

Project Title: Enhancing Patient Care Through IT :
Healthcare Case

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Version History

VERSION	DATA RELEASED	LAST UPDATE	DESCRIPTION
V2	2-4-2025	6-04-2025	Detailed descriptions and missing deliverables updated according to TOGAF format

Architecture project Description and Scope

Project Description:

This project aims to modernize the healthcare organization's IT architecture to improve patient experience, enable interoperability across departments, enhance data-driven care, and ensure security and compliance with healthcare regulations (e.g., HIPAA, Ayushman Bharat Digital Mission standards). The new architecture will support EHR (Electronic Health Records), telemedicine, AI-driven diagnostics, real-time monitoring, and cross-platform access.

Scope:

- **In Scope:**
 - Digitization of patient records (EHR/EMR)
 - Implementation of a centralized data lake and healthcare analytics
 - Secure mobile/web access for patients and clinicians
 - Baseline and Target Architectures across Business, Application, Data, and Technology domains
 - Introduction of cloud-native healthcare microservices
 - Establishment of an Architecture Governance Framework aligned with healthcare compliance
- **Out of Scope:**
 - Physical infrastructure and hospital building renovation
 - Procurement of medical equipment and devices (will be handled in the Operations Department)

Overview of Architecture Vision

Vision Statement:

To establish a patient-centric, secure, and interoperable digital healthcare ecosystem that empowers clinicians, enhances operational efficiency, and improves healthcare outcomes through integrated technology.

Objectives:

- Provide seamless access to digital health records for doctors, patients, and staff
- Ensure 24/7 real-time system availability with alert-based remote patient monitoring
- Enable predictive and personalized care through AI/ML integration
- Maintain data privacy and integrity through end-to-end encryption and RBAC
- Comply with standards such as HIPAA, HITRUST, NIC

Stakeholders:

Role	Concerns
Hospital Management	ROI, operational efficiency, scalability
Medical Professionals	Ease of access to patient history, user-friendly UX
IT Department	Integration, data security, performance
Patients and Families	Access to reports, teleconsultation, data privacy
Government / Regulators	Compliance, transparency, public health insights
Data Scientists	Real-time data analytics, access to clean structured data

Key Outcomes:

- Target Architectures for each domain (Business, Application, Data, Technology)
- Healthcare-specific Transition Architecture defined
- Stakeholder Communication Plan in place
- Reuse strategy defined (e.g., leveraging open-source health tools like OpenMRS)
- Establishment of an internal Architecture Repository

Capability Assessment

1. Business Capability Assessment

1.1 Capabilities of the Business:

- I. Patient data collection and analysis
- II. Remote consultation and diagnostics
- III. Health records management
- IV. Appointment scheduling and follow-up
- V. A unified system that connects multiple hospitals
- VI. Health campaign outreach and feedback

1.2 Baseline State Performance:

Capability	Baseline Performance Level	Issues Identified
Patient data management	Low	Manual, fragmented, lacks integration
Remote diagnostics	Very Low	Rarely used, minimal infrastructure
Appointment scheduling	Moderate	Managed via calls or basic forms
Health campaigns & feedback	Low	Inefficient, not data-driven

1.3 Future State Aspiration:

Capability	Target Performance Level	Notes
Patient data management	High	Real-time, secure, interoperable
Remote diagnostics	High	Integrated with AI and IoT support
Appointment scheduling	High	Automated, real-time slot selection
Health campaigns & feedback	Medium	Data-driven engagement via platform

1.4 Capability Realization – Baseline:

- Mostly manual processes
- Siloed systems with little IT integration
- Low use of cloud AI

1.5 Capability Realization – Target:

- Fully digitized with cloud-based architecture
- Integrated with AI, ML and HER systems
- Real time sync and automated processes

2. IT Capability Assessment

2.1 Maturity of Change Process:

Process Area	Baseline Maturity	Target Maturity
Change management	Ad hoc	Managed
DevOps pipeline	None	Partially automated

2.2 Operational Process Maturity:

Process	Baseline	Target
Data backup & security	Basic	Advanced with compliance
System monitoring	None	Automated + real-time

2.3 Capability and Capacity Assessment:

- **Current IT team:** Limited to basic infrastructure support.
- **Target:** Expanded team with DevOps, AI, cloud, cybersecurity, and frontend/backend roles.

2.4 Organizational Impact:

- Upskilling needed in cloud, AI, data analytics.
- Potential for role restructuring in operations and IT management.

2.5 Architecture Maturity Assessment

Area	Baseline	Target	Notes
Governance processes	Informal	Formalized	Architecture board needed
Architecture skills	Limited	Enhanced	Training and certifications
Repository landscape	None	Rich	Tooling to manage reusable assets
Standards definition	Minimal	Strong	Enterprise-wide consistency
Reference model usage	Not used	Used	TOGAF/healthcare-specific references
Reuse potential	Low	High	Modular components planned

3. Business Transformation Readiness Assessment

3.1 Readiness Factors:

- Leadership commitment
- Staff training
- Technology infrastructure
- Stakeholder engagement

3.2 Vision per Factor:

- Full digital transformation with a scalable tech stack and skilled workforce

3.3 Current and Target Readiness Ratings

Factor	Current Rating	Target Rating
Leadership Support	Medium	High
Staff Skill Level	Low	Medium
Infrastructure	Low	High
Stakeholder Buy-in	Medium	High

3.4 Readiness Risks:

- Resistance to change
- Limited funding for new tech
- Time constraints for deployment
- Integration complexity with existing systems

4. Architecture Maturity Assessment

4.1 Architecture Governance Processes, Organization, Roles, and Responsibilities

Aspect	Baseline	Target	Notes
Governance Processes	Informal	Formalized	Need establishment of an Architecture Review Board (ARB) and clear governance framework.
Organization Structure	Flat IT support	Defined roles & hierarchy	Clear accountability across architecture domains required.

Roles & Responsibilities	Unclear	Documented & aligned	Assign domain architects, solution architects, and enterprise architects.
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4.2 Architecture Skills Assessment

Skill Area	Baseline	Target	Notes
Enterprise Architecture	Basic awareness	Certified practitioners	TOGAF or equivalent certification encouraged
Cloud & DevOps	Limited	Skilled workforce	Upskilling programs and hiring needed
Data Architecture	Minimal	Proficient	Focus on governance, quality, and analytics

4.3 Architecture Repository - Landscape Definition

Criteria	Baseline	Target	Notes
Breadth	Narrow	Broad	Include all domains: business, data, application, tech
Depth	Shallow	Detailed	Capture artifacts for current and planned architectures
Quality	Unstructured	Organized	Introduce structured meta-models and version control

4.4 Architecture Repository – Standards Definition

Criteria	Baseline	Target	Notes
Breadth	Ad hoc	Comprehensive	Covering interoperability, security, performance
Depth	Superficial	Detailed	Document technology stacks, protocols, and formats
Quality	Inconsistent	Enforced	Standard reviews and governance processes to be applied

4.5 Architecture Repository - Reference Model Definition

Criteria	Baseline	Target	Notes
Breadth	Not used	Used	Adopt TOGAF, industry-specific (e.g., Healthcare, Finance) models

Depth	N/A	Contextual	Tailor reference models to specific use cases
Quality	None	Curated	Ensure applicability and relevance

4.6 Assessment of Re-use Potential

Criteria	Baseline	Target	Notes
Component Reusability	Low	High	Encourage modular design and shared services
Reuse Policy	Absent	Defined	Introduce asset lifecycle management and usage guidelines
Tools and Infrastructure	Manual	Automated	Leverage repository tools ArchiMate for versioning and discovery

Scope of the Architecture

Architecture Principles

Business Transformation and Risk Mitigation plan

The following table outlines the key business transformation risks identified during the Architecture Vision phase, including their initial risk level, mitigation strategies, and the resulting residual risk level after planned actions:

Risk Description	Initial Risk Level	Potential Frequency	Mitigation Strategy	Residual Risk Level
Resistance to Change by Healthcare Staff	Critical	Likely	Early stakeholder engagement, change management programs,	Marginal

			continuous training	
Data Privacy Breaches / Regulatory Non-Compliance	Catastrophic	Unlikely	Adopt security by design, regular audits, HIPAA/GDPR-aligned data handling policies	Marginal
Integration Failure with Legacy Systems	Critical	Possible	Conduct pilot testing, use proven integration middleware, allocate buffer timelines	Marginal
Technology Adoption Delays	Marginal	Likely	Phased rollout, continuous feedback loops, modular deployment	Negligible
Budget Overruns or Funding Shortfalls	Critical	Possible	Clear scope definition, phased investment approval, milestone-based reviews	Marginal
Inadequate User Adoption (Patients and Providers)	Critical	Likely	Conduct UX research, co-design with users, usability testing, feedback mechanisms	Marginal
Vendor Lock-in or Technology Obsolescence	Marginal	Possible	Favor open standards, periodic tech reviews, escape clauses in vendor contracts	Negligible
Cybersecurity Threats / System Downtime	Catastrophic	Possible	Implement multi-layered security, disaster recovery plan, penetration testing	Marginal

Architecture Vision

1. Problem Description:

The Indian healthcare system is currently fragmented, with disparate legacy systems across hospitals that hinder seamless care delivery, data accessibility, and patient engagement. Critical gaps exist in interoperability, digital patient services, predictive insights, and centralized data management — leading to inefficiencies, delayed diagnosis, suboptimal outcomes, and reduced trust among patients.

2. Stakeholders and Their Concerns:

Stakeholder	Concern
Patients	Real-time access to medical records, appointment ease, privacy, e-services
Doctors & Medical Staff	Unified view of patient data, decision support, diagnostics, efficient workflows
Hospital Admins	Operational efficiency, reduced cost, digital transformation compliance
Government Bodies (MoHFW)	Alignment with NDHM/Digital India, public health surveillance, compliance
IT & Security Teams	Scalable infrastructure, data security, regulatory adherence
Insurance Providers	Streamlined claims processing, real-time medical data access

3. List of Issues / Scenarios to Be Addressed:

- Inability to share patient data across facilities in real time
- Lack of patient engagement tools such as portals or telemedicine
- Minimal decision support for clinicians
- Redundancy in diagnostics due to fragmented records
- Manual workflows increasing delays and errors
- Security vulnerabilities in current legacy infrastructure
- Low visibility into population-level health data and KPIs

4 .Objective of the Statement of Architecture Work:

To define a **target enterprise architecture** that delivers an **integrated digital health ecosystem**, guided by the National Digital Health Mission (NDHM), through modernized cloud infrastructure, secure data access, enhanced patient interaction tools, and advanced analytics for real-time decision-making.

5. Summary Views

5.1 Business Architecture

- Unified clinical and administrative processes (appointment to discharge)
- Patient-centric engagement mode
- National-level health program alignment

5.2 Application Architecture

- Electronic Health Record (EHR) system as the core
- Integration of CDSS, Telemedicine, Patient Portal, Analytics Platform
- Modular microservices-based design

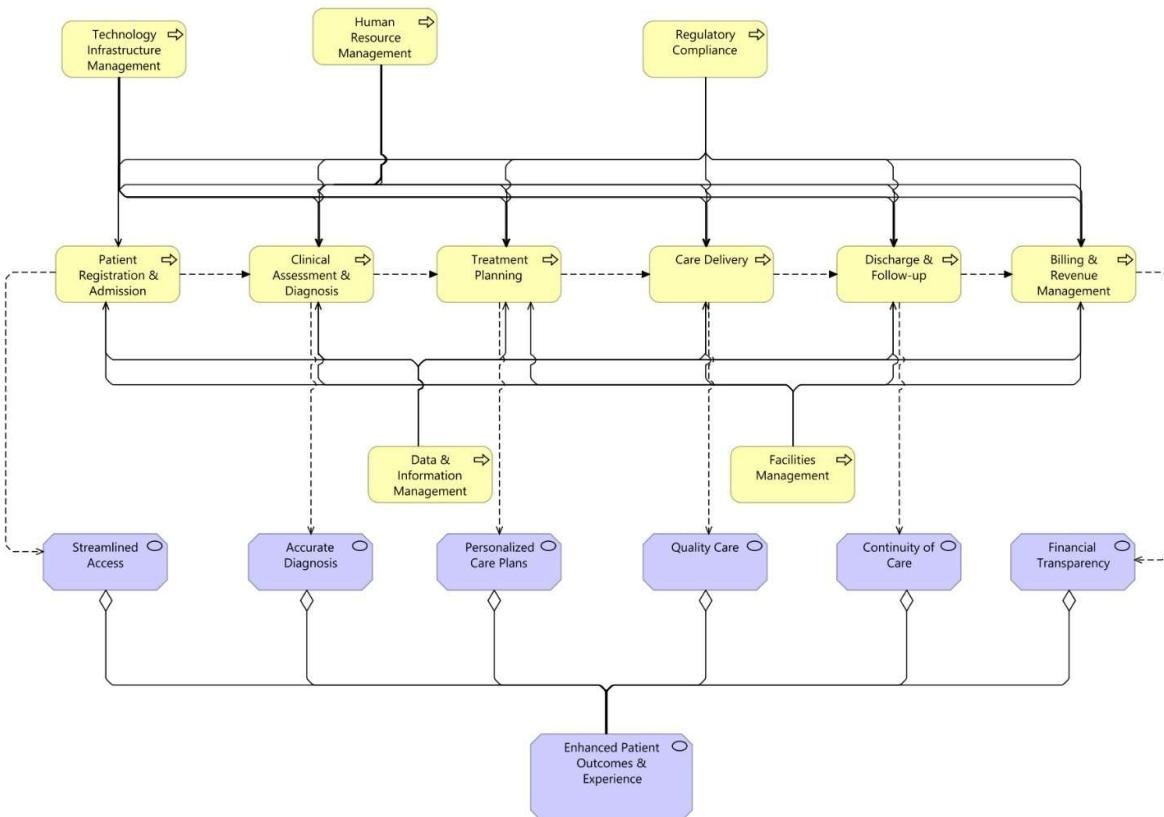
5.3 Data Architecture

- Longitudinal Patient Data Repository
- Structured & unstructured health records support
- Master Data Management and interoperability using HL7 FHIR standards

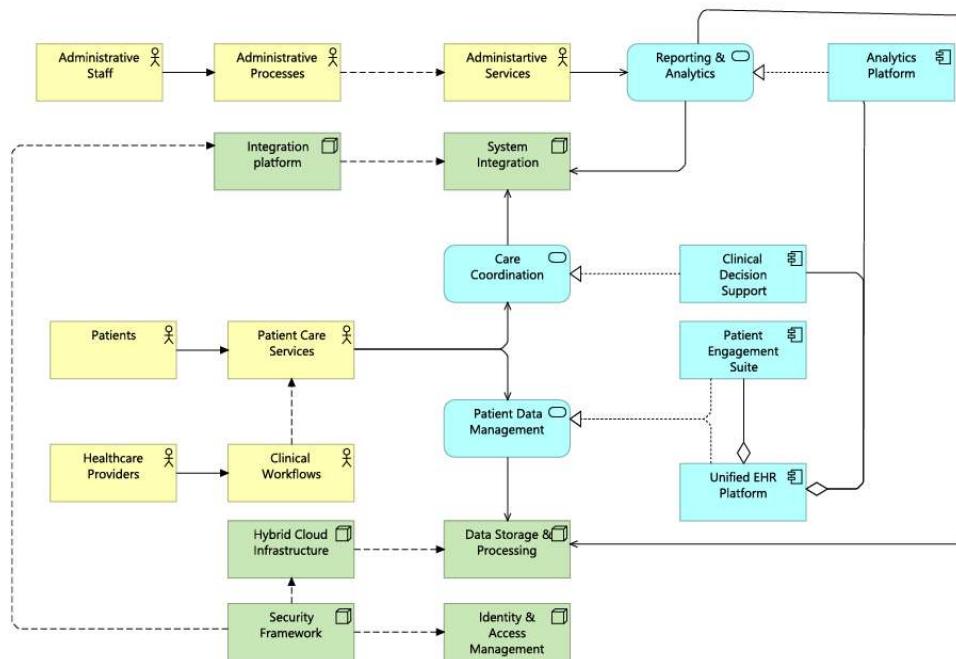
5.4 Technology Architecture

- Hybrid Cloud Infrastructure
- Secure IAM framework, SIEM integration
- Scalable platforms for AI/ML and mobile health

6 Value Chain Diagram



7 Solution Concept Diagram



8 Mapped Requirements

Requirement	Mapped Component
Centralized patient record	EHR System
Teleconsultation and remote access	Telemedicine & Patient Portal
Role-based secure access	IAM & Security Framework
Real-time dashboards	Analytics & KPI Monitoring Platform
Data privacy and compliance	Security & Compliance Architecture
Integration of existing hospital data	Interoperability Layer (FHIR, APIs)

COMMUNICATION PLAN

Purpose

This Communications Plan defines how architectural information related to the Unified Digital Healthcare Ecosystem will be communicated to stakeholders in a **structured, consistent, and timely** manner. It ensures alignment, transparency, and engagement across business, technical, and regulatory stakeholders to support the project's success.

Stakeholder Identification and Grouping

Stakeholder Group	Role/Interest	Communication Requirement
Hospital Management	Strategic oversight, funding	Executive summaries, ROI metrics, risks
Clinical Staff	End-users of EHR/CDSS	Use-case walkthroughs, change impacts

IT Department	System implementation & support	Technical models, data flows, deployment schedules
Government/Regulators	Policy compliance & data privacy	Legal compliance documentation, data security
Patients	End-users (external)	Awareness about features, data access & security
Vendors & Integrators	Technology solutions & tools	Technical architecture, APIs, standards
Architecture Board	Governance & review	Detailed models, milestone status, decisions
Project Team (PMO)	Coordination, execution	Weekly updates, roadmaps, integration plans

Communication Needs, Key Messages, and Risks

Stakeholder Group	Key Messages	Risks (if not communicated)	CSFs
Management	Strategic value, cost-benefit	Budget withdrawal, lack of buy-in	Show value early
Clinical Staff	Ease of use, enhanced care	Resistance to change	Continuous engagement
IT Department	Implementation clarity	Misalignment, rework	Detailed technical docs
Patients	Data safety, benefits	Distrust, underutilization	Clear communication
Regulators	Compliance and transparency	Legal non-compliance	Audit-readiness
Architecture Board	Architectural integrity	Governance issues	Timely decisions

Communication Mechanisms

Mechanism	Purpose	Frequency	Target Audience
Executive Presentations	Strategic updates and budget alignment	Monthly	Management, Regulators
Stakeholder Workshops	Hands-on engagement and feedback	Bi-Monthly	Clinical Staff, Patients
Technical Walkthroughs	Architecture model reviews	Bi-Weekly	IT Team, Vendors
Email Newsletters	Project milestones, user stories	Monthly	All Stakeholders
Intranet Portal / Wiki	Documentation, FAQs, Diagrams	Continuous	All Stakeholders
Training Sessions	EHR/Portal usage, data governance	Per Release	Clinical Staff, Patients
Steering Committee Calls	High-level decision-making	Bi-Monthly	Architecture Board, PMO
User Feedback Surveys	Capture feedback and adoption metrics	Post Go-Live	Patients, Clinical Staff

Ownership and Governance

Role	Responsibility
Chief Architect	Owns content, consistency, and timing
Communication Lead	Manages delivery channels and coordination
PMO	Tracks stakeholder engagement and feedback
Clinical Champion	Acts as liaison for end-user groups
IT Lead Architect	Technical documentation and developer liaison

Feedback and Improvement Loop

- Feedback from **surveys and workshops** will be reviewed monthly.

- A **communications retrospective** will be conducted after each major phase.
- Updates will be reflected in newsletters and internal portals.

Architecture Definition Document

1. Purpose

The **Architecture Definition Document** provides a **comprehensive, qualitative view** of the digital transformation initiative that seeks to build a secure, integrated, and patient-centric healthcare platform across hospitals. It defines baseline and target architectures, with intermediate transition architectures for effective realization. It serves as a key communication tool for stakeholders and guides implementation teams alongside the Architecture Requirements Specification.

2. Scope

This project covers the **end-to-end digital transformation** of hospital workflows, patient engagement, data systems, and infrastructure across multiple healthcare facilities. It includes:

- Business Process Digitization
- Implementation of EHR and CDSS
- Integration of Patient Portals and Telemedicine
- Cloud-based Infrastructure & Security
- Real-time Analytics and Dashboards

3. Goals, Objectives, and Constraints

3.1 Goals & Objectives

- Enable real-time, longitudinal access to patient data
- Improve clinical decision-making and reduce errors
- Increase patient convenience and trust
- Optimize operations using analytics and automation
- Ensure compliance with NDHM, HIPAA, and data privacy laws

3.2 Constraints

- Budget limitations
- Legacy systems dependency
- Compliance with data residency laws
- Interoperability requirements with external systems

4. Architecture Principles

- **User-Centricity:** Design services around user needs
- **Security by Design:** Embed security at every layer
- **Modularization:** Build loosely coupled, interoperable services
- **Scalability:** Support rapid growth of users and data
- **Open Standards:** Adopt HL7 FHIR, ICD, SNOMED CT
- **Cloud-First:** Use hybrid cloud infrastructure

5. Baseline Architecture

A. Business Architecture

- Manual, siloed hospital workflows
- Inconsistent data capture and patient experience
- Limited use of analytics or automation

B. Data Architecture

- Paper-based and localized electronic records
- No standardized data formats
- No Master Data Management (MDM)

C. Application Architecture

- Disconnected HIS systems
- No patient portal or CDSS
- No real-time integration or dashboards

D. Technology Architecture

- On-premises servers with basic backups
- No cloud adoption
- Limited security infrastructure

6. Target Architecture

A. Business Architecture

- Unified digital workflows (admission to discharge)
- Digital billing, diagnostics, insurance workflows
- Compliance and automation of governance processes

B. Data Architecture

- Unified EHR and clinical repository
- Adoption of HL7 FHIR, ICD, SNOMED CT
- Federated Master Data Management

C. Application Architecture

- Centralized EHR and CDSS platform
- Integrated Patient Portal and Telemedicine App
- AI-driven analytics and alerts

D. Technology Architecture

- Hybrid cloud platform with auto-scaling
- Identity & Access Management (IAM)
- SIEM integration, disaster recovery enabled

7. Transition Architecture

Purpose

Defines an intermediate architectural state for phased rollout of services while ensuring minimal disruption.

Component	Transition Approach
EHR	Pilots in 3 departments, federated integration with legacy HIS
Patient Portal	Basic version launched for appointments and health reports
CDSS	Introduce for top 5 high-volume diseases
Infrastructure	Migrate 40% of workloads to cloud (Phase I)
IAM	Centralized access control for staff in major hospitals
Analytics	Deploy dashboards for KPIs and admission rates

8. Architecture Models

- Business Process Models (BPMN)
- Data Flow Diagrams (DFD)
- UML Application Component Diagrams
- Infrastructure Deployment Views

9. Rationale and Justification

- **EHR centralization** is crucial to eliminating data fragmentation
- **CDSS** improves quality of care and reduces cognitive overload
- **Cloud infrastructure** supports scale, agility, and cost-efficiency
- **Omnichannel engagement** increases patient satisfaction and trust
- **Data standardization** ensures interoperability and national compliance

10. Mapping to Architecture Repository

A. Mapping to Architecture Landscape

- Builds upon government digital health stack (NDHM, Ayushman Bharat)
- Extends capabilities for rural and urban health centers

B. Mapping to Reference Models

- OpenHIE, TOGAF ADM, HL7 FHIR Reference Architecture

C. Mapping to Standards

- ISO/IEC 27001, HL7, SNOMED CT, ICD-10, GDPR/HIPAA

11. Re-use Assessment

- Open-source components for patient portals and HL7 APIs
- Reuse existing infrastructure with secure integration bridges
- Use of national health ID and insurance APIs

12. Gap Analysis

Area	Baseline	Target	Gap
EHR	None / Paper	Unified EHR	Full implementation
Patient Portal	None	Web & Mobile Portal	Full implementation
Infrastructure	On-Prem Only	Hybrid Cloud	Migration
IAM & Security	Minimal	Enterprise Security	Architecture upgrade
Analytics	Manual	Real-time Dashboards	New implementation

13. Impact Assessment

- **Training Needs:** Clinical staff, admin teams
- **Organizational Change:** IT governance, data stewardship
- **Infrastructure:** Data centers, bandwidth upgrades
- **Risk:** Downtime during transition, change resistance

