AI-Enabled Early Identification & Risk Stratification System

Executive Implementation Document

1. Executive Summary

Early childhood (0–6 years) is the most critical period for cognitive, physical, and socio-emotional development. Delays or risks that are not identified early often lead to irreversible long-term outcomes affecting education, health, and productivity.

Problem Statement A focuses on building an **AI-enabled, mobile-first screening and risk stratification system** that empowers frontline workers to identify developmental risks early, objectively, and at scale.

This document outlines **what problem we are solving, what exactly will be built, how it will be implemented end-to-end, and how the solution meets success criteria, scalability, and compliance expectations**.

2. Problem Statement (As Defined by the Challenge)

Problem A: AI-Enabled Early Identification & Risk Stratification

Develop AI solutions for early identification of developmental delays, disabilities, defects at birth, and diseases in children aged 0–6 years.

Expected Outcomes

- Objective and standardized screening
- Risk stratification and prioritization
- Predictive insights and early warnings
- Field-level usability with offline support

3. Core Problem We Are Addressing

Current Gaps in the System

- Screening quality varies by worker skill and experience
- Lack of standardized, objective assessment tools at field level
- Delayed identification of high-risk children
- Limited use of data for early warnings and prioritization
- Connectivity constraints in rural and semi-urban areas

Our Solution Objective

To create a **mobile-first, AI-assisted screening platform** that enables frontline workers to: - Screen children in 5–10 minutes - Automatically compute developmental risk - Understand *why* a child is at risk (explainability) - Trigger early action and referrals - Seamlessly integrate with state-level dashboards

4. What We Will Build (Solution Overview)

Final Deliverables

1. **Mobile Application (Primary System)**
2. Used by Anganwadi Workers / field staff
3. Offline-capable developmental screening
4. AI-driven risk stratification
5. **Backend & AI Risk Engine**
6. Centralized scoring, analytics, and prediction services
7. Secure APIs for data exchange
8. **Web Dashboard (Integration Layer)**
9. Supervisor, district, and state-level visualization
10. Seamless integration with existing state dashboards

5. System Architecture (High Level)

```
Mobile App (Offline-First)
        ↓
Secure Backend APIs
        ↓
AI Risk Scoring Engine
        ↓
State & District Dashboards
```

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6. Frontend Implementation (Mobile Application)

6.1 Target Users

- Primary: Anganwadi Workers (AWWs)
- Secondary: Supervisors (view-only)

6.2 Core Frontend Modules

A. Child Registration Module

- Child ID (auto-generated)
- Age (in months)
- Gender
- Birth history (preterm, low birth weight)

- Location (AWC, sector, mandal)

B. Developmental Screening Module

- Age-adaptive questionnaires
- Five domains:
- Gross Motor
- Fine Motor
- Language & Communication
- Cognitive
- Social-Emotional
- Simple Yes / No / Not Observed inputs

C. Nutrition & Environment Module

- Nutrition status indicators
- Feeding practices
- Home stimulation environment

D. Risk Result & Explanation Screen

- Risk category: Low / Medium / High / Critical
- Domain-wise delay visualization
- Plain-language explanation of risk
- Non-diagnostic disclaimer

E. Offline & Sync Module

- Local storage on device
- Auto-sync when internet is available
- Sync status indicators

7. Backend & AI Implementation

7.1 Backend Responsibilities

- User authentication & role management
- Secure data storage
- API orchestration
- AI scoring requests & responses
- Audit & compliance logging

7.2 AI Risk Scoring Engine

Approach

- Hybrid explainable AI model:
- Rule-based scoring for baseline risk
- ML model (logistic regression / tree-based) for prediction

Inputs

- Developmental screening responses
- Nutrition indicators
- Birth history
- Environmental stimulation factors

Outputs

- Risk score (numeric)
- Risk category (Low / Medium / High / Critical)
- Feature-level explanations

All outputs are **screening-level insights**, not medical diagnoses.

8. Workflow: How the System Works End-to-End

1. AWW registers child on mobile app
2. Conducts age-appropriate screening
3. App works offline if required
4. Data sent to backend when connectivity is available
5. AI engine computes risk & explanations
6. Risk category returned to mobile app
7. High-risk children flagged for early action
8. Aggregated data visible on state dashboards

9. Technology Stack

Frontend

- Flutter / React Native (Android first)
- Local storage: SQLite
- Multilingual support (i18n)

Backend

- Python (FastAPI)
- REST APIs
- Authentication: JWT

AI & Analytics

- Scikit-learn / XGBoost
- Explainability: Feature importance / SHAP

Database

- PostgreSQL / MongoDB

Hosting

- Cloud-ready (NIC / Government-approved cloud)

10. Success Criteria Alignment

Accuracy (95%+)

- Standardized screening inputs
- Scientifically aligned scoring rules
- Continuous validation on synthetic datasets

Multi-lingual Support

- Telugu & English UI
- Clear, actionable guidance

Integration

- API-based integration with state dashboards
- Role-based views

DPDP Act Compliance

- Consent-based data capture
- No clinical diagnosis
- Secure access & encryption

11. Scalability & Feasibility

- Offline-first design enables rural deployment
- Modular architecture supports state-wide scale
- Explainable AI ensures policy trust
- Reusable APIs for future Problems B, C & D

12. Business & Governance Value

- Early risk detection reduces long-term intervention cost
- Data-driven prioritization improves workforce efficiency
- Standardized screening improves equity
- Enables measurable impact at population scale

13. Conclusion

This solution directly addresses **Problem Statement A** by combining **field-ready mobile technology, explainable AI, and scalable system architecture**. It is practical, compliant, and ready for phased state-level adoption, while laying the foundation for long-term longitudinal impact measurement.

AI-Driven Personalized Intervention & Caregiver Engagement System

Executive Implementation Document

1. Executive Summary

Early identification of developmental risk delivers value only when it is followed by **timely, appropriate, and sustained intervention**. In many large-scale child development programs, the gap between identification and action results in lost developmental windows and sub-optimal outcomes.

Problem Statement B focuses on translating identified developmental risks into personalized, age-appropriate intervention pathways, while actively engaging caregivers and enabling frontline workers to track adherence and progress.

This document outlines **what problem is being solved, what will be built, how it will be implemented end-to-end, and how the solution aligns with scalability, compliance, and measurable developmental impact**.

2. Problem Statement (As Defined by the Challenge)

Problem B: Personalized AI-Driven Intervention & Caregiver Engagement

Develop AI-enabled systems that convert developmental risk insights into **actionable, personalized interventions** for caregivers and frontline workers, ensuring early identification leads to measurable developmental improvement.

Expected Outcomes

- Personalized, child-specific intervention plans
- Improved caregiver engagement in local languages
- Continuous monitoring of intervention adherence
- Measurable improvement in developmental outcomes

3. Core Problem We Are Addressing

Current Gaps in the System

- Risk identification does not consistently translate into structured action
- Generic interventions ignore age, domain, and severity
- Caregivers lack simple, understandable guidance
- Limited visibility into whether interventions are followed
- No feedback loop between intervention and outcomes

Our Solution Objective

To create an **AI-assisted, mobile-first intervention platform** that enables frontline workers and caregivers to:

- Receive personalized intervention plans automatically
- Deliver simple, actionable guidance at home
- Track adherence and follow-ups systematically
- Feed progress data into state-level monitoring systems

4. What We Will Build (Solution Overview)

Final Deliverables

1. **Intervention Recommendation Engine**

2. AI-driven mapping of risk profiles to intervention plans
3. Age- and domain-specific activities
4. Severity-aware prioritization
5. **Caregiver Engagement Module (Mobile-First)**
6. Local-language guidance (text, visual, audio)
7. Simple daily / weekly activity instructions
8. **Intervention Tracking & Feedback System**
9. Follow-up logging by Anganwadi Workers
10. Caregiver adherence indicators

5. System Architecture (High Level)

Risk Profile (Problem A)
↓
AI Intervention Recommendation Engine
↓
Mobile App (AWW + Caregiver Guidance)
↓
Intervention Tracking & Feedback
↓
State & District Dashboards

6. Frontend Implementation (Mobile Application)

6.1 Target Users

• Primary: Caregivers (guided by AWWs)
• Secondary: Anganwadi Workers (delivery & follow-up)

6.2 Core Frontend Modules

A. Intervention Plan Module

• Child-specific intervention plan
• Domain-wise activities (GM, FM, LC, COG, SE)
• Priority and frequency indicators

B. Caregiver Guidance Module

• Step-by-step activity instructions
• Visual and audio aids
• Local-language support
• Clear non-diagnostic disclaimers

C. Reminder & Nudge Module

• Daily / weekly activity reminders
• Simple adherence prompts
• Low-bandwidth friendly design

D. Follow-Up & Feedback Module

• AWW-logged follow-up visits
• Caregiver-reported activity completion
• Observation-based progress notes

7. Backend & AI Implementation

7.1 Backend Responsibilities

• Secure intervention plan generation
• Intervention versioning and updates

• Follow-up data storage
• API integration with Problems A, C & D
• Audit & compliance logging

7.2 AI Intervention Recommendation Engine

Approach

• Hybrid explainable AI approach:
• Rule-based intervention mapping (baseline)
• ML-assisted prioritization (optional enhancement)

Inputs

• Risk category & domain scores (from Problem A)
• Child age (in months)
• Nutrition indicators
• Environmental stimulation factors
• Prior intervention history

Outputs

• Personalized intervention plan
• Activity frequency & duration
• Domain-wise focus areas
• Explainable rationale for recommendations

All outputs are **supportive guidance**, not clinical or therapeutic prescriptions.

8. Workflow: How the System Works End-to-End

1. Risk profile generated in Problem A
2. Risk data sent to intervention engine
3. AI maps risks to personalized interventions
4. Intervention plan delivered to mobile app
5. AWW explains activities to caregiver
6. Caregiver performs activities at home
7. Follow-ups logged periodically
8. Adherence and progress data captured
9. Data feeds longitudinal systems (Problem D)

9. Technology Stack

Frontend

• Flutter / React Native
• Offline-first design
• Multilingual support (i18n)

Backend

• Python (FastAPI)
• REST APIs
• Authentication: JWT

AI & Analytics

• Rule-based recommendation engine
• Optional ML ranking models
• Explainability via rule traces / feature weights

Database

• PostgreSQL / MongoDB

Hosting

• Cloud-ready (NIC / Government-approved cloud)

10. Success Criteria Alignment

Personalization

- Age- and domain-specific intervention plans
- Severity-aware prioritization

Caregiver Engagement

- Simple language and visuals
- Minimal time burden
- Cultural appropriateness

Measurable Outcomes

- Intervention adherence tracking
- Domain-wise improvement signals

DPDP Act Compliance

- Consent-based engagement
- No clinical diagnosis
- Secure access and encryption

11. Scalability & Feasibility

- Offline-first design supports rural deployment
- Modular intervention library enables scale
- Reusable APIs across programs
- Seamless extension into Problems C & D

12. Business & Governance Value

- Converts identification into action
- Improves return on screening investments
- Reduces escalation to costly tertiary care
- Empowers caregivers as active partners

13. Conclusion

Problem Statement B ensures that **early identification leads to meaningful action**. By combining AI-driven personalization, caregiver-friendly delivery, and structured follow-ups, the solution creates a **closed-loop developmental intervention system** aligned with national early childhood goals.

AI-Enabled Decision Support & Performance Monitoring System

Executive Implementation Document

1. Executive Summary

Large-scale Early Childhood Development (ECD) programs generate vast amounts of screening, intervention, and follow-up data. However, **data alone does not translate into better outcomes unless it is converted into timely, actionable decisions**.

Supervisors and administrators currently lack real-time visibility into **screening coverage, risk concentration, referral effectiveness, and workforce performance**, resulting in delayed responses and inefficient resource allocation.

Problem Statement C focuses on building an AI-enabled decision support and performance monitoring system that transforms field data into **role-based, actionable insights** across Anganwadi, sector, district, and state levels.

This document outlines **what will be built, how it will function end-to-end, and how it enables data-driven governance at scale**.

2. Problem Statement (As Defined by the Challenge)

Problem C: Decision Support & Performance Monitoring

Develop digital platforms that convert screening, intervention, and follow-up data into **real-time decision support tools** for ICDS functionaries and administrators.

Expected Outcomes

- Real-time monitoring of screening and intervention coverage
- Identification and prioritization of high-risk children and geographies
- Workforce and system performance tracking
- Faster, data-driven administrative decision-making

3. Core Problem We Are Addressing

Current Gaps in the System

- Data is available but fragmented across multiple sources
- Reporting is retrospective, manual, and time-consuming
- Lack of role-specific dashboards for different governance levels
- Limited visibility into referral delays and follow-up gaps
- Inability to proactively identify emerging risk clusters

Our Solution Objective

To build an **AI-enabled decision support layer** that enables administrators to:

- Monitor program performance in near real time
- Identify priority children, centres, and geographies
- Track referrals, follow-ups, and workforce productivity
- Take timely corrective and policy actions

4. What We Will Build (Solution Overview)

Final Deliverables

1. **Role-Based Web Dashboards**
2. Anganwadi, Sector, Mandal, District, and State-level views
3. Contextual KPIs aligned to user responsibilities
4. **Risk & Priority Intelligence Layer**
5. High-risk child and cluster identification
6. Delay severity and domain-wise burden analysis
7. **Workforce & System Performance Monitoring**
8. Screening and follow-up productivity indicators
9. Training and capacity utilization metrics

5. System Architecture (High Level)

Data from Problems A & B

↓

Central Data Aggregation Layer

↓

KPI & Analytics Engine

↓

Role-Based Web Dashboards

↓

Administrative Action & Monitoring

6. Frontend Implementation (Web Application)

6.1 Target Users

- Anganwadi Workers (limited view)
- Sector Supervisors
- CDPO / District Officers
- State-Level Administrators

6.2 Core Frontend Modules

A. Screening & Coverage Dashboard

- Total children registered and screened
- Age-band-wise screening coverage
- AWC-wise screening completeness

B. Risk Distribution & Prioritization Module

- Low / Medium / High / Critical risk breakdown
- Domain-wise developmental delay burden
- High-risk geography heatmaps

C. Referral & Follow-Up Monitoring Module

- Children flagged for referral
- Referral completion status
- Average referral turnaround time

D. Workforce Performance Module

- Screenings per AWW
- Follow-up compliance rates
- Training and workload indicators

E. Drill-Down & Action Views

- Child → AWC → Sector → Mandal → District navigation
- Exception lists for immediate action

7. Backend & Analytics Implementation

7.1 Backend Responsibilities

- Aggregation of data from Problems A and B
- KPI computation and caching
- Role-based access control
- Alert and priority flag generation
- Audit and compliance logging

7.2 Decision Intelligence Engine

Approach

- Rule-based and analytics-driven decision intelligence
- Threshold-based alerts for critical indicators
- Trend and anomaly detection over time

Inputs

- Screening outcomes and risk categories
- Intervention adherence data
- Referral and follow-up status
- Workforce activity metrics

Outputs

- Priority alerts
- Performance flags
- Actionable task lists

All outputs are **decision-support insights**, not automated decisions.

8. Workflow: How the System Works End-to-End

1. Screening and intervention data captured in Problems A & B
2. Data aggregated at backend services
3. KPIs computed across governance levels
4. Dashboards updated in near real time
5. High-risk gaps and delays flagged automatically
6. Supervisors review insights and prioritize actions
7. Follow-up actions monitored through the system

9. Technology Stack

Frontend

• React / Angular
• Responsive, role-based UI
• Interactive charts and tables

Backend

• Python (FastAPI)
• REST APIs
• Role-based authentication (JWT)

Analytics

• SQL-based aggregations
• Pre-computed KPI tables
• Optional ML-based anomaly detection

Database

• PostgreSQL (analytics-optimized schemas)

Hosting

• Cloud-ready (NIC / Government-approved cloud)

10. Success Criteria Alignment

Operational Effectiveness

• Faster identification of high-risk clusters
• Reduced referral and follow-up delays

Efficiency

• Reduced manual reporting effort
• Clear accountability across roles

Scalability

• Supports district and state-wide rollouts
• Consistent KPIs across geographies

Compliance

• DPDP Act–aligned access controls
• Secure data handling and audit trails

11. Scalability & Feasibility

• Modular KPI framework supports expansion
• Hierarchical aggregation from AWC to State
• Designed for millions of child records
• Low operational and maintenance overhead

12. Business & Governance Value

• Enables proactive program management
• Improves allocation of limited resources
• Increases transparency and accountability
• Supports evidence-based policy decisions

13. Conclusion

Problem Statement C transforms the ECD ecosystem from **data collection to intelligent governance**. By delivering role-based insights, automated prioritization, and measurable performance indicators, the system empowers leadership to **act early, intervene effectively, and continuously improve outcomes at scale**.

AI-Enabled Longitudinal Impact Measurement & Data Governance System

Executive Implementation Document

1. Executive Summary

Early Childhood Development (ECD) programs achieve meaningful impact only when **improvements in child outcomes can be measured, validated, and sustained over time**. While screening and interventions may be implemented, most systems lack the capability to **track developmental trajectories longitudinally**, evaluate intervention effectiveness, and ensure responsible data governance at scale.

Problem Statement D focuses on building a longitudinal impact measurement and governance layer that tracks child development over repeated assessments, quantifies intervention outcomes, and provides policy-level insights — while ensuring privacy, compliance, and ethical use of data.

This document outlines **what will be built, how it will function end-to-end, and how it enables outcome-driven, accountable governance** for large-scale ECD programs.

2. Problem Statement (As Defined by the Challenge)

Problem D: Longitudinal Impact Measurement & Governance

Develop systems that enable **long-term tracking of child development outcomes**, evaluate intervention effectiveness, and ensure ethical data governance across the ECD lifecycle.

Expected Outcomes

• Measurement of developmental improvement over time
• Evaluation of intervention effectiveness
• Evidence-based policy insights
• Strong data governance and compliance

3. Core Problem We Are Addressing

Current Gaps in the System

• Screening data is captured as isolated snapshots
• Limited ability to track child progress longitudinally
• No systematic measurement of intervention impact
• Weak feedback loops into policy and planning
• Inadequate governance controls for sensitive child data

Our Solution Objective

To build a **longitudinal analytics and governance platform** that enables:

- Tracking developmental trajectories across time
- Measuring outcomes of interventions objectively
- Identifying improving vs worsening trends

- Ensuring privacy, auditability, and responsible data use

4. What We Will Build (Solution Overview)

Final Deliverables

1. **Longitudinal Analytics Engine**
2. Baseline vs follow-up comparison models
3. Trend detection (improving / stagnant / worsening)
4. **Outcome Measurement Dashboards**
5. Domain-wise improvement metrics
6. Exit-from-high-risk indicators
7. **Governance & Compliance Layer**
8. Audit trails and access logging
9. Consent and data retention controls

5. System Architecture (High Level)

Repeated Assessments (A & B)
↓
Longitudinal Data Store
↓
Trend & Outcome Analytics Engine
↓
Impact Dashboards
↓
Policy & Governance Layer

6. Frontend Implementation (Web Application)

6.1 Target Users

• District and State Program Managers
• Policy Makers
• Monitoring & Evaluation (M&E) Teams

6.2 Core Frontend Modules

A. Child Outcome Tracking Module

• Baseline vs follow-up comparisons
• Domain-wise score trajectories
• Risk category transitions over time

B. Intervention Effectiveness Dashboard

• Intervention adherence vs outcome improvement
• Comparative analysis across cohorts
• Domain-specific impact indicators

C. Population-Level Trend Analysis

• Improving vs worsening trend distribution
• Exit-from-high-risk rates
• Long-term delay reduction metrics

D. Governance & Audit Module

• Data access logs
• Consent status indicators
• Retention and archival views

7. Backend & Analytics Implementation

7.1 Backend Responsibilities

- Longitudinal data storage and versioning
- Trend computation and cohort analytics
- Role-based access enforcement
- Audit logging and compliance reporting

7.2 Longitudinal Impact Analytics Engine

Approach

- Time-series and cohort-based analytics
- Rule-based outcome classification
- Optional ML-assisted trend detection

Inputs

- Repeated developmental assessments
- Intervention history and adherence data
- Referral and treatment outcomes

Outputs

- Improvement / stagnation / deterioration flags
- Outcome effectiveness metrics
- Policy-level indicators

All outputs are **program evaluation insights**, not clinical or diagnostic judgments.

8. Workflow: How the System Works End-to-End

1. Baseline screening captured (Problem A)
2. Interventions delivered and tracked (Problem B)
3. Follow-up assessments conducted periodically
4. Longitudinal models compute trends
5. Impact metrics generated at child and cohort level
6. Insights surfaced on dashboards
7. Governance rules enforced throughout lifecycle

9. Technology Stack

Frontend

- React / Angular
- Advanced analytics dashboards
- Secure role-based views

Backend

- Python (FastAPI)
- REST APIs
- RBAC and audit services

Analytics

- SQL-based time-series analysis
- Optional ML trend detection models
- Cohort comparison pipelines

Database

- PostgreSQL (partitioned longitudinal tables)

Hosting

- Cloud-ready (NIC / Government-approved cloud)

10. Success Criteria Alignment

Impact Measurement

- Clear baseline vs follow-up improvement signals
- Quantifiable intervention effectiveness

Policy Utility

- Evidence-based insights for planning and budgeting
- Identification of high-impact interventions

Governance & Compliance

- DPDP Act-aligned data handling
- Consent tracking and auditability
- Secure access and encryption

11. Scalability & Feasibility

- Designed for multi-year data retention
- Supports millions of child records
- Modular analytics pipelines
- Minimal incremental operational cost

12. Business & Governance Value

- Shifts focus from activity to outcomes
- Enables accountable, impact-driven governance
- Improves long-term return on public investment
- Builds trust through transparent measurement

13. Conclusion

Problem Statement D completes the ECD ecosystem by enabling **longitudinal outcome measurement, intervention effectiveness evaluation, and responsible data governance**. It ensures that early identification and intervention efforts translate into **measurable, sustained developmental impact**, supporting evidence-based policy decisions at scale.

Unified Technology Stack for Problem Statements A, B, C & D

1. Overall System Architecture (High-Level)

Mobile App (AWW / Caregiver)
Web App (Supervisors / Admin / Policy)
↓
API Gateway (Secure, Versioned)
↓
Backend Microservices
↓
AI / Analytics Layer
↓
Central Data Platform
↓
Government Systems (ICDS, Health APIs)

2. Frontend Technology Stack

A. Mobile Application (Primary Field Tool)

Layer	Technology
Framework	**Flutter** (single codebase: Android-first, future iOS ready)

Layer	Technology
State Management	Bloc / Riverpod
Offline Support	SQLite / Hive
Media	Local audio/video playback for caregiver guidance
Localization	Multi-language (i18n, regional languages)
Sync	Background sync with retry & conflict resolution
Security	Device-level encryption, secure storage

Used For:

- Developmental screening (A)
- Intervention guidance (B)
- Alerts & task lists (C)

B. Web Application (Supervisory & Policy Layer)

Layer	Technology
Framework	**React.js** (Admin dashboards)
UI	Material UI / Ant Design
Charts	Recharts / Chart.js
Auth	Role-based access (RBAC)
Usage	Desktop & tablet optimized

Used For:

- Decision support dashboards (C)
- Impact monitoring (D)
- Governance & audit views (D)

3. Backend Technology Stack

Core Backend

Component	Technology
Framework	**FastAPI (Python)**
API Style	REST + JSON
Auth	OAuth2 + JWT
RBAC	Role-based authorization
Validation	Pydantic schemas
Background Tasks	Celery / FastAPI background jobs

Microservices (Logical Separation)

Service	Responsibility
Screening Service	Problem A – assessments, scoring
Risk Engine	A – stratification & prediction
Intervention Service	B – recommendations & tracking
Notification Service	Alerts, nudges, reminders
Analytics Service	C & D – dashboards & metrics
Governance Service	Consent, audit, access logs

4. AI / ML Technology Stack

A. Problem A – Risk Stratification & Early Identification

Layer	Technology
Feature Engineering	Pandas, NumPy
Models	XGBoost / Random Forest
Time-based Risk	Rule + ML hybrid
Explainability	SHAP values
Inference	Python services
Versioning	MLflow

Why Hybrid AI?

Works with limited data
Explainable for government use
Safer than black-box DL

B. Problem B – Personalized Interventions

Component	Approach
Recommendation Engine	Rule + scoring based
Inputs	Domain scores, age, risk
Outputs	Daily activities, nudges
Adaptation	Feedback-based re-ranking
AI Level	Lightweight (field-safe)

C. Problem C – Decision Support Analytics

Component	Technology
Aggregations	SQL + Python
Trends	Time-series analytics
Alerts	Rule-based triggers
Insights	Cohort-level comparisons

D. Problem D – Impact Measurement

Component	Technology
Longitudinal Analysis	SQL time-series
Outcome Tracking	Cohort analytics
Effectiveness	Baseline vs follow-up
Evidence	Exportable reports

5. Database & Data Layer

Primary Databases

Purpose	Technology
Transactional Data	**PostgreSQL**
Offline Sync	SQLite (mobile)

Purpose	Technology
Analytics Views	PostgreSQL materialized views

Data Modeling Approach

- Child-centric schema
- Time-stamped assessments
- Versioned records
- Soft deletes for audit

6. Data Governance & Security Stack (Problem D)

Area	Technology / Practice
Encryption	AES-256 (at rest), TLS (in transit)
Consent	Explicit consent tables
Audit Logs	Immutable audit records
Access Control	RBAC + scoped APIs
Compliance	DPDP Act, Govt cyber norms
Ownership	Govt-controlled infra

7. Interoperability & Integration

Area	Approach
ICDS Integration	API-based
Health Systems	REST APIs
Data Exchange	JSON
Future Proofing	Open standards

8. Deployment & Infrastructure

Layer	Technology
Containerization	Docker
Orchestration	Kubernetes
Hosting	NIC / MeitY / Govt cloud
CI/CD	GitHub Actions
Monitoring	Prometheus + Grafana
Logs	ELK Stack

9. Scalability Strategy

- Stateless backend services
- Horizontally scalable APIs
- Async background processing
- Partitioned longitudinal tables
- Offline-first field apps

10. Mapping Tech Stack to Problem Statements

Problem	Stack Focus
A	AI risk models, mobile data capture
B	Recommendation engine, caregiver UX
C	Dashboards, alerts, performance analytics
D	Governance, longitudinal impact, compliance