urban and rural areas, increasing burdens of communicable and non-

communicable diseases, limited specialist services, and resource constraints. These challenges have intensified the need for innovative technologies capable of improving healthcare delivery and expanding access to quality services. Recognizing the importance of digital transformation, the Government of Zambia has prioritized digital health through the Ministry of Health's Digital Health Strategy 2022–2026, which seeks to strengthen health information systems, improve interoperability, promote electronic health records, enhance digital governance, and establish an integrated digital health ecosystem capable of supporting advanced technologies such as AI.

The implementation of Zambia's Digital Health Strategy represents an important foundation for future AI adoption because AI systems depend heavily on reliable digital infrastructure, interoperable information systems, standardized health data, and effective governance mechanisms [7]. The strategy aligns with broader national efforts to improve healthcare quality, strengthen disease surveillance, enhance service delivery, and accelerate progress toward Universal Health Coverage through digital innovation. While AI is not yet widely deployed across Zambia's healthcare facilities, the country's increasing investment in digital health infrastructure creates opportunities for future integration of AI into clinical practice, health management, and public health programmes.

Recent developments further indicate Zambia's growing interest in AI governance and digital innovation. Alongside broader digital transformation initiatives, policymakers have begun exploring national AI policy and regulatory frameworks to guide the responsible adoption of AI across sectors, including healthcare. Such initiatives recognize that successful AI implementation requires not only technological investment but also appropriate legislation, ethical governance, workforce development, cybersecurity, and protection of patient privacy.

Given the rapid evolution of AI technologies and Zambia's ongoing digital health transformation, there is a need to consolidate current evidence to better understand how AI can contribute to strengthening healthcare delivery within the Zambian context. A narrative review provides an appropriate methodological approach for synthesizing diverse evidence from peer-reviewed literature, policy documents, and implementation reports to identify recent clinical applications, implementation strategies, opportunities, and challenges. Such evidence can inform policymakers, healthcare professionals, researchers, technology developers, and healthcare institutions in designing contextually appropriate AI implementation frameworks that promote equitable, ethical, and sustainable adoption of AI within Zambia's healthcare system [6].

Therefore, a narrative review is necessary to synthesize recent evidence on AI in healthcare, identify implementation strategies and challenges, and provide context-specific insights that can guide future research, policy formulation, and responsible AI adoption in Zambia [8-10].

The specific objectives are:

1. To determine the clinical applications of artificial intelligence in healthcare, focusing on diagnostic imaging, clinical decision support, public health surveillance, and telemedicine.
2. To examine the strategies used to implement artificial intelligence in healthcare in Zambia, including governance, infrastructure, stakeholder involvement, and capacity building.
3. To identify the major technological, infrastructural, regulatory, ethical, and financial challenges affecting the adoption of artificial intelligence in Zambia’s healthcare system.
4. To explore the opportunities and future prospects of artificial intelligence for

improving healthcare delivery in Zambia.

Materials and Methods

Description of the Site

The study was carried out in Zambia focusing on various AI in health care studies that were done from 2019–2026.

Description of the Experiments Done

The study adopted a narrative literature review design. The narrative review design was considered appropriate because the study sought to examine recent clinical applications of artificial intelligence (AI), implementation strategies, challenges, and future opportunities within the healthcare sector, particularly in Zambia. The study was underpinned by the interpretivist research philosophy.

Description of the Laboratory Methods

The study adopted a qualitative and inductive research approach. Literature was obtained from both peer-reviewed and grey literature sources to ensure comprehensive coverage of current evidence.

A comprehensive literature search was conducted using Boolean operators (AND, OR) and Medical Subject Headings (MeSH) where applicable. Searches were limited to publications between 2019 and 2026 to capture recent developments in AI healthcare applications.

The study included English-language studies published between 2019 and 2026 that examined AI applications in healthcare, particularly in Zambia and Southern Africa, including quantitative, qualitative, mixed-methods and review studies, as well as peer-reviewed articles and recognised institutional reports. Studies were excluded if they were published before 2019, in languages other than English, focused on AI outside healthcare, lacked empirical or analytical evidence, were duplicates, unavailable in full text, or did not address AI implementation or adoption in healthcare.

The screening process followed four stages adapted from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Description of Analysis Methods Used

The study employed the Narrative Synthesis Framework proposed by Popay et al [8]. Narrative synthesis is appropriate where evidence originates from diverse methodologies and contexts, making statistical meta-analysis inappropriate.

Results

Summary of Reviewed Literature

The reviewed literature covered a wide range of clinical domains. Diagnostic imaging was the most extensively represented domain, with studies on AI applications in radiology, pathology, dermatology, and ophthalmology.

Table 1 shows the Key Zambian AI Studies and Initiatives carried out from 2019–2026.

Table 1. Key Zambian AI Studies and Initiatives (2019–2026)

Study/Initiative	Year	Focus	Key Findings/Outcomes
InferRead DR Chest Evaluation for TB Screening (Somwe et al., 2025)	2025	Diagnostic performance of CAD for TB in adults	AUC 0.81 (95% CI: 0.78-0.83); acceptable performance in high HIV/TB burden setting; additional training recommended
CAD for TB Diagnosis in Children (Muyoyeta et al., 2025)	2025	Diagnostic accuracy of CAD systems for paediatric TB	CAD4TB_v7 and qXR_v4 achieved AUCs of 0.75 and 0.69 against microbiological reference; accuracy improved against expert reader reference (AUCs 0.81 and 0.83)

Thermalytix Breast Cancer Detection (Mwale et al., 2025)	2025	AI-enhanced breast thermal imaging	Strong correlation with mammography; potential as additional tool for early detection in Zambia
CAD4Silicosis and CAD Spirometry (Zambart, 2025)	2025	AI tools for occupational lung disease	WHO-endorsed CAD4Silicosis; world's first tool predicting lung function from chest X-ray; real-world validation study underway
National Telemedicine and AI Health Diagnostics Pilot (TechAfrica News, 2025)	2024-2025	AI-supported remote diagnostics	Expanded to 20 health facilities in 2025; integrates remote diagnostics, AI-supported clinical analysis, enhanced connectivity for rural clinics
National AI Strategy 2024-2026 (OECD, 2026)	2024	National framework for AI adoption	Positions Zambia for AI-driven economic growth; six priority sectors including healthcare; National AI Council established
SmartCare Pro Initiative (ITWeb Africa, 2026)	2014–present	Electronic health records	Consolidated >12 million patient records; over 2,000 health facilities connected; >14,000 health workers trained; foundation for AI-ready healthcare system
Digital Health Data Governance Framework (CIDRZ, 2024)	2024	Health data governance	First-ever framework for Ministry of Health; co-developed with CIDRZ
Health Informatics Programmes at UNZA (CIDRZ, 2024)	2024–2025	Health informatics education	Undergraduate and postgraduate programmes established; health informatics competency framework developed

Source: *Field data (2026)*

Table 2. Clinical Applications of AI in Healthcare

Author/s	**Findings**
Muyoyeta et al. (2025)	AI-based CAD tools showed potential for paediatric TB diagnosis in Lusaka. CAD4TB_v7 and qXR_v4 achieved AUCs of 0.75 and 0.69 against microbiological standards, improving to 0.81 and 0.83 against expert-reader standards. Further training using paediatric images was recommended.
TechAfrica News (2025); ITWeb Africa (2025)	Zambia's National Telemedicine and AI Health Diagnostics Pilot, launched in 2024 and expanded to 20 health facilities in 2025, demonstrates growing use of AI-supported clinical analysis to improve healthcare access, particularly in rural areas.

Global Fund (2024); Somwe et al. (2025); Muyoyeta et al. (2025)	Zambia's electronic health records and integrated disease surveillance systems provide opportunities for AI-supported disease prediction, early intervention and public health surveillance, particularly for TB and HIV. However, data sparsity and limited analytical capacity remain barriers to adoption.
Ministry of Technology and Science (2025)	Larry RX AI, a Zambian-developed tool, supports medication safety by analysing drug–drug interactions and compliance. Pilot implementation across 20 health posts in 10 provinces demonstrates emerging local capacity for AI-driven clinical decision support.

Source: *Field data (2026)*

The literature in Table 2 indicates that AI has significant potential to strengthen healthcare delivery in Zambia, particularly in diagnosis, telemedicine, disease surveillance and medication safety. Muyoyeta [10] demonstrate that AI-based diagnostic tools can support paediatric TB detection, although further local training is required to improve accuracy. The expansion of the National Telemedicine and AI Health Diagnostics Pilot shows that AI can help extend specialised healthcare services to rural and underserved populations. Zambia's electronic health records also provide an important foundation for AI-supported disease prediction and surveillance, although poor data quality and limited analytical capacity remain major barriers. Finally, the development of Larry RX AI demonstrates growing local capacity to develop AI solutions for medication safety.

Table 3. Implementation Strategies

Author/s	**Findings**
OECD (2026)	Zambia's National Artificial Intelligence Strategy (2024–2026) provides a framework for using AI to promote economic growth, improve public services and support inclusive development. However, Zambia's AI ecosystem remains at an early stage, facing limited digital infrastructure, shortages of skilled AI professionals, fragmented data systems and inadequate dedicated AI governance frameworks.
ITWeb Africa (2026)	The SmartCare Pro initiative has consolidated more than 12 million patient records into a unified electronic health records system. More than 2,000 health facilities have been connected and over 14,000 health workers trained, providing an important foundation for AI-enabled healthcare and data-driven decision-making.
CIDRZ (2024)	CIDRZ, in partnership with the Ministry of Health, developed Zambia's first Digital Health Data Governance Framework. It also supported a health informatics competency framework and the development of health informatics programmes at the University of Zambia. These initiatives strengthen data governance, workforce capacity and digital health implementation.

TechAfrica News (2025)	Zambia's National Telemedicine and AI Health Diagnostics Pilot, launched in 2024 and expanded to 20 health facilities in 2025, integrates remote diagnostics, AI-supported clinical analysis and improved connectivity. The initiative particularly aims to expand access to quality healthcare in rural areas and support decentralisation of healthcare services.

Source: *Field data (2026)*

Table 3 shows that Zambia is establishing important foundations for the adoption of AI in healthcare, but significant gaps remain. The National AI Strategy provides policy direction, while SmartCare Pro has strengthened the country's digital health infrastructure by consolidating patient records and connecting health facilities. CIDRZ has further contributed through data governance and health informatics capacity development, which are essential for effective and responsible AI use. The expansion of the National Telemedicine and AI Health Diagnostics Pilot also demonstrates the potential of AI to decentralise healthcare and improve access in rural areas.

Table 4. Challenges Affecting AI Adoption

Author/s	**Findings**
Owoyemi et al. (2024)	AI research in low- and middle-income countries is largely focused on AI model development, with limited evidence of external validation and actual clinical deployment. In Zambia, shortages of skilled healthcare workers and under-resourced facilities further constrain AI adoption.
Muyoyeta et al. (2025)	The paediatric TB CAD study in Lusaka found that AI diagnostic tools may require additional training using paediatric images to improve performance. The paucibacillary nature of TB in children may also make comparison with expert readings more appropriate.
Global Fund (2024)	Zambia's dependence on hydropower (83% of installed generation capacity) exposes health facilities to power disruptions. Droughts have also affected electricity, internet connectivity and telecommunications, creating significant infrastructure barriers to AI adoption. Solar power and internet support for 650 priority facilities are helping address these challenges.
OECD (2026)	Zambia has established a national AI strategy, but AI healthcare regulation and governance remain at an early stage. The strategy promotes ethical and responsible AI through policy and regulatory frameworks, but practical implementation of safeguards is still developing.

Source: *Field data (2026)*

Table 4 highlights that AI adoption in Zambia's healthcare system faces several interconnected challenges. Limited skilled personnel and under-resourced health facilities restrict the capacity to develop, validate and deploy AI technologies. The need for further training of AI diagnostic tools also shows that local validation is essential to ensure accuracy

for Zambian populations. In addition, unreliable electricity, internet connectivity and telecommunications create major infrastructure barriers, particularly in rural areas. Although Zambia has established a National AI Strategy, regulatory and ethical governance mechanisms are still developing. Overall, successful AI adoption will require investment in infrastructure, workforce skills, local validation, data systems and effective regulation.

Table 5. Opportunities and Future Prospects

Author/s	Findings
Somwe et al. (2025); Muyoyeta et al. (2025)	AI-enhanced point-of-care diagnostics can help address diagnostic gaps, improve accuracy among non-specialist healthcare workers, and provide quality assurance at scale, particularly in under-resourced settings.
Alowais et al. (2024)	The widespread use of ChatGPT among pharmacy students in Zambia indicates growing AI literacy and acceptance among future healthcare professionals, creating opportunities for wider adoption of AI technologies in healthcare.
CIDRZ (2024)	CIDRZ and the Ministry of Health developed Zambia's Digital Health Data Governance Framework and supported health informatics programmes at UNZA. These initiatives strengthen data governance, digital skills and local capacity necessary for AI innovation in healthcare.

Source: *Field data (2026)*

The table 5 indicates that Zambia has significant opportunities to leverage AI to strengthen healthcare delivery and build local capacity. AI-supported diagnostics can help address shortages of specialists by assisting non-specialist healthcare workers and improving the quality of diagnosis. The growing use of AI tools such as ChatGPT among pharmacy students suggests increasing AI literacy and acceptance among future healthcare professionals. Furthermore, the Digital Health Data Governance Framework and health informatics programmes supported by CIDRZ and the Ministry of Health are strengthening data governance, digital skills and institutional capacity.

Discussion

Recent evidence shows that AI is increasingly being applied to clinical diagnosis and disease surveillance in Zambia, particularly in diagnostic imaging. Studies in Lusaka demonstrate that computer-aided diagnosis (CAD) tools can support tuberculosis detection among both children and adults, although further training and local validation are required to improve performance across different patient groups [10, 17]. AI-enhanced technologies such as Thermalytix also show potential for early breast cancer detection, while CAD4Silicosis and CAD Spirometry offer promising applications for occupational lung disease among Zambia’s mining population [11]. In addition, Zambia’s electronic health records and disease surveillance systems provide opportunities for AI-driven prediction and early intervention for diseases such as TB and HIV, although data sparsity and limited analytical capacity remain significant barriers to implementation [10, 15, 17].

The literature shows that Zambia is developing a multi-level implementation framework for AI in healthcare, supported by the National AI Strategy (2024–2026), which emphasises ethical governance, human-capital development, digital infrastructure, data

systems, research, innovation and multi-stakeholder collaboration (OECD, 2026). These efforts are reinforced by the Zambia Digital Health Strategy (2022–2026), the Digital Health Data Governance Framework, health informatics training programmes and the expansion of SmartCare Pro, which has consolidated over 12 million patient records and connected more than 2,000 health facilities [13, 28]. Infrastructure and capacity-building are further supported through Global Fund investments in connectivity, solar power, digital equipment and workforce training, while partnerships with Finland, the World Bank and other international organisations provide technical and financial assistance for AI and digital health development [15, 20]. At the clinical level, the expansion of the Telemedicine and AI Health Diagnostics Pilot and introduction of AI technologies for occupational health demonstrate practical efforts to integrate AI into service delivery and generate local evidence [12]. Overall, Zambia's implementation strategy combines policy and governance, digital infrastructure, data integration, workforce development, international partnerships and local validation, although persistent challenges such as unreliable electricity, limited technical skills, fragmented systems and emerging AI governance requirements may constrain large-scale adoption [14, 15, 18].

The literature identifies infrastructural, technical, regulatory, ethical, human-resource and financial challenges as major barriers to AI adoption in Zambia. Under-resourced health facilities and shortages of skilled healthcare workers limit the capacity to implement and sustain AI, while limited external validation and clinical deployment of AI models in low- and middle-income countries raise concerns about their applicability to local populations [17]. Data sparsity, poor quality and limited interpretability of machine-learning models further constrain the effective use of electronic health records for AI-supported decision-making [11, 12]. In addition, Zambia's dependence on hydropower makes healthcare facilities vulnerable to power outages and disruptions to internet and telecommunications, particularly during droughts [15]. Although the country has developed a National AI Strategy and emerging regulatory guidelines, AI governance, accountability and ethical oversight remain at an early stage [14]. Concerns regarding data privacy, algorithmic bias, inclusion and potential job displacement also require stronger safeguards, while limited domestic financing and competing health priorities make long-term investment in AI infrastructure, maintenance, training and system updates difficult despite support from organisations such as the Global Fund and World Bank [15, 22].

The literature indicates that Zambia has significant opportunities to leverage AI to strengthen healthcare delivery, improve access and enhance health-system efficiency. AI-supported point-of-care diagnostics can improve the accuracy of diagnosis, particularly where specialist healthcare workers are scarce, while telemedicine and AI-enabled clinical analysis can extend specialised services to rural and underserved communities [21]. Expanding fibre-optic and satellite connectivity further creates opportunities for remote healthcare and digital service delivery [16]. AI also has potential to improve pharmaceutical supply chains, reduce costs and enhance medication safety, as demonstrated by the locally developed Larry RX AI for identifying drug interactions [18]. Furthermore, Zambia's National AI Strategy, SmartCare Pro, digital health investments, and emerging regulatory frameworks provide an enabling policy and technological foundation for responsible AI adoption [19]. Membership in the Health AI Global Regulatory Network also provides access to international expertise and collaboration [21]. Overall, Zambia is making progress towards AI readiness, but continued investment in infrastructure, human capacity,

data systems, governance and local research will be essential to realise the full benefits of AI in healthcare.

Conclusion

The narrative review concludes that AI has considerable potential to strengthen healthcare delivery in Zambia, particularly through computer-aided diagnosis, telemedicine, disease surveillance, medication safety and occupational health applications. Initiatives such as the National AI Strategy, SmartCare Pro, the Digital Health Data Governance Framework and international partnerships provide an important foundation for responsible AI adoption. However, the benefits of AI remain constrained by inadequate infrastructure, unreliable electricity and internet connectivity, poor data quality, limited technical and analytical skills, emerging regulatory frameworks and financial limitations. Although locally developed innovations and AI validation studies demonstrate growing capacity, the limited amount of Zambia-specific empirical evidence highlights the need for greater local validation, investment in infrastructure and human capacity, stronger governance, sustainable financing and inclusive implementation to ensure that AI produces equitable and sustainable improvements in healthcare outcomes.

Conflict of Interest

None declared.

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Ethics

Professionalism was upheld in carrying out the research.

Data Availability

The grey literature that was examined in the course of this study can be obtained from the corresponding author upon a reasonable request.

Author Contributions

The author made most of contribution to the development, conceptualization, analysis, and composition of this paper. A research assistant was engaged in data cleaning and proofreading.

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