Intelis Insights

Governed Analytics for Laboratory Intelligence

Transforming laboratory data into actionable program intelligence with strict privacy controls and AI-assisted interpretation.

Open Source | Privacy-First | Multi-Disease

THE CHALLENGE

Why Do We Need This?

Manual Reporting Burden

Lab managers spend hours compiling reports manually from raw operational data

Inconsistent Metrics

Different teams calculate the same indicators differently, leading to conflicting results

Siloed Disease Programs

Each disease program operates in isolation with no unified analytics platform

Privacy Risks

Ad-hoc queries risk exposing patient-level data through unrestricted database access

OVERVIEW

What is Intelis Insights?

A governed analytics platform built on top of Intelis (FOSS Laboratory Information System) that transforms laboratory data into actionable program intelligence.

This is NOT a generic chat-over-database tool. It is a structured insight engine with governed metrics, privacy enforcement, and AI-assisted interpretation.

Smart Dashboard

Predefined national indicators with executive-level visibility

Saved Reports

Reusable structured analyses that can be shared and pinned

Conversational Authoring

AI-assisted natural language query building

Knowledge Assistance

AI-powered, privacy-safe documentation help

PRINCIPLES

Core Design Principles

01 **Privacy by Architecture**

Built into every layer, not bolted on

02 **Privacy-Enforced Analytics**

LLM never accesses PII; guardrails block all exposure

03 **RAG-Grounded Analytics**

AI queries grounded by retrieval of approved schemas and rules

04 **AI-Generated SQL**

AI generates SQL; application validates and executes queries securely

05 **Application-Controlled Execution**

AI has no database access; application validates and runs all queries

06 **Modular AI Components**

AI features are optional — system works without them

07 **Disease-Agnostic Design**

Extensible to any disease program

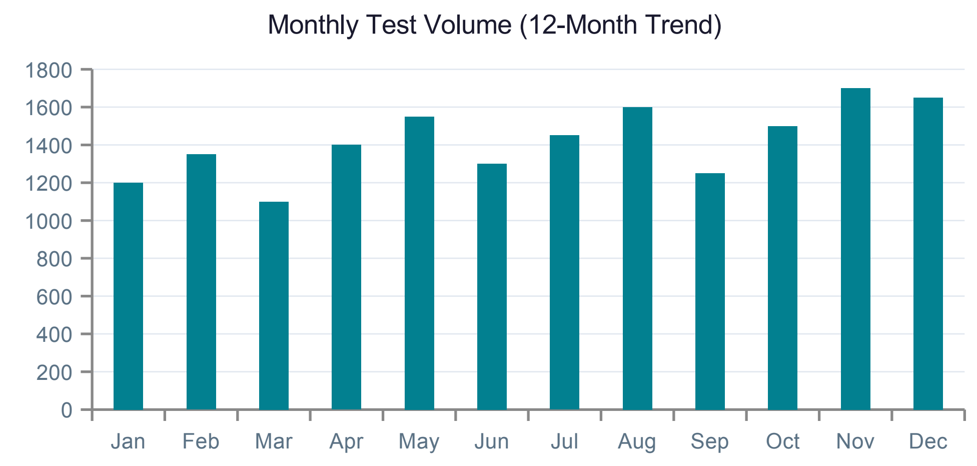
08 **Full Auditability**

Every query, metric use, and report is logged

FEATURE

Smart Dashboard

Immediate executive-level visibility into key laboratory indicators.



Sample visualization

Phase 1 Indicators

- Test volume (12-month trend)
- Turnaround time summary
- Rejection rate summary
- Backlog distribution
- Regional comparison

All backed by governed indicator definitions

FEATURES

Reports & Conversational Authoring

Saved Reports

Reusable, structured analytics that persist and can be shared.

- Save chat-generated insights as reports
- Pin reports to the dashboard
- Schedule delivery (future phase)
- Share within role scope
- Reports store query definitions and results

Conversational Authoring

Generate structured reports via natural language queries.

1. User asks a question in plain language
2. System validates intent and scope
3. RAG retrieves relevant schema and rules
4. AI generates a validated SQL query
5. Application executes SQL securely
6. Results displayed; user can save as report

FEATURE

Knowledge Assistance

AI-powered answers grounded in approved documentation — never in patient data.

Approved Data Sources

- Indicator definitions
- Business rules
- National SOP documents
- Metric documentation

Example Questions

"What is positivity rate?"

"How is turnaround time calculated?"

"What qualifies as backlog?"

Restrictions

No patient-level content indexed

No operational tables indexed

Only approved static documents

Privacy by Design

Zero PII exposure — enforced by forbidden columns, validation rules, and suppression thresholds.

Data Isolation

- LLM never accesses database
- Application runs all queries locally
- Guardrails ensure PII is never returned

Suppression Rules

- No group shown when n < 5
- Forbidden columns block all PII fields
- No facility data below threshold

Audit Logging

- User ID + timestamp
- Metric used + filters applied
- Report saved or not

Designed for national reporting and partner reviews — fully audit-ready.

SCOPE

Multi-Disease & Phase 1 Scope

Supported Disease Programs

- ✓ HIV
- ✓ TB
- ✓ EID
- ✓ Hepatitis
- ✓ Emerging Pathogens (as definitions are provided)

Architecture avoids hard-coded disease logic.

Extensible via new metric definitions.

Phase 1 Scope

INCLUDED

- VL support
- RAG knowledge corpus
- Dashboard + Saved reports
- Conversational authoring
- Knowledge assistance
- Privacy enforcement + Audit logging

EXCLUDED (FUTURE)

- Predictive modeling
- Cross-country benchmarking
- Alert automation

PROGRESS

What We’ve Already Built

Intelis Insights is not just a concept — foundational components are already in development.

VL Module (In Progress)

- Direct query pipeline to vlsm database
- RAG corpus pipeline (schema + rules)
- Privacy-enforced analytics schema
- Dashboard wireframes and indicators
- Conversational authoring prototype
- Audit logging foundation

What’s Next

- Complete VL dashboard with live data
- Knowledge assistance (approved doc search)
- Saved reports with sharing and pinning
- Multi-disease metric expansion
- Stakeholder validation and feedback loop

IN ACTION

From Question to Insight

Three examples of how a natural language question becomes an actionable report.

"Show TB positivity rate by district, last 6 months"

Bar chart: positivity rate per district, monthly trend. Saved as a pinnable report.

"What is the average turnaround time for VL tests this quarter?"

Summary card: average TAT with breakdown by lab. Exportable for partner reviews.

"How many samples were rejected last month, by reason?"

Stacked bar: rejection reasons by volume. Can be pinned to the national dashboard.

SUCCESS

Success Criteria

Zero PII Exposure

Patient names, IDs, and contact info are blocked by forbidden column rules

Consistent Metrics

Same indicator always produces the same result regardless of who runs it

Reusable Reports

Reports can be saved, shared, and pinned to dashboards across roles

Reduced Manual Effort

Significant reduction in time spent on manual reporting workflows

Multi-Disease Ready

System supports extension to new disease programs without code changes

Stakeholder Validation

Positive feedback from national program managers and lab stakeholders

PART TWO

Technical Deep Dive

Architecture, AI Model, APIs, and Implementation Details

ARCHITECTURE

System Architecture

1 User

2 Insights API

3 Intent Validation

4 RAG Context Retrieval

5 AI-Generated SQL

6 SQL Validation & Execution

7 Database (Read-Only Access)

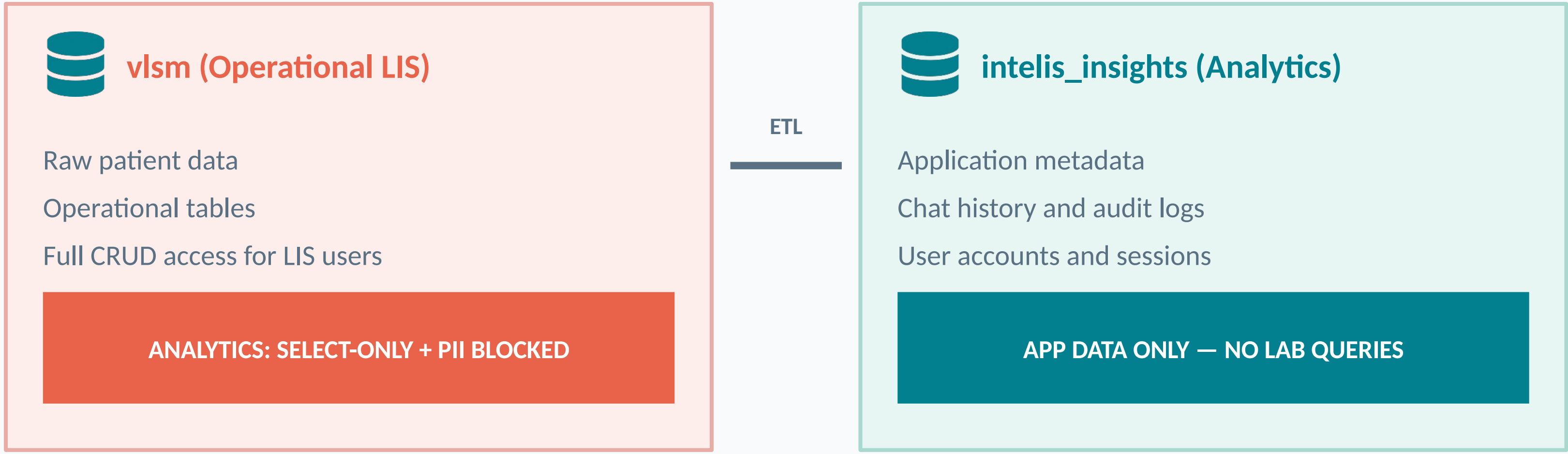
8 Dashboard / Reports / Chat Output

AI generates SQL only. The application validates, grounds, and executes all queries securely.

DATA MODEL

Data Boundary Model

Two logically separated databases enforce strict data isolation.



vlsm (Operational LIS)

- Raw patient data
- Operational tables
- Full CRUD access for LIS users

ANALYTICS: SELECT-ONLY + PII BLOCKED

ETL

intelis_insights (Analytics)

- Application metadata
- Chat history and audit logs
- User accounts and sessions

APP DATA ONLY — NO LAB QUERIES

Hard Rule: Analytics queries run against vlsm with SELECT-only access. Forbidden columns (patient names, IDs, contacts) are hard-blocked from all queries.

AI Integration Model

AI generates SQL queries — the application controls database execution.

AI Is Used For

- Clarifying user intent
- Generating validated SQL queries
- Grounding answers in approved documentation
- Recommending chart types
- Optional narrative summaries

AI Is NOT Used For

- Directly accessing the database
- Accessing patient data
- Overriding privacy suppression rules

AI components are modular and optional — the system works without them.

GROUNDING

RAG-Grounded Query System

AI-generated SQL is grounded by RAG retrieval of approved schemas, business rules, and query patterns.

RAG Snippet Types

- `Table & column definitions`
- `Business rules & thresholds`
- `Terminology synonyms`
- `Example query patterns`
- `Clinical threshold rules`

Grounding Validates

Tables Used

Every table in SQL must exist in the allowlist

Column Access

Every column must exist in the schema

Privacy Rules

No forbidden columns (patient names, IDs, etc.)

SQL Syntax

Valid MySQL syntax verified before execution

Business Rules

Domain-specific rules applied (e.g., VL thresholds)

Audit Trail

Every query and its grounding sources are logged

KNOWLEDGE

RAG Knowledge System

How RAG (Retrieval-Augmented Generation) grounds AI-generated SQL in approved knowledge.

Two Knowledge Sources

Schema & Business Rules

Table definitions, column descriptions, business rules, clinical thresholds, and terminology mappings. Indexed as vector embeddings in Qdrant.

Query Patterns & Corrections

Successful query examples and user-corrected mappings. The system improves SQL accuracy by retrieving similar past patterns.

How It Works at Query Time

When a user asks a question, the system searches both sources for the most relevant definitions and past patterns — filtered by the user’s country and access level. Only approved, non-patient content is ever retrieved.

API

API Specification Overview

Insights API (Slim PHP) • JWT Authentication • JSON Responses • Paginated Endpoints

Endpoint Group	Key Endpoints	Purpose

Chat / Query	`/v1/chat/validate-intent`
	`/v1/chat/plan`
	`/v1/query/execute`
	`/v1/chart/suggest`
		Intent validation, query planning, execution, chart recommendation

Reports	`/v1/reports (CRUD)`
	`/v1/reports/{id}/pin`
	`/v1/reports/{id}/unpin`
		Create, read, update, delete reports; pin/unpin to dashboard

Dashboard	`/v1/dashboard` `/v1/dashboard/layout`	Get widgets, pinned reports, update layout

Memory	`/v1/memory`
	`/v1/memory/success`
	`/v1/memory/failure`
	`/v1/memory/reindex`
		Store/retrieve interaction patterns; admin reindex

SECURITY

Roles & Adaptive Learning

User Roles & Access Control

National Admin

Full access across all programs

Regional Manager

Regional data within programs

Lab Manager

Lab-specific data

Viewer

Read-only dashboard access

Controls: disease visibility, regional scope, report access, dashboard modification

Adaptive Learning (Optional)

A governed memory layer that improves query accuracy over time.

- Stores successful query patterns
- Captures failed/corrected mappings
- Country-specific terminology
- User must explicitly opt-in
- No raw data or queries stored
- Admin can review/delete/export

FUTURE VISION

LIS-Agnostic Architecture

The Insights Engine will eventually operate independently of any specific LIS.

1

External LIS

Any source system

2

Adapter Layer

Data connectors (ETL, FHIR, CSV, API)

3

Normalized Schema

Governed analytics contract

4

Insights Engine

This platform

Phase 1 is Intelis-native but avoids hard-coded assumptions — ensuring future portability to any LIS.

Intelis Insights

Governed analytics that protect privacy,

standardize metrics, and empower decisions.

Privacy-First

Open Source

Multi-Disease

Thank You