

# 3MTT Hackathon

## Articulated Problems

The proposed system targets systemic challenges in Nigeria's healthcare ecosystem, where fragmented, inaccessible, and insecure patient data hinders effective care delivery, safety, and national health planning. Below, I outline the primary problems it aims to solve.

### 1. Fragmented Medical Records

- Right now, your doctor's notes, test results, and medicine lists are stuck in shelves in different hospitals, clinics, or labs.
- If you switch doctors, they start from scratch with no full picture. This means extra tests (wasting money and time), wrong guesses about your health, and spotty care (no clear cause, suggestions of cause of illness).



## 2. Duplicate & Inaccurate Records

- No single ID for your health, so you might get listed twice (or more) with small mix-ups, like a wrong spelling of your name.
- This confuses everyone in a rush, like during an emergency or when you're sent to another doctor. It wastes supplies and can lead to mistakes.

## 3. Limited Data Interoperability

- Hospitals, labs, drug stores, and insurance companies use separate apps or papers that don't connect with each other.
- Sharing info is a hassle, no easy way to pass details between them. This slows down your care, like waiting days for a lab report to reach your doctor.

## 4. Patient Safety Risks

- Key factors like what you're allergic to, medications you're taking, or long-term illnesses aren't always handy for the doctor treating you.
- Without this, they might give the wrong medicine, causing harm or even danger. Think: giving peanuts to someone allergic which can avoidable if this info was easy to grab.

## 5. Poor Healthcare Delivery in Rural Areas

- Many village clinics have bad internet or no computers, so they stick to paper notes that get lost or fade.
- The Villagers there wait longer for help or lose track of their health story, making simple illnesses worse.

## 6. Inefficient Policy & Research Support

- Government and health agencies lack real-time, reliable data to track disease trends or evaluate healthcare programs.
- This makes it hard to design effective policies or respond quickly to outbreaks .

## 7. Weak Data Security & Trust Issues

- Paper files can get lost, stolen, wet, or burnt in basic custom setups and there is no tracking of who saw what in patients files.
- People worry their private health secrets (like HIV) will leak.

## Solution Overview

The solution is a national digital health platform that assigns every Nigerian a Unique Health ID (UHID), tied to their National Identification Number (NIN). This UHID acts as a universal health passport that allows patients, doctors, hospitals, labs, and pharmacies to access a single, accurate, and continuously updated medical record.

The platform integrates healthcare stakeholders through a centralized, cloud-hosted database and a secure API layer, enabling real-time data sharing while enforcing role-based access and strong encryption. With offline-first support, even rural health facilities can capture and sync patient data, ensuring no Nigerian is left behind.

Key differentiators include an emergency mode for life-saving access and analytics for policy insights, positioning this as Nigeria's backbone for Universal Health Coverage.

Imagine a patient from Lagos traveling to Kano for work and gets into an accident: upon arrival at a local clinic after the accident, the doctor asks/scans for the patients UHID (via app or card or phone), requests patient consent, and instantly views their medical history, blood type(in the cases of blood transfusion), allergies, medications without delays. The platform integrates all healthcare stakeholders through a secure API layer, supporting real-time data sharing with role-based access, end-to-end encryption, and consent management. With offline-first capabilities, even rural facilities can capture data locally and sync when connected, ensuring equitable access nationwide

## 1. **Emergency Quick-View Mode**

- In a case of crisis (crash, fire), the Emergency mode shows only life-saver stuff: blood type, allergies, main illnesses, current pills, and family contacts no strenuous waiting..

- Perfect for travelers where your history follows you across states, saving precious time. (Solves safety risks and scattered info fast.)

## 2. **One Central Storage Spot**

- All your health info lives in one safe online vault, tied to your Health ID. Move to another state? Any clinic pulls it up (with your permission), to keep your care going smooth.

- No more lost papers or repeat test and diagnosis, scans, medication. It's always there, updating as doctors add notes. Fixes duplicates, wrong records, and rural gaps.

## 3. **Easy Sharing Between Health institutions**

- The system links every registered healthcare together, Hospitals send diagnoses and treatments, labs upload tests, drug stores check your scripts: all instant and tracked. For example if someone is being referred from a teaching hospital to a general hospital for more intensive medical care.


- Works offline too, save in the village, sync when you can. Patients get their own app view to check records. (Tackles slow coordination.)

## 4. **Family and Caregiver Links**

- Add family members or helpers (like kids for elderly parents) to your ID with limited views

- In emergencies ,the hassle to make calls to family members, next-of-kin is solved. Great for big families or elders traveling between states. (Boosts trust, continuity, and emergency help.)

## 5. **Big-Picture Tools for Government and Research**



- Auto-charts show trends, like “Malaria, cholera, HIV, small-pox, polio, measles e.t.c. Government logs in for reports on national health, specific locations reports on growing trends of diseases and offer nationwide health intervention programs.

- All data hidden (no names) for studies, so experts spot outbreaks early without privacy worries. (Solves planning headaches and slow responses.)

## 6. **Easy Backup**

- Auto-saves everything daily to extra safe spots. For example, if a flood hits a clinic, no data is lost. You can print a paper “passport” card with QR code for no-phone days.


# Technical Components

## 1. Core Database Architecture

- Relational Database (PostgreSQL/MySQL): For structured data such as patients, appointments, prescriptions, diagnoses, lab results.
- NoSQL Database (MongoDB): For unstructured data such as imaging files, reports, and scanned documents.
- Master Patient Index (MPI): Prevents duplicate records by generating UHIDs.
- Hybrid Cloud Hosting: Scalable, fault-tolerant infrastructure with regional backup servers for disaster recovery.

## 2. Database Schema (Key Entities)

- Patients: Stores demographics, allergies, and contact info.

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- Doctors: Captures provider identity, specialty, and institution affiliation.
  - Institutions: Defines hospitals, clinics, labs, pharmacies, and HMOs.
  - Appointments: Manages scheduling, consultations, and outcomes.
  - Lab Results: Stores test results, linked to patients and appointments, using standard codes (LOINC).
  - Prescriptions: Tracks prescribed medications, dosage, and instructions.
  - Imaging: Stores imaging data (X-ray, MRI, CT scans) with secure links.
  - Users & Roles: Manages authentication, authorization, and access permissions.
  - API Endpoints: Defines exposed REST endpoints for integration with external systems.

### **3. API & Interoperability Layer**

- RESTful APIs: Exposes core functionality (register patient, retrieve history, upload results, issue prescriptions).
- FHIR (Fast Healthcare Interoperability Resources): Standard for exchanging healthcare data across different platforms.
- OAuth2 Authentication: Secure token-based API access for third-party systems.
- Integration Points: NHIA/NHIS, labs, pharmacies, insurance platforms, mobile health apps.

### **4. Security & Privacy Mechanisms**

- Encryption:
  - At Rest: AES-256 encryption for stored data.
  - In Transit: TLS 1.3 for secure data transmission.
- Authentication: Multi-factor authentication for healthcare staff.
- Role-Based Access Control (RBAC): Doctors, labs, pharmacies, insurers, patients, and government only see what they need.
- Audit Logging: Every access or modification is logged with timestamp, user ID, and institution.
- Consent Management: Patients control who can view or share their records.

## 5. Offline-First & Rural Support

- Local caching and storage for clinics without reliable internet.
- Data automatically syncs with the central database once connectivity is restored.
- Lightweight web/mobile apps optimized for low-bandwidth environments.

## 6. User Interfaces

- Provider Dashboards: Hospitals, clinics, and labs use dashboards to register patients, upload results, retrieve histories, and issue prescriptions.
- Pharmacy Portals: Dispense drugs only against valid prescriptions linked to UHID, reducing abuse.

- Patient Portal: Allows patients to view medical history, prescriptions, lab results, and manage consent.
- Emergency Mode Access: Quick retrieval of critical information (blood type, allergies, chronic conditions) via UHID or QR code.
- Government Analytics Dashboard: Provides anonymized, aggregated health data for monitoring disease trends and planning resources.

## **7. Analytics & Reporting**

- Institution-Level Dashboards: Track case volumes, disease patterns, and patient outcomes.
- National-Level Analytics: Support outbreak detection, policy design, and resource allocation.
- Predictive Insights: Use AI/ML models on anonymized data for disease trend forecasting.


## **Expected Impacts**

### **A. Impact on Healthcare Delivery**

- Doctors and nurses gain instant access to complete patient records, reducing misdiagnosis.
- Eliminates unnecessary duplicate tests and delays, improving efficiency.
- Enhances coordination between providers through a unified platform.

### **B. Impact on Patients**



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- Every Nigerian has a trusted, lifelong health identity accessible across the country.
  - Safer treatments due to allergy and medication visibility.
  - Better emergency outcomes with instant access to critical medical data.
  - Empowerment through patient self-service portals.

### **C. Impact on Healthcare Institutions**

- Reduced administrative overhead from fragmented record systems.
- Increased trust in hospitals and clinics using standardized, modern systems.
- Access to real-time analytics for decision-making and performance tracking.

### **D. Impact on Government & Policy Makers**

- Real-time disease surveillance for faster epidemic response.
- Reliable health statistics to inform national health policy and planning.
- Stronger NHIS/NHIA insurance verification through validated health records.

### **E. Impact on Economy & Society**

- Cost savings from avoided test duplication and administrative inefficiencies.
- Increased adoption of digital health innovations and health-tech jobs.
- Boosts public trust in Nigeria's healthcare system and digital infrastructure.

# Technical Data Model (Database Schema)



## Patients Table

Stores core demographic and medical identity details of every patient.

Column	Type	Description
patient_id (PK)	INT	Unique auto-increment patient ID
uhid	VARCHAR(50)	Unique Health ID (linked to NIN)
first_name	VARCHAR(100)	Patient's first name
last_name	VARCHAR(100)	Patient's last name
birth_date	DATE	Date of birth
sex	VARCHAR(10)	Gender/sex
phone	VARCHAR(20)	Contact number
address	TEXT	Home address
has_allergy	BOOLEAN	Allergy flag

primary_allergy	VARCHAR(200)	Main allergy details
created_at	TIMESTAMP	Record creation timestamp
updated_at	TIMESTAMP	Last update timestam

## Doctors Table

Stores details of healthcare providers.

Column	Type	Description
doctor_id (PK)	INT	Unique doctor ID
staff_number	VARCHAR(50)	Hospital-assigned staff number
name	VARCHAR(150)	Full name
speciality	VARCHAR(100)	Field of specialization
contact	VARCHAR(100)	Contact info

institution_id (FK)	INT	Linked institution
created_at	TIMESTAMP	Record creation timestamp

## Institutions Table

Captures information about registered healthcare facilities.

Column	Type	Description
institution_id (PK)	INT	Unique institution ID
name	VARCHAR(200)	Institution name
type	VARCHAR(50)	Type (hospital, lab, pharmacy, HMO, etc.)

address	TEXT	Physical address
contact	VARCHAR(100)	Contact info
created_at	TIMESTAMP	Record creation timestamp

## Appointments Table

Tracks consultations and medical visits.

Column	Type	Description
appointment_id (PK)	INT	Unique appointment ID
patient_id (FK)	INT	Linked patient
doctor_id (FK)	INT	Linked doctor
institution_id (FK)	INT	Healthcare facility

scheduled_at	TIMESTAMP	Appointment date/time
reason	TEXT	Reason for visit
status	VARCHAR(30)	Pending/Completed/Cancelled
created_at	TIMESTAMP	Record creation timestamp
updated_at	TIMESTAMP	Last update timesta

## Lab Results Table

Stores results of lab investigations.

Column	Type	Description
lab_id (PK)	INT	Unique lab record ID
patient_id (FK)	INT	Linked patient
appointment_id (FK)	INT	Linked appointment
test_name	VARCHAR(150)	Name of test


test_code	VARCHAR(50)	Standardized code (LOINC, etc.)
test_date	DATE	Date test was carried out
result_value	VARCHAR(100)	Result value
units	VARCHAR(50)	Measurement unit
image_link	VARCHAR(255)	Path to related files/images
created_at	TIMESTAMP	Record creation timestamp

## Prescriptions Table

Captures medications prescribed to patients.

Column	Type	Description
rx_id (PK)	INT	Unique prescription ID
appointment_id (FK)	INT	Linked appointment
patient_id (FK)	INT	Linked patient





medicine_name	VARCHAR(150)	Name of medication
dose	VARCHAR(50)	Dosage details
frequency	VARCHAR(50)	Frequency of administration
start_date	DATE	Start of prescription
end_date	DATE	End of prescription
instructions	TEXT	Additional instructions
created_at	TIMESTAMP	Record creation timestamp

## Imaging Table

Stores medical imaging records (X-rays, CT scans, MRIs, etc.).

Column	Type	Description
image_id (PK)	INT	Unique image record

patient_id (FK)	INT	Linked patient
appointment_id (FK)	INT	Linked appointment
image_type	VARCHAR(50)	Type of image (X-ray, MRI, etc.)
image_path	VARCHAR(255)	File path or URL
taken_at	TIMESTAMP	Date/time image was captured
notes	TEXT	Notes from radiologist
created_at	TIMESTAMP	Record creation timestamp

## Users Table

Authentication and authorization for system users.

Column	Type	Description
user_id (PK)	INT	Unique system user

username	VARCHAR(100)	Login username
password_hash	VARCHAR(255)	Hashed password
role_id (FK)	INT	Role of user (Doctor, Nurse, LabTech, Patient, Admin)
institution_id (FK)	INT	Linked institution
doctor_id (FK)	INT	Linked doctor (if applicable)
patient_id (FK)	INT	Linked patient (if applicable)
created_at	TIMESTAMP	Account creation timestamp
last_login	TIMESTAMP	Last login timestamp

## Roles Table

Defines user roles and permissions.

**Column**

**Type**

**Description**

role_id (PK)	INT	Unique role ID
role_name	VARCHAR(50)	Role title (Admin, Doctor, Patient, etc.)
description	TEXT	Permissions and responsibilities

## API Endpoints Table

Tracks all exposed API routes for integration.

Column	Type	Description
endpoint_id (PK)	INT	Unique endpoint ID
http_method	VARCHAR(10)	GET, POST, PUT, DELETE
route	VARCHAR(150)	API route path
description	TEXT	What the endpoint does
related_table	VARCHAR(50)	Related database entity



## Key functionalities

- Normalization prevents duplication (every patient has one UHID).
- Foreign keys link data across patients, doctors, appointments, labs, and prescriptions.
- Extensibility: Can add modules (insurance claims, billing, AI analytics) without restructuring.
- Auditability: Timestamps and logs across all tables support accountability.
- Scalability: Cloud-hosted, supporting millions of records with horizontal scaling.