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Literature Review

Artificial Intelligence and Health Education in Nigeria: Implications for Healthcare Delivery, Workforce Capacity, and Digital Health Systems

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Abstract

Artificial Intelligence (AI) is slowly reconstituting health systems globally with new approaches to diagnosis, disease surveillance, clinical decision-making and service delivery. In Nigeria, where health infrastructure faces persistent challenges-verging on limited funding, workforce shortages, uneven access to care and fragmented data systems. AI is also a test of preparedness and an opportunity. We investigate the implications, uses and health informatics problems of AI adoption within the Nigerian health system. The paper discusses several practical applications including but not limited to AI-assisted radiology, predictive modeling for infectious disease outbreaks, telemedicine support tools, EMR optimization and community level decision support. Such technologies have the potential to enhance early detection of high-burden diseases (including tuberculosis, malaria, cancer, and complications associated with pregnancy) while also democratizing access among disadvantaged rural populations. However, the success of such implementation heavily relies on health data quality, availability and interoperability. Key barriers remain significant. Many health facilities still use paper-based records, digital infrastructure is uneven, electricity and internet access are unreliable in some areas, and capacity for health informatics is sparse. Adoption of these technologies is further complicated by ethical considerations such as data privacy, algorithmic bias, accountability and patient trust. Emerging regulatory frameworks are weak, coordination and enforcement capacity for governance need strengthening. The paper concludes that AI can play a meaningful role in supporting Nigeria's health system if deployed responsibly with strong data systems and sound workforce training, and guided by clear ethical and regulatory safeguards. What made sense for AI-assisted generated health solutions is the principle of ensuring that they do not replace human expertise while keeping patient-centric and equitable health eValue- outcomes.

Keywords: *Artificial Intelligence in Health Care; Nigeria; Health Informatics; Digital Health Infrastructure; AI Ethics; Predictive Health Analytics.*

1. Introduction

Nigeria's health sector is gradually embracing a digital dimension due to recent policies and partnerships. The recently-enacted Nigeria Data Protection Act (NDPA, 2023) has fortified the legal foundation for privacy a crucial bulwark against AI in medicine. If you're interested in the national push towards responsible adoption of AI — including in health care — consider the National Artificial Intelligence Strategy (2024; updated 2025), led by NITDA and NCAIR.

Simultaneously, the Federal Ministry of Health and Social Welfare (FMOH) is pushing digitization with initiatives like the Nigeria Digital in Health Initiative (NDHI) as well as the Enterprise Content Management (ECM) project. Such initiatives are designed to upgrade patient record systems, link up facilities and solidify the way health data is stored and shared.

Nonetheless, the divide between policy and real-world impact is as large as ever. Many facilities rely on paper records, the adoption of EMRs in routine practice is still low, internet connectivity is patchy, ubiquitously inconsistent power supply and limiting number of data-literate health staff. Regulatory coherence is also maturing, navigating the challenges of overlapping mandates and limited capacity to enforce algo validation and transparency or hold AI-supported decision-makers accountable when something goes wrong.

This paper explores where AI can realistically assist Nigeria's health system, what needs to be fixed first (especially data and infrastructure), and how trust can be built through governance, ethics and human capacity.

The Potential of Artificial Intelligence in Nigeria's Healthcare System

But barring systemic challenges, AI has meaningful potential for Nigeria's health system if deployed carefully. Machine-learning tools can aid earlier diagnosis of tuberculosis, breast cancer and pregnancy complications. Predictive models might be used to identify malaria or cholera outbreaks before they become widespread. Natural language systems can help clinicians with documentation and translate complicated medical information into local languages that recipients understand."

In rural areas, where there is a shortage of doctors, AI-enabled telemedicine platforms and mobile decision support tools could bring care outside the hospital. These systems potentially have the power to guide community health workers, improve referrals, send medication reminders, and relieve overburdened facilities. If used responsibly, AI will augment not replace the work of health professionals.

But technology is only as good as its data. Nigeria's health data is still fragmented, with many of the country's facilities stuck on paper records and digital systems that aren't standardized. Garbage data leads to biased or unreliable output. Building electronic medical record coverage, enhancing interoperability and appropriately investing in secure digital infrastructure are therefore foundational.

Governance matters, trust matters. At this crucial juncture, policymakers need to find a way to balance innovation with safeguarding patient rights. Problems like algorithmic bias, informed consent, accountability and data privacy need established regulatory frameworks and real-time monitoring. Healthcare AI systems should be transparent, explainable, and performance monitored. Public trust relies on transparency and responsible usage.

Transitioning from silos of pilot projects to ongoing national integration requires aligned action. Nigeria must instead focus on expanding interoperable digital health systems within the country, upskilling its workforce training in health informatics and integrating AI ethics into medical education and professional development within government healthcare systems. Digital initiatives also need sustainable financing mechanisms so they do not collapse after short-term funding ends.

Local innovation should be encouraged through partnerships between universities, teaching hospitals and technology startups to ensure solutions reflect Nigeria's disease patterns and social realities. There must remain a emphasis on community engagement, ensuring that the citizen is aware of how AI is being used and how their data is being protected.

Artificial Intelligence is not a panacea. However, with a solid foundation of governance, inclusive education and reliable infrastructure underneath it, it can facilitate a move toward more proactive, data-driven and patient-centred care. Nigeria is at a historic juncture: the opportunity is tangible, but how it plays out will come down to focused and sustained resolve.

2. Literature

The Potential of Artificial Intelligence in Health Care

Although much remains to be done, AI can bring real value in Nigeria—if applied judiciously and supported by strong data systems. Machine-learning tools can help detect tuberculosis, breast cancer, pregnancy complications and other high-burden conditions faster. Predictive models can also help alert earlier to the risk of malaria or cholera, giving health teams time to respond.

For rural populations with acute doctor shortages, chatbots and AI-enabled telemedicine as well as mobile decision-support tools can help community health workers, facilitate referrals, remind patients to take their medications and reduce the burden on overworked hospitals. Using these language tools to translate health information into local languages and, at times, in more simple terms (as you provided) would help improve the understanding retention and adherence.

But the performance of AI is dependent on the quality of data. Where inputs are patchy or lack uniformity — particularly when they remain in a physical paper form — the outputs can also suffer from unreliability or bias. Which is why scaling EMRs, standardizing data formats and enabling interoperability are not “nice-to-have” steps; they’re the bedrock for safe, reliable A.I. in Nigerian health care.

2.0 Clinical Decision Support and Diagnostics

Clinical decision support and diagnostics are still the most visible and immediate sectors of AI impact. Machine-learning systems trained on troves of patient records, lab results and medical images are able to detect patterns that human clinicians could overlook. These tools are helping to triage cases, flag high-risk patients, offer potential diagnoses and advise care decisions.

Nigeria, which has a doctor-to-patient ratio of about 1:6,000, would benefit considerably. AI systems for imaging are already being trialed in Africa for tuberculosis and cervical cancer screening. Chest X-ray models can identify early pulmonary TB, which is very useful in those regions with limited radiologists. AI tools also assist dermatology screening and aid community health workers in obstetric risk identification during prenatal care.

New multimodal AI systems can read text, analyze images and interpret lab data in parallel to summarize findings and warn them and translate instructions for care into the local language. However, local validation is essential. The performance of models trained on datasets not including African populations in Nigerian population is therefore likely to be biased if not fine-tuned.

AI is being used as well to advance pathology and laboratory analysis, from malaria detection to cytology screening. When integrated with EMRs, these systems can send alerts and follow-up reminders, enabling more proactive, data-led care.

2.1 Public-Health Intelligence

The impact of A.I. extends far beyond hospitals and clinics — it’s transforming how nations track and safeguard public health. Early detection is everything, especially in a country as epidemiologically complex as Nigeria, which still has malaria, cholera and Lassa fever alongside rising non-communicable diseases.

Machine-learning models can take comprehensive weather data, mobility trends and lab reports to predict where the next malaria surge or cholera outbreak will land. For instance, algorithms can correlate the fluctuations in precedence rainfall and temperature with those of mosquitoes’ breeding patterns to assist public-health teams in implementing preemptive coping measures before an outbreak sets in. Natural language processing (NLP) tools, for example, can sift through social media and hospital logs for unusual symptom patterns — suggesting a potential epidemic weeks before traditional systems might.

A 2024 World Health Organization-backed pilot project in West Africa demonstrated how A.I.-enabled earlywarning systems could signal an outbreak hot spot up to two weeks before it happened, saving thousands of lives in the process.

The country's public-health data systems are still fragmented — while there's little coordination with the Nigeria Centre for Disease Control (NCDC), primary health centers and academic institutions. Embedding AI analytics into these systems has the potential to transform disease surveillance. For example, algorithms can track health trends among internally displaced persons (IDPs) or predict vaccine shortages in conflict-affected regions. AI may also enhance immunization coverage through identifying at-risk communities (low vaccination rates) or weaker cold-chain logistics.

In short, AI turns public-health intelligence from slow, reactive reporting into a proactive, predictive network — one that can spot and halt threats before they spiral.

2.2 Operational Efficiency

AI isn't purely clinical genius, it's also a matter of making the health system work better.

Hospitals can decongest care and manage drug shortages through the insights that predictive analytics provide for anticipated patient loads. Algorithms can forecast when demand will peak for oxygen, blood or medications — giving administrators time to prepare — by analyzing historical data on patient admissions and seasonal disease trends and input from supply chain s. Natural- language tools can also automate repetitive administrative work, like documentation, billing or claims processing — allowing doctors and nurses to spend more time with patients. In bustling Nigerian hospitals with thin staffing, this kind of automation could prove life saving. For instance, AI transcription systems can capture and summarize consultations in EMRs directly while generating prescriptions or lab orders automatically.

At bigger hospitals, machine-learning can help with theatre scheduling, bed allocation and equipment maintenance, spotting faults before they lead to downtime. Those efficiencies not only save money — they enhance care continuity, reduce burnout and make hospitals more resilient overall.

2.3 Access and Equity

AI's most transformative promise may be democratizing care. AI chatbot-powered telemedicine platforms may provide medical advice to remote or underserved places — where hospitals are miles away, and doctors few and far between. A patient in rural Borno or Cross River might describe symptoms on the phone, be guided through triage by A.I., and connect virtually with a physician in Lagos within minutes.

AI can also help community health workers (CHWs). Mobile decision-support apps enable CHWs to assess patients, adhere to standardized care protocols, and know when to refer cases. This standardization increases quality and confidence in the health system, regardless of where someone resides.

AI-driven language accessibility is another game changer. Nigeria's myriad of languages has long been an impediment to communication in care. AI can then transform that health information into vernacular dialects and adapt it to cultural or literacy contexts. Think of a maternal-health bot that sends gentle voice reminders in Hausa about antenatal visits to expectant mothers, or tips on nutrition in Igbo for new mothers — such small interventions can save lives.

AI helps health care be more inclusive and equitable by eliminating barriers of geography, language and literacy. AI makes available to Nigeria a potent toolkit to address structural limitations — including diagnostic delays and labor shortages as well as inefficiencies and access gaps. Its potential extends across every layer of the health system: clinical care, public-health surveillance, hospital operations and patient empowerment.

But technology alone isn't enough. In order for AI to fundamentally change Nigerian health care, the country should invest in data infrastructure, ethical governance, capacity-building and inclusive design. Under guidance of transparency, fairness and accountability, AI can transcend from a technology of the future to a genuine, life-saving tool for millions.

3. The Focus of AI in Nigeria's Health Care System

Nigeria's experience with Artificial Intelligence (AI) in health care is still nascent, but the groundwork could not be stronger. The country is slowly nurturing an ecosystem of supportive policies, pilot programs and innovation hubs that could sustain mass adoption over the long term. And while full integration of AI into everyday clinical practice remains elusive, Nigeria has charted a well-defined institutional and regulatory course for responsible innovation. In the past five years, national frameworks intended to facilitate digital transformation, and secure data while also fostering research and innovation in AI-enabled health solutions have been spearheaded by agencies like the Federal Ministry of Health and Social Welfare (FMOH), the National Information Technology Development Agency (NITDA) as well as the National Centre for Artificial Intelligence and Robotics (NCAIR).

3.1 Digital Transformation of Health Sector

Initiatives such as the Enterprise Content Management (ECM) system, which was launched in 2025, and the Nigeria Digital in Health Initiative (NDHI), are contributing to Nigeria's digital-health transformation picking up considerable momentum.

The ECM facilitates the digitization of FMOH's internal workflows by transitioning from paper-based processes to secure, searchable electronic records. This initiative aligns with NDHI's overall plan to create a national digital-health backbone — an integrated system connecting all tiers of care via interoperable data systems and live tracking. NDHI aims to incorporate electronic health records (EHRs), health-information exchanges, and national registries (master-patient indexes and facility databases). The ultimate aim is to have every Nigerian having a dynamic digital health record available to approved providers anywhere in Nigeria. When the data can broadly be standardized into a common environment, this will provide a solid foundation upon which powerful AI systems can seek to train, validate and deploy.

Through digitizing patient records, supply-chain processes and disease-surveillance networks, NDHI is laying the groundwork for predictive analytics, automated alerts and AI-assisted decision support — essential components of a modern data-driven health system.

3.2 AI Enablement in Health Financing Reform

The National Health Insurance Authority (NHIA) Act 2022, therefore, signified a monumental shift from voluntary to mandatory health insurance coverage with all sectors of the economy contributing towards Universal Health Coverage (UHC). The Act's performance-based purchasing model links provider payments to quality and outcomes, not service volume.

This reform is directly beneficial for the AI adoption. When providers get paid based on efficiency and better outcomes, then a tool that uses AI to decrease readmissions or optimize logistics or improve diagnostics becomes financially beneficial. Gradually, setting NHIA's reimbursement formulas based on AI-driven performance metrics could knit artificial intelligence into the fabric of Nigeria's health system and ensure its sustainability.

3.3 Academic and Industry Developments

Interest in AI-driven health innovation is booming in academia and the private sector. A gradual increase in AI application research in radiology, triage automation, hospital operations, and remote patient monitoring was observed from studies listed on ResearchGate and Dialnet.

But the vast majority of these projects are small-scale — usually pilot projects inside teaching hospitals or donor- funded efforts. In a cross-sectional study conducted in 2025 (Dialnet, 2025), four persistent barriers were identified: Inadequate digital infrastructure

1. Poor interoperability between health systems

2. Workforce for data science and informatics still limited

3. Undefined governance and accountability frameworks for AI validation and clinical usage

4. Startups are also rushing into the field, with AI-powered telemedicine services, chatbots and diagnostic tools. But without standard data formats or a national shared repository, these solutions tend to work in silos.

The absence of centralized de-identified datasets hinders local model training and benchmarking, leading to performance variability across geographical regions.

Closer collaboration between the FMOH, universities and private innovators is critical in building robust, open datalakes that comply with Nigeria's Data Protection Act (NDPA 2023) whilst serving as a feedstock for domestic AI research.

Informed Health Delivery to Combat Implementation Challenges within Nigeria

The most prominent barrier to AI implementation in Nigeria's health system is not a lack of interest—it is the fragility of foundational systems. AI and ML rely heavily on trustworthy, organized, and interoperable data. But in many public health facilities, patient data is still captured on paper, stored across disparate databases or entered inconsistently. Algorithmic outputs become unreliable when data is incomplete or poorly standardized.

Increased Adoption of Electronic Medical Record at Tertiary and Donor Programs However, nationwide coverage remains uneven. Most primary health centres lack reliable internet access, consistent electricity, or trained IT staff. These gaps are on the quality of the data used for AI training and validation.

Infrastructure limitations extend beyond connectivity. Server capacity, cybersecurity safeguards and data storage standards have yet to mature. Without robust protection frameworks, the privacy of patients can be jeopardized. While the Nigeria Data Protection Act lays down a legal framework, enforcement capability and institutional preparedness are still under construction. Laws are only as good as their safe implementation; they have to be supported by sound operational systems.

Human capacity is another issue of high importance. Few health professionals are trained in health informatics, data science or interpreting AI systems. Even with the introduction of AI tools, staff may not always feel confident enough, or sufficiently trained or skilled to incorporate outputs into clinical-decision making. Without an empowered workforce, technology cannot deliver impact.

Ethical concerns further complicate adoption. Or if algorithms are trained on non-representative datasets they can lead to biased recommendations, including for diverse population. Community trust in health institutions could erode if AI systems are viewed as black boxes or biased. Transparency and explainability and accountability are therefore essential — not optional.

Financial sustainability also presents challenges. Most digital health initiatives in Nigeria are funded through donors or pilot programs with limited durations. Typically, systems stagnate when external support is withdrawn. AI should be planned for long-term investment, lifelong maintenance planning, and integrity of institutional ownership to ensure that we do not repeat the cycle of abandoning new innovations.

In the end, this is a structural challenge, not a technical one. AI is not a back door for inadequate data systems, low levels of governance coordination, or patchy infrastructure. Now, before Nigeria can scale advanced tools, it must strengthen the digital backbone of its health system. That is how AI will graduate from experimentation to sustained transformation.

4. Uses of AI: From Diagnostics to Preventive Care

AI isn't a futuristic concept anymore—it's an expanding toolkit with real impact throughout the continuum of care. In Nigeria, where infectious diseases and maternal mortality rub shoulders with rising chronic illnesses and limited budgets, these technologies are not utopian but practical answers capable of saving lives and making care more equitable.

4.1 Image and Waveform Interpretation

The most mature health-care applications of A.I. are in imaging. Algorithms can now read X-rays, CT scans, ultrasounds and retinal images with expert-level precision. In Nigeria — where the few radiologists available are limited to tertiary centers — AI imaging can help fill vital diagnostic gaps for tuberculosis, pneumonia, breast cancer and obstetric complications.

WHO accredited AI triage tools for tuberculosis screening already show that automation can hasten case detection, shorten the time to diagnosis. Similar systems are cropping up in obstetrics, harnessing ultrasound analysis to catch fetal abnormalities sooner. In cardiology, AI can autonomously determine ejection fraction from echocardiograms; ophthalmology tools are able to diagnose diabetic retinopathy or glaucoma in community clinics.

Yet every model must also be locally calibrated and validated by regulators. The lighting, imaging quality, and prevalence of local diseases differ enormously between care points, so we must continuously monitor the model for any drop in quality to avoid inaccuracies or unethical outcomes.

4.2 Triage and Clinical Decision Support (CDS)

CDS systems powered by AI can analyze clinical data in real time to predict complications before they happen. By tracking vital signs and lab results, they can signal sepsis risk, predict obstetric emergencies or detect trends in antimicrobial resistance.

For example, predictive models that identify patterns of early sepsis can send an immediate alert to the attending clinician, slashing mortality rates. Generative systems called Large Multimodal Models (LMMs) take this a step further — summarizing charts, for example, retrieving national treatment guidelines or suggesting next steps based on Nigeria's disease patterns.

Both the WHO and Nigeria's National AI Strategy (2025) emphasise that these systems should complement rather than substitute human judgment. The human factor guarantees accountability and maintains trust in clinical decisions.

4.3 Maternal, Newborn and Child Health (MNCH)

Maternal mortality remains one of Nigeria's biggest public-health challenges, with some regions seeing more than 800 deaths per 100,000 live births. AI provides tools that could detect high-risk pregnancies early and aid in channeling resources to areas of greatest need.

Predictive models have been developed to parse antenatal records — blood pressure, anemia levels, past delivery history — so as to anticipate problems such as pre-eclampsia or obstructed labor. In rural areas, AI-powered mobile apps assist community health workers (CHWs) by guiding them with standardized screening protocols and flagging danger signs for referral automatically.

AI can also map facility capacity and travel distances to maximise the use of referral networks, making sure that emergency care is timely and equitable. In neonatal units, smart monitoring systems are tracking temperature, oxygen and risk of infection to reduce mortality among infants.

4.4 Surveillance of Infectious Disease

Nigeria converts its disease-surveillance system from reactive to predictive with AI. By extracting trends from environmental, demographic, and mobility data, algorithms can predict malaria or cholera outbreaks weeks ahead of time.

Integration with the Nigeria Centre for Disease Control (NCDC) surveillance network can also facilitate automated alerts based on hospital admissions, lab reports or even spikes in keywords used in social media. Predictive modelling also improves contact tracing and outbreak containment, helping to conserve scarce resources and save lives.

4.5 Non-Communicable Diseases (NCDs)

As lifestyles have changed, Nigeria has seen a rise in hypertension, diabetes and cancer. AI could help alleviate this double burden of infectious and chronic disease.

Risk-prediction models can alert which people are at high risk to develop heart disease or diabetes, allowing for early counseling and preventive care. AI retinal-scanning-powered tools can highly detect diabetic retinopathy, and mobile adherence applications use chatbots to remind patients to take medications.

Among other things, predictive analytics can also direct cancer-screening programs to underserved populations that may be reached most effectively by limited tors and maximize limited screening resources.

4.6 Supply-Chain and Hospital Operations

Operational inefficiency drains scarce resources. AI holds tangible solutions — from predicting inventory demands to optimizing surgical schedules and forecasting patient flows.

Predictive models can then analyze usage patterns and predict shortages of blood, oxygen or medicines before a crisis hits. Automated scheduling could assign theatre time on the basis of urgency and available resources, while predictive-maintenance systems alert engineers to equipment faults before breakage occurs.

This process intelligence enhances both cost effectiveness and the patient experience, driving more efficient processes throughout the health system.

4.7 Telehealth and Virtual Triage

Since the majority of Nigerians live in rural areas, AI-enabled telehealth can increase access to care. Chatbots and triage tools can screen symptoms, offer guidance, and route urgent cases to clinicians. Local dialects and a lighter, more offline approach to language support for disadvantaged regions. But transparency and human oversight are still necessary to ensure safety, accountability and public trust.

5. Availability, Quality and Interoperability of Clinical Data

Good data is the lifeblood of AI and AI processes. Algorithms can only be as good as the data that they learn from; if it is incomplete, contradictory or unrepresentative, the output will be biased or unreliable. While Nigeria's clinical data environment is improving, it remains uneven — fragmented systems, limited digitization and variable standards make it difficult to build trustworthy AI at scale. Recognizing what's happening now is the first step to a lasting, AIready foundation.

5.1 A Brief Overview of Nigeria's Data Landscape

Nigeria's health information ecosystem is the result of a patchwork of paper registers, siloed program databases and nascent electronic systems. At most public facilities — particularly at primary care — paper is still king. Records kept in physical folders slow down retrieval, prevent real- time analytics and interrupt continuity of care. The upshot, however, is repetition in tests, history information that gets lost and lead-time on decisions.

The Nigeria Digital in Health Initiative (NDHI) launched by the Federal Ministry of Health and Social Welfare (FMOH) to bring together these previously discrete components through a "paperless" approach that captures relevant data in real time on 2024–2025, seeks to change this that script. NDHI's vision (a national digital health backbone that synthesizes clinical, laboratory and administrative data) sets the stage for AI — large, structured and representative datasets outlining Nigeria's true health realities.

5.2 The Influence of Electronic Medical Record (EMR)

In areas where Electronic Medical Records (EMRs) have been implemented, the advantages are clear and quantifiable. The study, done at a single 2024 tertiary hospital, reported dramatic improvements in data completeness (whether more than twice as many key fields got filled out), documentation of vitals and medications, and clarity of follow-up plans. But these improvements aren't only there to make audits easier; they turbo charge clinical decisions and enable dashboards monitoring utilization, disease trends and outcomes close to real time.

For AI, this matters enormously. For models to learn the correct distributions, and thus create reliable predictions, data must be clean, structured and longitudinal. The challenge is one of reach: most early wins sit in tertiary centers, as many secondary and primary facilities still lack computers, reliable power, and broadband. Addressing this digital divide is critical to ensuring the benefits of AI accrue to all — not just patients in large hospitals.

5.3 Significant Low EHR Penetration and Structural Barriers

Although progress has been made, EHR penetration remains low — approximately the mid-teens nationally — with significant public–private variation. Five entrenched barriers slow adoption:

Infrastructure holes: unreliable electricity, limited bandwidth, and no hardware maintenance. It's expensive: licensing, implementation and support all tap tight facility budgets.

1. Skills: lack of training in digital documentation and informatics at all levels in the workforce.

2. Culture: Though not all at first, paper-accustomed clinicians tend to view digital tools as slower.

3. Standards: fragmented approaches lead to incompatible systems unable to talk with each other.

4. These restrictions reduce the quantity and diversity of data available for training, restrict cross- facility analytics, and dull A.I.'s potential to generalize across Nigeria's diverse populations.

5.4 Standers, Coding and Interoperability

Interoperability is the door that digital health swings open on. Without shared standards, data can't flow — and therefore A.I. can't learn broadly, or safely. And NDHI's backbone includes open, shared architectures to prevent vendor lock-in and enable secure exchange.

Key enablers include:

i. Unique Identifiers: National health identification number (NHIN) that follows every person across facilities.

ii. Use of standard vocabularies: its logs are based upon ICD-10/11 and SNOMED CT to preserve the consistency of semantic.

iii. Open APIs: so EMRs, LIS, pharmacy and other systems share data on purpose via secure by-design exchange.

iv. Data-quality protocols: regular audits, validation rules and metadata standards to ensure datasets remain reliable.

With these pieces in play, AI models are able to train on standard high-fidelity data across institutions, which can increase generalizability and improve patient safety—while also reducing redundant tests and enhancing continuity of care.

The Path to Good Training Data for Reliable AI

Nigeria needs to scale with both the quantity and quality of AI if it wants to unlock all that it can offer: Cloud and offline able tools for low resource settings of EMR for scale up across all tiers using solar energy. Link vertical program data: establish connections between programs databases (HIV, TB, immunization) to create unified queryable repositories.

1. Institute quality: periodic audits, completeness checks and clinician feedback loops.

2. Build capacity: by training clinicians, IT staff and data officers on accurate entry, stewardship and ethics.

3. Collaboration public–private: co-development of affordable and interoperable solutions EMR, aligned with the national standards.

These steps will produce the large, representative datasets required for epidemic forecasting, precision triage and operational optimization — the core AI use cases imagined under NDHI.

6. Discussion

Application of Artificial Intelligence in Nigerian Health Care System

AI can drive meaningful change in Nigeria's health system, but only if policy enthusiasm is translated into infrastructure, governance and data readiness as well as human capacity. This section collates where Nigeria is at: the enabling frameworks are there, but implementations are wanting.

Moving forward requires disciplined focus on safety, trust, finance, innovation and equity across health systems including humanitarian settings.

6.1 Preparation and Foundational Gaps

The NDPA (2023), National AI Strategy (2024/2025), NDHI (2025) and the NHIA Act (2022) are key frameworks for digital health and the AI economy in Nigeria. However, foundational gaps remain. Power, broadband access and stable computing infrastructure are patchy at best, and this is especially true in primary care. Most EMRs are not only low adoption, but also very limited interoperability and at scale machine learning. Governance clarity is needed on AI approval in devices, device classification and post-market monitoring. The capacity of humans is limited too, clinicians need to be digitally literate and health informatics specialists and data scientists must be upskilled so policy vision can be implemented safely and effectively.

6.2 Safety, Effectiveness and Equity

The framework for manufacture of Large Multimodal Models (LMMs) by WHO (2025) is based on evaluation, transparency, representative data, human supervision and long term monitoring. In Nigeria's heterogeneous setting, local validation is essential: a model developed in another context can misclassify conditions or be suboptimal in some groups.

Practical safeguards:

i. Local benchmarking on Nigerian datasets, wedge of sex, age group region and other equity variables

ii. Ongoing auditing for accuracy, false positives/negatives, and drift (particularly for radiology and triage).

iii. Human-in-the-loop as a standard: clinicians confirm AI recommendations before execution.

iv. Equitable access: user-friendly interfaces, offline modes and multilingual outputs for rural facilities mean AI closes — not widens — gaps.

6.3 Trust and Data Stewardsmanship

Public trust underpins adoption. NDPA compliance is a start, but true confidence comes from privacy-by-design: role-based access controls; strong de-identification and pseudonymization for use in research; and clear multilingual notices that explain how this kind of data are used.

Visible accountability also matters. Consistent enforcement in response to violations signals that patient data are safe. Moving beyond compliance, a culture of responsibility transparent data sheets, model cards, version logs and independent ethics boards incorporating community voices propels legitimacy and keeps systems aligned with societal values.

6.4 Financing and Incentives

Pilots stall without sustainable funding. The NHIA and state purchasers can normalize AI through value- based contracts that pay for measurable improvements: e.g., per-case TB detection rates with AI CXR triage, or verified reductions in stock-outs from predictive supply- chain algorithms.

Public–private partnerships can fund infrastructure; donors can move from short pilots to long-horizon integration. Continuous after =grant through budgeting AI under FMOH digital plan Procurement reform will be transparent, performance-based and interoperability based— that will reward compliant solutions built on standards.

6.5 Local Innovation Ecosystems

Nigerian ecosystem startups, universities, teaching hospitals is bubbling with AI ideas from radiology support to maternal risk prediction. The National AI Strategy (NITDA/NCAIR, 2025) proposes sandboxes, grants and tax incentives. As NDHI and FMOH priorities are TB, MNCH, NCDs, aligning these with the priorities will catalyse innovation where it matters most.

New Innovation Centers can anchor research, validation and commercialization. Global partnerships must facilitate technology licensing and open, de-identified data sharing as Nigerian clinicians co-design tools for cultural fit and usability.

6.6 Humanitarian and Primary-Care Contexts

Inareas affected by conflict with significant IDP populations, AI should complement human caregivers, not replace them. CHWs work best with 'low-bandwidth', ofline-tolerant tools for supervised triage and screening. Predictive analytics assist humanitarian actors in anticipating outbreaks, deploying supplies and targeting at-risk populations. But fragile systems won't be solved with technology alone. Without early investment in workforce and referral networks, as well as basic infrastructure, there is a risk that AI will inadvertently widen gaps. Ethical AI Integration means that humans are operated with transparency on the escalation chains, equity in resources provided and resilience under pressure.

Nigeria has the vision and existing framework to take the lead on responsible AI for health. The next mile is execution: wire up facilities, standardize and secure data flows, clarify regulation, fund what works and build people's skills and trust. With these steps in place, Nigeria can move from policy pioneer to practical leader: using AI to shape safer, fairer and more resilient care for all.

7. Ethical and Regulatory Considerations

Artificial Intelligence (AI) holds immense promise for Nigerian health care, but comes with profound ethical, legal and regulatory challenges. Because AI is dependent on large amounts of sensitive personal data, policymakers face a challenge to maximize innovation while promoting privacy, accountability and fairness. While the Nigeria Data Protection Act (NDPA, 2023) already offers a robust legal framework for lawful data processing and oversight, AI introduces additional complexity involving automated decision-making, opaque algorithms, and cross-border data transfers that require adaptive regulation.

Ethical governance must also evolve alongside technology, to make sure Nigeria's AI-enabled health system will be more lawful, trusted and equitable.

7.2 Limited Purpose and Data Minimization

We anchor responsible use of AI with two NDPA principles — purpose limitation and data minimization. Health institutions should restrict themselves to collecting only what is strictly necessary for articulated clinical or research purposes and avoid secondary uses such as the sale of "de-identified" records without renewed consent. AI developers need to have formal data-sharing agreements (DSAs) with hospitals, landing details on retention periods, deletion schedules, and audit rights. Institutional ethics boards routinely review these agreements and ensure that the projects align with our legal obligations as well as moral ones.

These rules prevent "mission creep," in which data collected for care becomes repurposed for nontransparent analytics or commercial exploitation.

7.3 AI Assurance and Safety Governance

The WHO (2025) recommends a lifecycle-driven AI system assurance framework that covers every stage of the process, from design to retirement. Nigeria can indeed adapt this approach by institutionalizing four fundamental safeguards.

First, AI tools should be thoroughly pre-deployment tested on platforms that rely on Nigerian representative datasets to ensure they are accurate and locally relevant. Second, transparency should be compulsory; all models must be clearly documented regarding where their training data came from, how they were designed and what limitations are known. Third, human oversight should be front and center clinicians must maintain authority. Fourth, ongoing monitoring after deployment of the model is needed to identify drift in performance and risk for bias and safety problems during real-world use.

Creating a national AI-for-Health registry could improve accountability by cataloging approved systems, intended use, validation results and mechanisms for reporting adverse events. Clearly indicating that AI-assisted instruction has been utilized in these outputs would serve to improve transparency, so clinicians and patients know when machine- generated guidance contributes to care decision-making.

7.4 Bias, Fairness, and Representativeness

Ethical AI depends on fairness. Bias is a common consequence of training on non-representative data. Nigeria's demographic diversity 250 ethnic groups, multiple languages and wide socio- economic variation means local validation is critical.

Developers must disclose algorithm performance by sex, age, ethnicity, region and income. Regulators should require approval disclosure of these metrics. Training datasets would ideally include representational coverage from diverse geographic zones and both public and private facilities. Imported systems are required to undergo independent testing with Nigerian data prior to use in the clinical setting.

7.5 Regulatory Pathway for AI as Medical Device

Nigeria must now create a clear regulatory pathway for determining when AI software is classified as a medical device — that is to say, it was given diagnostics, monitoring or therapeutic features.

Harmonization of standards with best-in-class regulations like the U.S. FDA and EU MDR frameworks requires coordination amongst these regulatory agencies (FMOH, NITDA and NAFDAC).

A public national registry of AI medical devices, along with an incident-reporting mechanism, would allow public rapid recalls and ongoing public accountability.

7.6 Data transfer and localization

AI research often relies on cloud processing and worldwide cooperation, but the NDPA limits international data flow unless an equivalent level of protection already exists abroad. Cross-border transfer of data for the purposes of model training should depend on standard contractual clauses, binding corporate rules or adequacy decisions from the NDPC.

Where possible, Nigeria ought to promote data localization—keeping clinical data on national or regional servers in order to protect sovereignty and guarantee access in a moment of crisis. Cloud providers that store health data will be required to meet the NDPA and follow security standards for digital-health established by the FMOH.

7.7 Community Engagement and Ethical Co-Design

Regulation alone cannot guarantee legitimacy. Multilateral organizations should finance these community participations with the revenue made from successful AI in preventative healthAIs against the vast amounts of data generated from Nigeria's patients. Patients, clinicians, and community health workers should inform priorities, test tools and interpret outputs to make sure that solutions meet lived needs.

Public consultations, focus groups and structured feedback mechanisms can also help to establish clearer societal frameworks of fairness, transparency and accountability. Hospitals and professional organizations should also implement clear multilingual mechanisms for lodging complaints, so users have recourse when AI-assisted decisions seem to be flawed or harmful.

Usability and trust are mutually strengthening with inclusive co-design. When folks see the pain points that they have and their cultural realities reflected in a system, they are more likely to adopt it and use it in ways that are responsible. In the end, ethics and regulation will decide if A.I. is a force for equity or exclusion. Although the NDPA establishes a solid legal foundation for data protection, responsible deployment of AI necessitates continuous validation of outputs, biases monitoring, clear communication of capabilities and limitations, and synergy between NITDA, FMOH, NDPC and NAFDAC. Accountability at every stage of the AI lifecycle will require adaptive collaborative governance.

8. Conclusion and Recommendations for Nigeria

Artificial Intelligence is a new frontier that can transform Nigerian health care. When responsibly implemented, and rooted in reliability, ethics, and governance it can raise the quality of care we provide to patients, improve population health outcomes across communities while closing equity gaps. The country already has the necessary foundational components in place: NDPA (2023), National Artificial Intelligence Strategy (2024/2025) and FMOH's digital-health modernization programs including NDHI and ECM. But policies by themselves are insufficient. Making a meaningful difference requires rigorous execution, constant assessment and congruence of technology with human capability.

8.1 Develop the Digital Health Infrastructures

Machine Learning Model's performance relies on the data. Accelerate the NDHI's vision of a national digital-health backbone to interconnect all levels of care in Nigeria. Progress should be guided by realistic milestones, for example >70 percent EMR/EHR coverage in secondary and tertiary facilities within five years.

This backbone will require—like the USA's national blood transfusion system—a master-patient index, facility registries, and shared APIs allowing secure data exchanges between public and private providers. And for respondents across all wealth groups, reliable power and broadbroad are just as important; in fact, collaboration among the FMOH, Ministry of Communications and Digital Economy, and the Rural Electrification Agency is critical to ensure these utilities go national.

8.2 Enhance data governance and trust

Trust is to digital health what prevention is to medicine. Tools for implementation needed include Data Protection Impact Assessments (DPIAs), algorithmic-impact checklists and structured guidance on lawful processing, all of which is incorporated in the NDPA process.

All AI in care delivery should embody privacy-by-design, explicit consent and transparent explanations on how automated systems shape care. Audit of compliance by the NDPC and FMOH should be conducted collaboratively while visible enforcement of breaches will enhance patient confidence.

8.3 Investing in the People and Change Management

Technology works only when people know and believe in it. Clinical-AI fellowship: Building on joint investment in these priority areas, government and academia should co-create clinical-AI fellowships and health informatics postgraduate programs mixing medicine, engineering, and data science. Clinicians and administrators must go through continual digital-literacy training that emphasizes interpretation and ethics, not just button-pushing. Hospital leaders must lead by example when it comes to adoption, reward and recognize innovation where they see it, and make clear through their communications that AI is an auxiliary tool — not a replacement for professional judgment.

8.4 Prioritize High Impact Use Cases

Nigeria should adopt AI in a focused way, concentrating on use cases that can deliver clear and measurable health impact. Instead of diffusing resources in multiple experimental projects, policymakers should focus on opportunities where AI can respond to pressing public health needs and existing system gaps.

There are strong starting points in the many high-burden conditions like tuberculosis, malaria maternal complications, hypertension and cancer screening. AI-based diagnostics, predictive outbreak modeling and decision-support tools for frontline health workers can provide immediate real value in these areas. For example, we can leverage telemedicine platforms and automated patient follow-up systems to ensure continuity of care — something that will be especially important in rural and underserved communities.

Priority use case selection should be based upon the disease burden data, cost-effectiveness analysis, feasibility within existing infrastructure, and readiness of health personnel. Pilot programs should have explicit performance indicators, local validation and methods for scaling successful models.

With focus on high-impact contexts and use cases, Nigeria can underset visible benefits early on, nip their way in clinical circles and patients, generating the catalyzing momentum for a wider digital transformation.

8.5 Sustainability and Long-Term System Integration

To turn pilot projects into successful AI applications in Nigeria, sustainability has to be integrated from the joint beginning of implementation. Digital health systems cannot rely on donor funding or short-term innovation grants. rather, AI- enabled tools should be embedded in national and state health budgets, underpinned by clear maintenance plans, workforce training and periodic evaluation."

Over the long term, institutional ownership is also needed for integration. Hospitals, regulators and training institutions need to view AI as part of normal service delivery in their organizations instead of an external technology experiment. This requires continuous monitoring of these systems, assessment of the impact they have on various disparate groups, and the upgrading of these systems; this should become standard practice.

Equally important is adaptability. AI frameworks need to be adaptable and responsive as disease patterns, technologies, and data systems evolve. Sustainable integration means avowing to progress over time rather than awaiting overnight transfiguration.

And managed responsibly, AI can and should become a permanent part of Nigeria's health infrastructure — helping support resilience, efficiency and better patient outcomes for decades to come.

8.6 Synthesis and Outlook

If implemented rigorously, these strategies could unite Nigeria's network of AI pilots into a comprehensive national program. The likely dividends include:

i. Predictive diagnostics and standardized decision- support = safer, more equitable care.

ii. Better public-health intelligence that can predict outbreaks and direct resources.

iii. Improved patient experiences through seamless data flow, reduced wait times and multilingual engagement.

Realizing this vision will require ongoing political commitment, intersectoral coordination, and a culture of ethical innovation. AI has the potential to make quality healthcare affordable and accessible • AI should not be seen as a luxury technology, but rather as a strategic imperative that enhances UHC and SDGs.

With such audacious ambition and disciplined execution, Nigeria can emerge as a continental leader in responsible, human-centered AI for health — ensuring that every algorithm ultimately serves its people.

Conclusion

By harnessing the potential of these technologies, Nigeria can arise as one among other countries better positioned to leverage Artificial Intelligence and Biomedical Informatics for exceptional healthcare delivery. While the challenges are real from weak data systems to governance and capacity gaps these potential benefits are equally significant. AI can assist with early diagnosis, enhance disease surveillance, improve efficiency and widen access to care for underserved groups.

But technology by itself won't change the system. Sustainable advances require robust digital infrastructure, ethical safeguards, trained health professionals and public trust. AI must keep the focus on helping human beings with their clinical judgment rather than working to take it away.

With intentional investment, inclusive governance, and sustained integration in mind, AI could be more than an innovation fad in Nigeria—it could be a crosscutting instrument for equity, resilience and better health outcomes throughout the country.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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