

Primary Health Care Health Informatics

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Publication Date: 2026/08/08

Abstracts: Primary Health Care (PHC) is the foundation of Nigeria's health system. It refers to the first level of care that people receive when they are sick, need a check-up, or want to prevent illness. PHC centers are usually located close to communities in villages, towns, and city neighborhoods so that families can access care without traveling far or spending too much money. Primary Health Care (PHC) Informatics is the scientific field that focuses on the effective use of data, information, and technology to support and improve health services at the community and primary care levels. Research Technique employed in this case is an evaluation of relevant literatures patterning to implementation of Primary Health Care Informatics in some African Countries that are having emerging economy and developing their health systems to attain the Universal Health Coverage through database management system. Countries like Malawi, Kenya, South Africa, etc are transiting to technological innovative level for better healthcare system.

➤ **Recommendation:**

Nigeria needs the following strategic plains to be implemented: Telemedicine with viable broadband infrastructures, streamline, licensing, and development of multi-telemedicine platforms, digital literacy campaigns. Having a Health information system with better public and private organizations investing in infrastructures, training professionals in leadership management, and capacity building in database management system is worthy of recommendations.

➤ **Conclusion:**

There is need for PHC informatics which functions as an ecosystem where data can move between community health workers, clinics, and national management systems. Enhancing primary health care delivery in Nigeria by adopting advanced technologies holds substantial promise for improving healthcare accessibility, quality and efficiency. Primary health care focuses on a community –Based, essential care that is practical, socially acceptable, and affordable.

How to Cite: Zitta Pius Bamko; Demi Michael Yil'ep; Danbaki Zingfa; Dorcas Luka Daniel; Kopya Dagyen Policarp; Hosea Gwontok; Makodeng Fuky Daniel (2026) Primary Health Care Health Informatics. *International Journal of Innovative Science and Research Technology*, 11(7), 3317-3324. <https://doi.org/10.38124/ijisrt/26jul1345>

I. INTRODUCTION

Health informatics is the development and assessment of methods and systems for the acquisition, processing and interpretation of patient data with the help of knowledge from scientific research (Imhoff, Webb, Goldchmit, 2000).

Primary Health Care (PHC) Informatics is the scientific field that focuses on the effective use of data, information, and technology to support and improve health services at the community and primary care levels.

Unlike hospital-based clinical informatics, PHC informatics is designed for the population health level, emphasizing preventive care, chronic disease management, and the social determinants of health.

➤ **Objectives:**

The goal of PHC informatics is to move from reactive data reporting (looking at what happened) to predictive health management (anticipating what the community will need).

➤ **Core Components of PHC Informatics**

There is need for PHC informatics which functions as an ecosystem where data can move between community health workers, clinics, and national management systems. Enhancing primary health care delivery in Nigeria by adopting advanced technologies holds substantial promise for improving healthcare accessibility, quality and efficiency. Primary health care focuses on a community –Based, essential care that is practical, socially acceptable, and affordable.

Despite efforts to improve healthcare delivery, challenges persist, particularly in rural and underserved areas. Exploring the use of information technology here is a transformative potential in addressing these challenges.

(Umar, Saifuddeen, Sani, Lukman, Aliyu, ,MaryamImmam, Usman, Haruna, Adamu, Ibrahim & Don E.Lucero-Prino111, 2024)

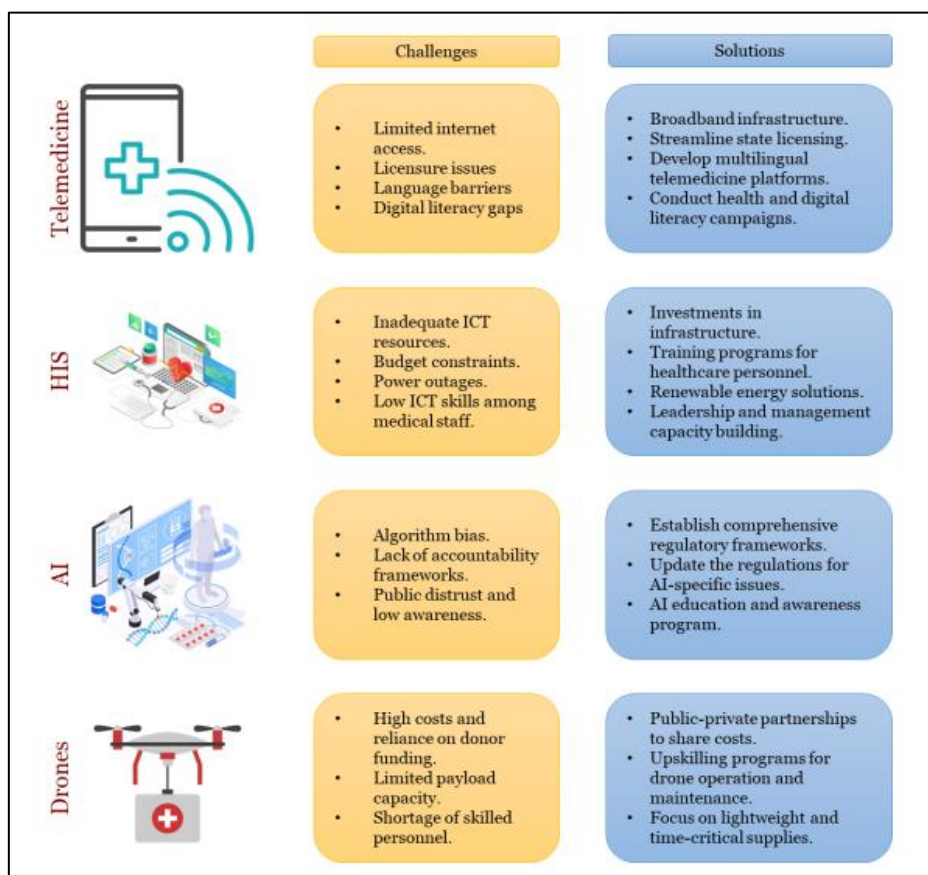


Fig 1 Diagram Showcasing Challenges and New Technology Employed in PHC (Umar et al., 2024)

In 2013, the District Health Information System 2 (DHIS2), an open software package, was introduced in Nigeria as the data management tools of the NHMIS for the monthly aggregation of service statistics from health facilities (Health, 2021), the backbone for collecting routine data from primary health facilities to monitor public health trends and resource allocation Electronic Health Records (HER) & EMR: Implementing EHRs can significantly address the inefficiencies in Nigeria's primary healthcare system by enhancing service delivery, reducing administrative burdens, and improving patient outcomes (Umar, et al., 2024) mHealth (Mobile Health): Handheld tools used by community health workers (CHWs) for field-based data collection, patient tracking, and health education. mHealth solutions have also been shown to bridge health inequalities by facilitating information exchange and remote training of frontline healthcare workers in rural and remote settings a Malawi experience (Kachimangu, Malwafu, Iddamda, Harare, Markhenjee, Vkul9nkina, Mbae, Ndarama, Vanden, & Abejirinde, 2024)). Here in Nigeria, the Federal Ministry of Health and the private companies can develop applications that can be used to communicate with both the Community health Workers (CHEWs) and the

patients on critical health Issues which the patients may be in remote areas. In Malawi, they used powerful applications called Yendanafe for collection of data and also analyses of such data as reported by a CHW

“YendaNafe made my work easy and simple. I no longer spend much of my time writing. I just click the phone.” (CHW, Neno District Hospital) and experiences such as *“When following up with a pregnant woman, YendaNafe brings a page that asks about danger signs, and it has a list of those danger signs, such as swollen legs and vaginal bleeding. If the woman is showing any of those signs, we have to refer the woman to the hospital for medical help”* (Kachimangu, et al., 2024).

Telemedicine: Platforms that can connect rural PHC centers to specialists, bridging the gap in regions with limited human resources for health.

➤ Functional Applications in Primary Care

PHC informatics is not just about digitizing paper; it is about transforming clinical and administrative outcomes.

Table 1 Application Areas and its Impacts on PHC Delivery

Application Area	Impacts on PHC Delivery
Disease Surveillance	Real-time tracking of outbreaks (e.g., malaria, cholera) through mobile reporting, allowing for rapid response in specific districts
Healthcare Financing	Digital management of Community-Based Health Insurance (CBHI) schemes to track enrollment, verify identities, and manage claims efficiently.
Patient Satisfaction	Using digital surveys and Likert-scale tools to analyze patient experience, identifying specific service gaps in clinical care.
Supply Chain	Monitoring drug and vaccine inventory levels to prevent "stock-outs" at the facility level.

➤ *Current Trends*

The field is shifting toward more proactive and personalized models of community health Worker proactive measures to take in emergency cases; where to refer and when to refer for specialized care. Health informatics has a proactive role in providing structures for pooling, communicating and applying clinical evidences. It also provides organizational processes to minimize resources used while securing maximal benefits. Health informatics has the essential developmental tools and methods to achieve stated objectives (Imhoff et al., 2000)

- *Other Areas where Health Informatics Becomes Essential Include the Following;*

✓ *Interoperability Standards:*

Growing adoption of HL7 FHIR (Fast Healthcare Interoperability Resources) to ensure that data collected at a local primary care clinic can follow the patient to secondary or tertiary facilities during referral of cases. (Vorisek, Lehne, klopfenstein, Mayer, Bartschke, Haese, & Thun, 2022).

✓ *Digital Twins for Population Health:*

Creating virtual models of community health profiles to simulate the impact of different health policies or environmental changes. (Gazzarata, Almeida, Lindskola, Cangioli, Gaeta, Fico, & Chronaki, (2024).

➤ *Implementation Challenges*

Despite its potential, several barriers often hinder the adoption of informatics in primary care settings:

- **Infrastructure Gaps:** Unreliable power supply and limited internet connectivity in rural or per-urban areas.
- **Interoperability:** Fragmented systems that do not "talk" to each other, leading to data silos.
- **Data Privacy:** Ensuring that sensitive patient information remains secure while remaining accessible to authorized providers.
- **Capacity Building:** The need for continuous training for healthcare staff to move from traditional paper-based recording to digital proficiency is very important.

Table 2 Summaries of the Advanced Technology Integration in Primary Healthcare Delivery Based on Studies in Nigeria and Other Relevant Countries (Umar et al., 2024)

Study Population	Type of Technology	Benefits of Technology Integration
Individuals with or at risk of MDR TB in Nigeria	Telemedicine, including DOT, remote consultations, and digital health monitoring	Improved access to care, enhanced treatment adherence, cost reduction, minimized transmission risk, real-time monitoring, and increased patient engagement
Multi stakeholders in Nigeria	eHealth, telemedicine, mHealth, and EHR	Strengthened health systems, improved governance and coordination, cost-effective service delivery, enhanced capacity building, and support for achieving UHC
Pregnant and children n Nigeria	MedStrat health insurance management system	Increased health insurance enrolment, improved access to maternal and child health services, enhanced efficiency in health insurance management, and reduced maternal mortality rates
Federally funded tertiary health institutions in Nigeria	Telemedicine, EHR and digital health platforms	Improved healthcare continuity, cost-effectiveness, enhanced health equity, better emergency preparedness, and the ability to address healthcare workforce shortages
Pregnant mothers and their spouses in Nigeria.	Text message based telemedicine (Text4Life)	Improved emergency transportation, increased use of healthcare facilities, reduced maternal mortality, and better communication between patients and healthcare providers
Diabetes mellitus patients in Nigeria	mHealth with voice calls, text messaging, and basic digital features for diabetes management	Increased access to healthcare, improved treatment adherence, cost reduction, enhanced health education, and better management of diabetes related outcomes
Patients and healthcare personnel in Nigeria	Blockchain-based Electronic Health Data System (BEHeDaS)	Enhanced data security, interoperability, transparency, scalability, patient trust, and compliance with HIPAA standards or medical records

		management
Healthcare workers in Nigeria	AI-based diagnostic tools and automated systems	Improved diagnostic confidence, reduced medical errors, minimized time spent on monotonous tasks, and enhanced efficiency healthcare delivery
Infants and rural communities in Nigeria	Medical drones for vaccine delivery	Improved vaccine distribution, reduced transportation challenges, enhanced healthcare equity, and decreased infant mortality
Patients in rural areas of Rwanda	Medical drones for delivering blood products	Faster delivery times, reduced blood wastage, improved emergency responses and reduced transportation challenges.
Multi stakeholders in Ethiopia	mHealth, EHR, AI, and cloud-based applications	Improved access to healthcare, enhanced clinical decision-making, increased patient engagement, and cost-effective

Clinical data informatics in Nigerian Primary Health Care (PHC) has shifted from “aspirational pilot projects” to a more structured national architecture. The current focus has moved beyond just collecting data for reporting (CHIS2) toward active clinical decision support and financial integration.

Here is the current landscape of clinical informatics within the Nigerian PHC system:

➤ *The National Digital Health Initiative (NDHI)*

Health Informatics may reshape the way we deliver care to meet the demands of the future (Imhoff et al., 2000). Federal Government, through the Nigeria Digital in Health Initiative, is implementing national digital health architecture. The goal isn’t just “going paperless” but creating a National Health Information Exchange (NHIE).

- *Interoperability:*

The NHIE aims to allow a patient’s record to move from a rural PHC in Plateau State to a specialist hospital in Jos without the patient carrying a physical folder.

- *Standardization:*

Use of HL7 FHIR standards is becoming the “gold standard” for new software deployments to ensure different systems (like those used by different states or NGOs) can actually talk to each other.

➤ *EMR & HER Deployment in PHCs*

While tertiary hospitals have used EMRs for years, PHCs are finally seeing tailored solutions.

- *Offline-First Systems:*

Since internet in rural areas remains “moody,” the current standard for PHC software is offline-capability with delayed sync. Systems like Open MRS, Bahmni, and locally optimized versions of ClinikEHR allow Workers to input data without a signal, syncing to the state cloud once they get to a town with better coverage.

- *The “L2” Standard:*

The NPHCDA’s “Functional Level 2” PHC designation now includes requirements for digital tools and 24/7 solar power (through the Power for Health Initiative) to keep the tablets and servers running

➤ *Clinical Decision Support Tools (CDSTs)*

One of the most exciting current developments is the use of Artificial Intelligent to assist community health workers.

- *Frontline Assistance:*

Frontline workers are using AI-enabled CDSTs for triage and referral guidance. For example, an AI tool can analyze a patient’s symptoms and Likert-scale satisfaction data to flag high-risk malaria cases or identify clusters of vaccine-hesitant households.

- *Medvax and Local Tech:*

Nigerian startups are leading the way in creating AI tools that work specifically for the local disease burden (malaria, TB, maternal health) rather than relying on western-centric algorithms. (Scheonmaker, Versluis, Chavannes, Kamp, & Kasteleyn, 2021).

➤ *Informatics in Healthcare Financing (NHIA & PLASCHEMA)*

For researchers interested in sustainability, this is the most critical “missing link” being filled:

- *Claims Management:*

Clinical data is being directly linked to insurance platforms like PLASCHEMA (Plateau State contributory) and the national NHIA. When a provider records a treatment, it automatically generates a digital claim, reducing the “rejection rate” caused by manual errors.

- *Biometric Verification:*

To combat “ghost patients” and fraud, many PHCs have moved to biometric-linked clinical records, ensuring the person receiving the treatment is the one enrolled in the contributory scheme.

➤ *Implementation Current Challenges*

It isn’t all smooth sailing. The “Big Three” hurdles remain:

- *The “Data Grave” Problem:*

While we are better at collecting clinical data, many PHC managers still struggle with analyzing it. Data often sits in a dashboard without being used for local facility management.

- **Fragmented Funding:**

Different donors (WHO, World Bank, Bill & Melinda Gates) sometimes push different software, leading to a “digital alphabet soup” where one clinic might use three different tablets for three different programs.

- **Human Capital:**

Training 2.5 million healthcare workers for digital proficiency is a massive undertaking. There is a high “turnover rate” as digitally-trained staff often moves to private sectors or abroad (the “Japa” syndrome applied to informatics).

➤ **Defining the Informatics Need**

Focusing on Nigeria’s PHC Informatics curriculum; this paper centers on official standards from Nigerian health and education regulators. The man needs sited in

(Scheonmaker et al., 2021) as e-health is characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology

➤ **Exploring PHC Informatics in Nigeria**

The existing healthcare scenario in Nigeria underlines the critical need for telemedicine to solve systemic inadequacies effectively (Chinaka, 2008). To make headway in understanding the Nigerian PHC informatics context, several key courses, like “Introduction to Computers” and “Disease Classification and Clinical Coding,” providing a foundational understanding. “Health Planning and Management” is also present, which adds a crucial system-level perspective.

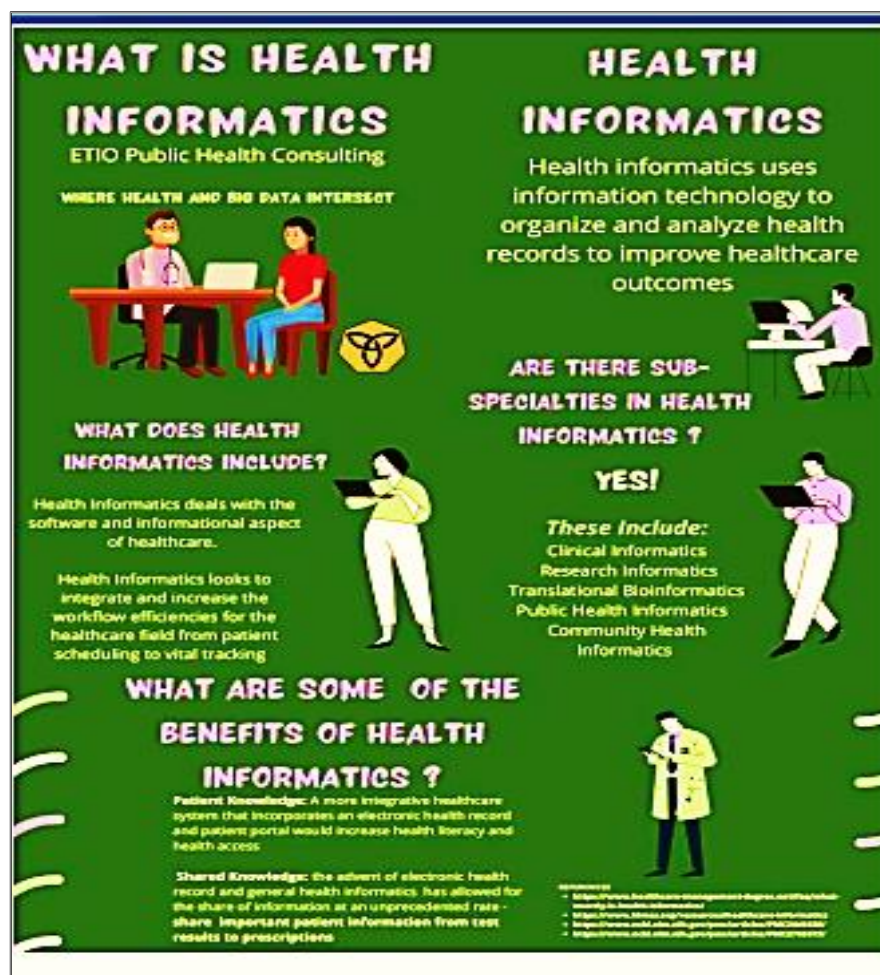


Fig 2 What Health Informatics is All About (Al-Saad, 2000)

➤ **Analyzing Key Informatics Topics**

Diving deeper into the specifics, highlighting core areas; Computer packages, health informatics, database management, and EHRs are all integrals. Noting the importance of Nigeria’s Health Records Officers Registration Board and the standard curriculum. The NPHCDA’s learning portal and the NHMIS, with its CHIS2 focus, are vital for data management. This includes data capture, analysis, and visualization. (Al-Saad, 2000)

➤ **Defining Curriculum Scope**

Focusing on structuring the response for good benefit, keeping expertise in mind, the sketched framework (Chinaka, 2008) overview, academic training, in-service training, curriculum domains (data management, technology, HER, analytics), and key regulatory bodies (NPHCDA, FMOH, HRORBN). The synthesized “curriculum” from the course lists, also wondering whether a standardized “PHC Informatics Curriculum” document

exists—likely not as a single booklet, but integrated within documents like the NHMIS 2019-2023 or the revised plan.

➤ *Analyzing PHC Informatics Curriculum*

Sifting through, the wealth of specific information on the Primary Health Care (PHC) Informatics curriculum in Nigeria includes a lot of integral facets.

➤ *Examining HIM and CHEW/CHO*

Analyzing Health Information Management (HIM) programs; the NUC and HRORBN's B.HIM curriculum is solid, especially the emphasis on EHRs and clinical coding. There is a good alignment with other programs. Plus, the inclusion of "Introduction to Computer" and NHMIS in the CHEW/CHO curriculum suggests integration of informatics in primary healthcare education in Nigeria focusing on the commonalities (NHMIS, 2021).

➤ *Component Focus Area*

BHCPF Informatics Data requirements for the Basic Health Care Provision Fund, focusing on enrollment and financial reporting, Clinical Logistics Management Systems (CLMS), for tracking vaccine and essential drug stocks.

PHC Dashboard Training officers to interpret facility-level data to make management decisions, and Competency Domains for PHC Informatics.

Regardless of the specific school, the curriculum in Nigeria is currently shifting toward these four digital pillars:

➤ *Data Capture and Quality*

Transitioning from paper-based registers to Electronic Medical Records (EMR), Identifying and correcting "data outliers" before submission to the LGA level.

➤ *Interoperability and Standards*

Understanding how community-level data (collected by Village Health Workers) integrates with facility-level NHMIS tools. (NHMIS, 2021)

➤ *Public Health Surveillance*

Using informatics for Integrated Disease Surveillance and Response (IDSR), particularly for tracking outbreaks like Lassa Fever or Cholera at the primary level.

➤ *Ethical & Legal Frameworks*

Nigerian Data Protection Regulation (NDPR) compliance in a clinical setting maintaining patient confidentiality in communal PHC environments

The Primary Health Care (PHC) informatics curriculum in Nigeria is tiered based on the level of professional responsibility, ranging from basic data recording at the community level to advanced systems design at the university level.

The curricula for JCHEW and CHEW are regulated by the Community Health Practitioners Registration Board of Nigeria (CHPRBN), while BSc programs are governed by the National Universities Commission (NUC) under the new Core Curriculum and Minimum Academic Standards (CCMAS). (Chinaka, 2008)

Table 3 Comparative Overview of Informatics Curricula (Agency, 2007)

Feature	JCHEW (Junior)	CHEW (Mid-Level)	BSc (HIM / Public Health)
Duration	2 Years (Certificate)	3 Years (Diploma)	4–5 Years (Degree)
Primary Focus	Data Capture: Recording raw household data.	Data Aggregation: Summarizing facility data.	Systems & Analytics: Designing and managing health IT.
Key Informatics Tool	Community Tally Sheets (NHMIS 000).	NHMIS Facility Registers (001) & DHIS2.	SQL Databases, EHR, AI, & Biometrics.
Digital Literacy	Minimal; basic mobile reporting.	Moderate; "Intro to Computers" (COM 111).	High; Programming, Networking, & Security.
Work Context	90% Community / 10% Facility.	50% Community / 50% Facility.	Administrative / Policy / Hospital Management.

Curriculum -data as is viewed by each cadre

- JCHEW: The "Data Capturer" JCHEW sees data as a task (recording a patient visit).
- The JCHEW curriculum is the most basic. Informatics is not taught as a separate science but as a reporting obligation.
- Curriculum Emphasis: Filling out the NHMIS Form 000 (Community-based summary forms).
- Competencies: Accuracy in recording births, deaths, and immunization status during household visits.
- Technology: Transitioning from paper booklets to basic mobile-based reporting apps for the National Primary Health Care Development Agency (NPHCDA).

• *CHEW: The "Data Aggregator"*

- ✓ CHEW sees data as a report (submitting monthly numbers to the LGA).
- ✓ The CHEW curriculum adds a layer of technical literacy and statistical management.
- ✓ Core Modules: COM 111 (Introduction to Computer): Basic hardware/software knowledge and office suites.
- ✓ CHE 253 (Health Statistics): Calculating vital rates (morbidity, mortality) at the facility level.
- ✓ NHMIS Mastery: Training on summarizing daily registers into monthly facility reports (Form 001).
- ✓ Technology: Intensive training on the Community Health Information System (CHIS2) portal for uploading facility-level data.

- **BSc (HIM/Public Health):**

The "Systems Architect" BSc graduates see data as an asset (analyzing trends to inform national health policy or facility budgeting). University-level informatics is vastly more complex, focusing on the architecture of health information.

- **Core Modules (CCMAS Standards):**

- ✓ Database Management Systems: Principles of SQL and database design for large-scale health records.
- ✓ HIM 424 (System Analysis & Design): Learning how to build an Electronic Health Record (EHR) from scratch.
- ✓ AI & Expert Systems: Understanding the role of machine learning in clinical decision support and disease surveillance.
- ✓ Organizational Information Security: Mastery of the Nigerian Data Protection Regulation (NDPR) and cyber security.
- ✓ Technology: Advanced data visualization tools (Power BI/Tableau), Python/R for health data science and cloud computing.

- **Practical Application:**

In states like Plateau, the BSc curriculums will increasingly be incorporating insurance informatics to manage enrollment data for agencies like PLASHEMA, whereas CHEWs will be trained primarily on the clinical reporting side of the same system.

Specifically, the Primary Health Care (PHC) Health Informatics framework and the 2026 National Digital Primary Education curriculum—provide a unique vantage point for both systemic workforce improvement and individual career growth within the Nigerian health sector.

- **Workforce Development: Strengthening the PHC Foundation**

The integration of informatics into the JCHEW, CHEW, and BSc Community Health tracks is a critical shift from manual record-keeping to data-driven decision-making.

- **Operational Efficiency:**

For the community health workforce, mastering informatics means moving beyond just "collecting data" to "using data." This is vital for managing complex health schemes like the Plateau State Contributory Healthcare Management Agency (PLASHEMA), where real-time enrollment and encounter data are essential for financial sustainability.

- **Data Integrity in Malaria Control:**

Given the focus on patient satisfaction in malaria treatment, an informatics-trained workforce can utilize digital Likert-scale tools and thematic analysis software to bridge the gap between clinical outcomes and patient experience.

- ✓ **Digital Literacy Pipeline:**

The inclusion of coding and AI in the primary education curriculum will ensure that the *next* generation of health workers will enter the field as "digital natives," reducing the future cost of professional retraining.

- ✓ **Personal Academic Progression:**

Positioning for Leadership For a professional or researcher, these curricula offer a roadmap to transition from a specialized practitioner to a high-level policy or systems consultant.

II. RECOMMENDATIONS AND CONCLUSION

Nigerian government is restructuring and reforming the healthcare system in various ways that include decentralization, integration of different health programmes, strengthening of management practices and in some cases introducing information communication technology to strengthen the health information system under the umbrella of Health Reform Foundation of Nigeria (Chinaka, 2008).

➤ The Academic Pivot

Mastering the intersection of Artificial Intelligent and Pedagogy allows for a transition into Health Education and Promotion roles. By understanding how the digital curriculum is structured at the primary level, you can design advanced training modules for health professionals that leverage the same AI-driven learning frameworks mostly at the first, second and third degrees in the Universities to promote PHC at a global scale level.

➤ Research & Specialized Competency

- **Health Systems Engineering:**

Moving from "Management" to "Informatics" enables research into predictive health modeling—using AI to forecast budget needs or malaria outbreaks in most regions of the country.

- **Pedagogical Innovation:**

There is a growing academic niche for experts who can apply Artificial Intelligent to healthcare training. Specializing here places you at the forefront of "Med-Edu.Tech" in emerging economies.

Table 4 Comparative Evaluation (Agency, 2007)

Feature	PHC Health Informatics (JCHEW/CHEW/BSc)	National Digital Curriculum (AI/Coding)
Immediate Impact	High; improves facility-level data reporting and insurance billing.	Moderate; builds long-term technical literacy for the future workforce.
Skill Acquisition	Electronic Health Records (EHR), data ethics, and public health surveillance.	Logic-based thinking, algorithmic problem solving, and AI interaction.
Academic Value	Essential for MPH or PhD tracks in Health Informatics/Systems.	High for specialization in EdTech, Pedagogy, or Data Science.

➤ *Strategic Recommendation*

To maximize professional leverage, consider the "T-Shaped" approach:

Deepen your expertise in the PHC Health Informatics curriculum (the vertical bar) to maintain your authority in health management, while using the Digital/AI Curriculum (the horizontal bar) to broaden your reach into education, policy design, and technology-driven research.

• *Sustainability:*

The success of these curricula depends heavily on the "Motivation-Hygiene" factors of the health workers themselves. Technical skills are only effective if the organizational environment (the Professional Board- the Community Health Registration Board of Nigeria) provide the necessary digital infrastructure (hardware and connectivity) to support them.

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