

PulseSG AI-ECG STEMI Detection Network

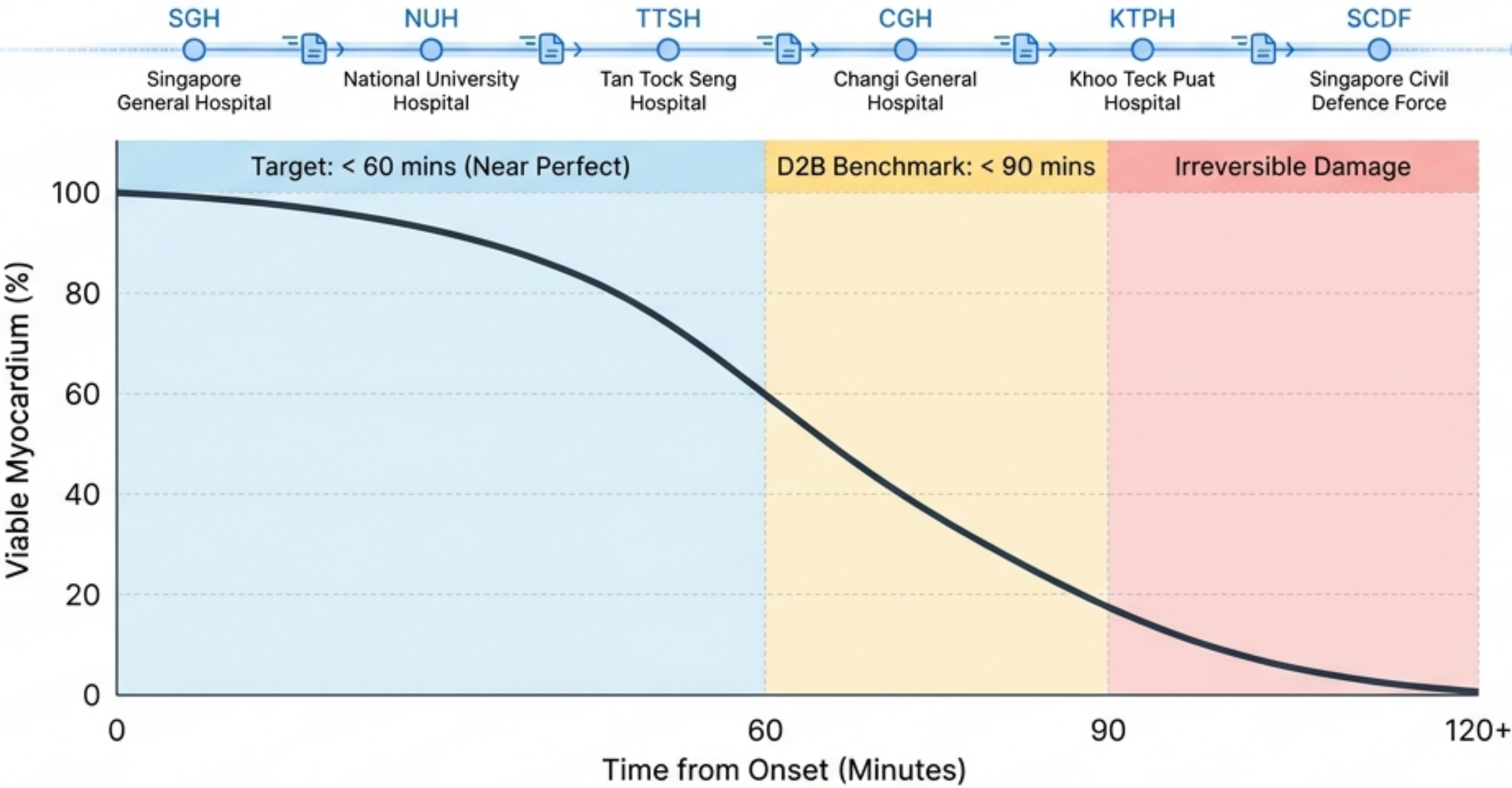
Singapore's Governed Clinical AI Orchestrator

Every Beat Counts. Every Minute Matters.



Diagnostic delay at 3 AM dictates permanent myocardial loss

The Heart Muscle Decay Curve



The Core Problem

Cardiologists cannot be everywhere instantly.

Without live AI triage at the point of ECG capture, critical minutes are lost waiting for human routing.



Clinical orchestration requires a foundation built on systemic trust

Speed

Regulator-Cleared AI

- Demonstrates TRUST through external validation.
- Live model versioning and explainability.
- Not just raw predictions; calibrated clinical confidence.

Agency

Human-in-the-Loop

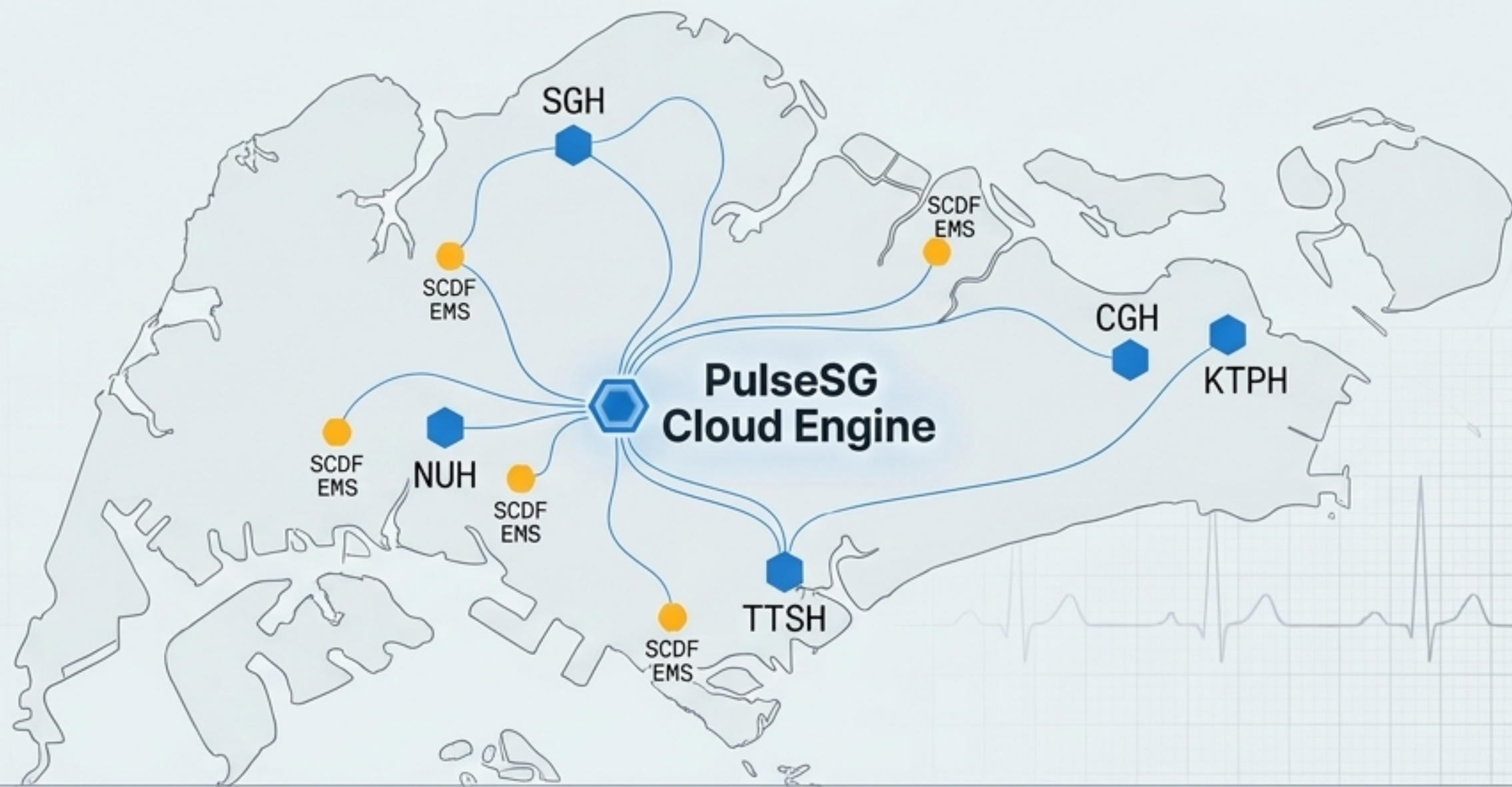
- Empowers ACTION by drafting precise escalations.
- Pre-compiles patient context and summaries.
- Strictly restricts 'SEND' authority to human physicians.

Accountability

Audit-Grade Governance

- Ensures LOGGING of every micro-action.
- Tracks configuration changes and human decisions.
- Regulator-defensible, PDPA-aligned framework.

A unified neural network connects Singapore's primary acute care nodes



INGESTION

Ambulance & ED ECGs

React/TypeScript frontend,
WebSocket live updates

INFERENCE

LSTM-based AI engine

Externally validated AUC
0.987 / 0.967, HSA-cleared

FastAPI,
TimescaleDB,
pgvector RAG

OUTPUT

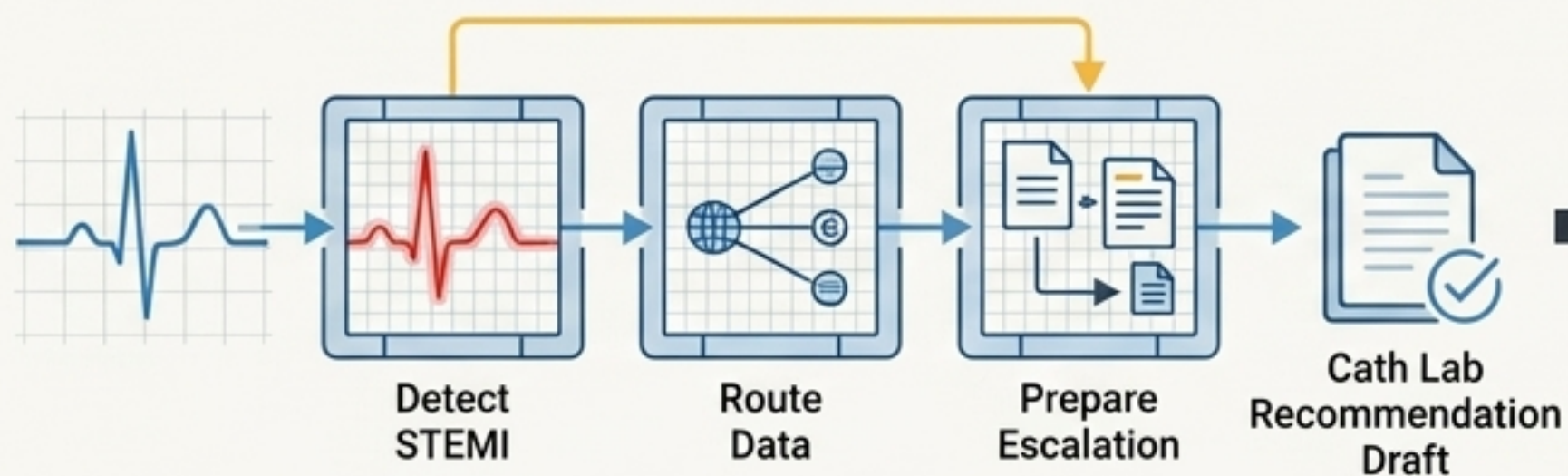
SMS + App link routing

Targets active on-call
cardiologist roster

Agents assemble the draft; physicians authorize the deployment

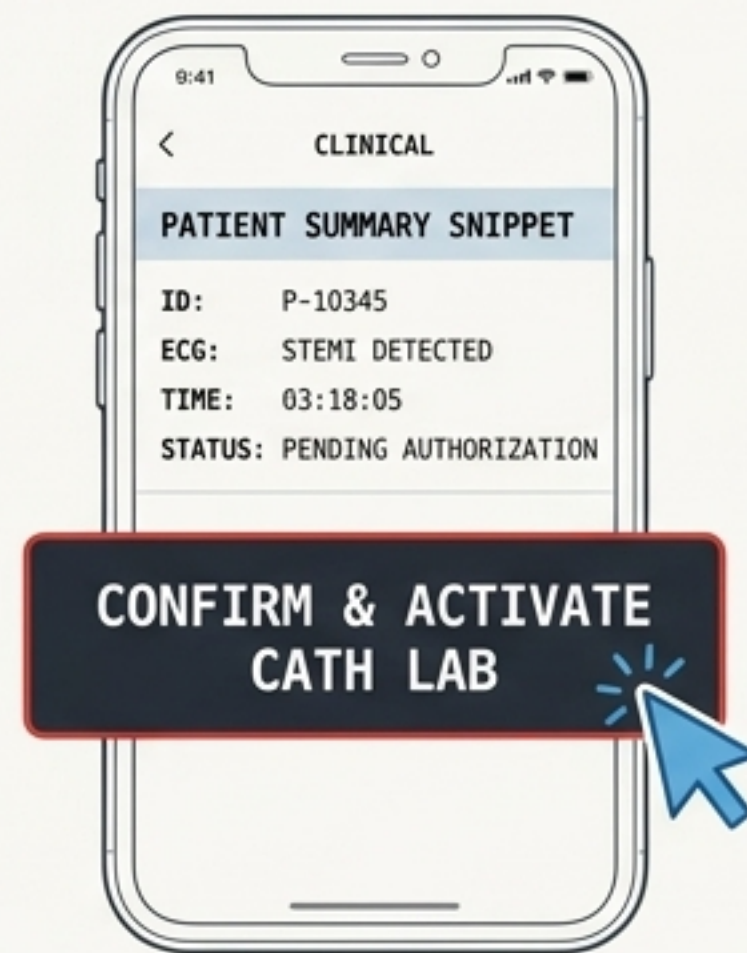
SYSTEM CONSTRAINT: Operations strictly follow a “Draft to Send” paradigm.

The AI Draft Assembly



The AI acts as an advanced **cognitive filter**, preparing the exact protocol.

The Human Gatekeeper



Only an authenticated **physician** possesses the **systemic authority** to execute the final activation.

Orchestration replaces linear pager chains with parallel processing

	Traditional STEMI Workflow	PulseSG Orchestration
Diagnostic Speed	Minutes to hours, waiting for visual review.	Milliseconds at the point of ECG capture via LSTM.
3 AM Cognitive Load	High: manual chart digging, fragmented calls.	Low: structured SMS + App link with pre-compiled patient context.
Error Handling	Opaque: missed STEMI's lost in retrospective audits.	Transparent: live feedback loops tag false positives for instant model retraining.
Systemic Memory	Episodic: relies on individual doctor experience.	Semantic: agents remember rejected suggestions and never repeat them.

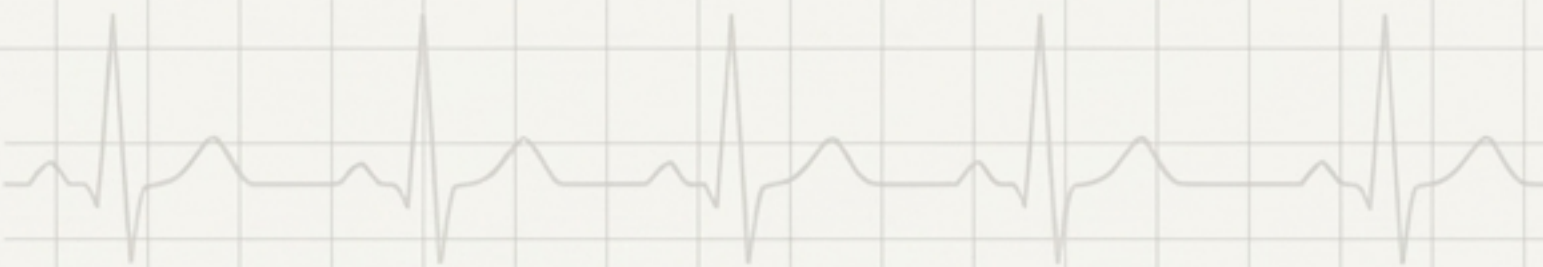
A specialized fleet of five agents manages the clinical lifecycle



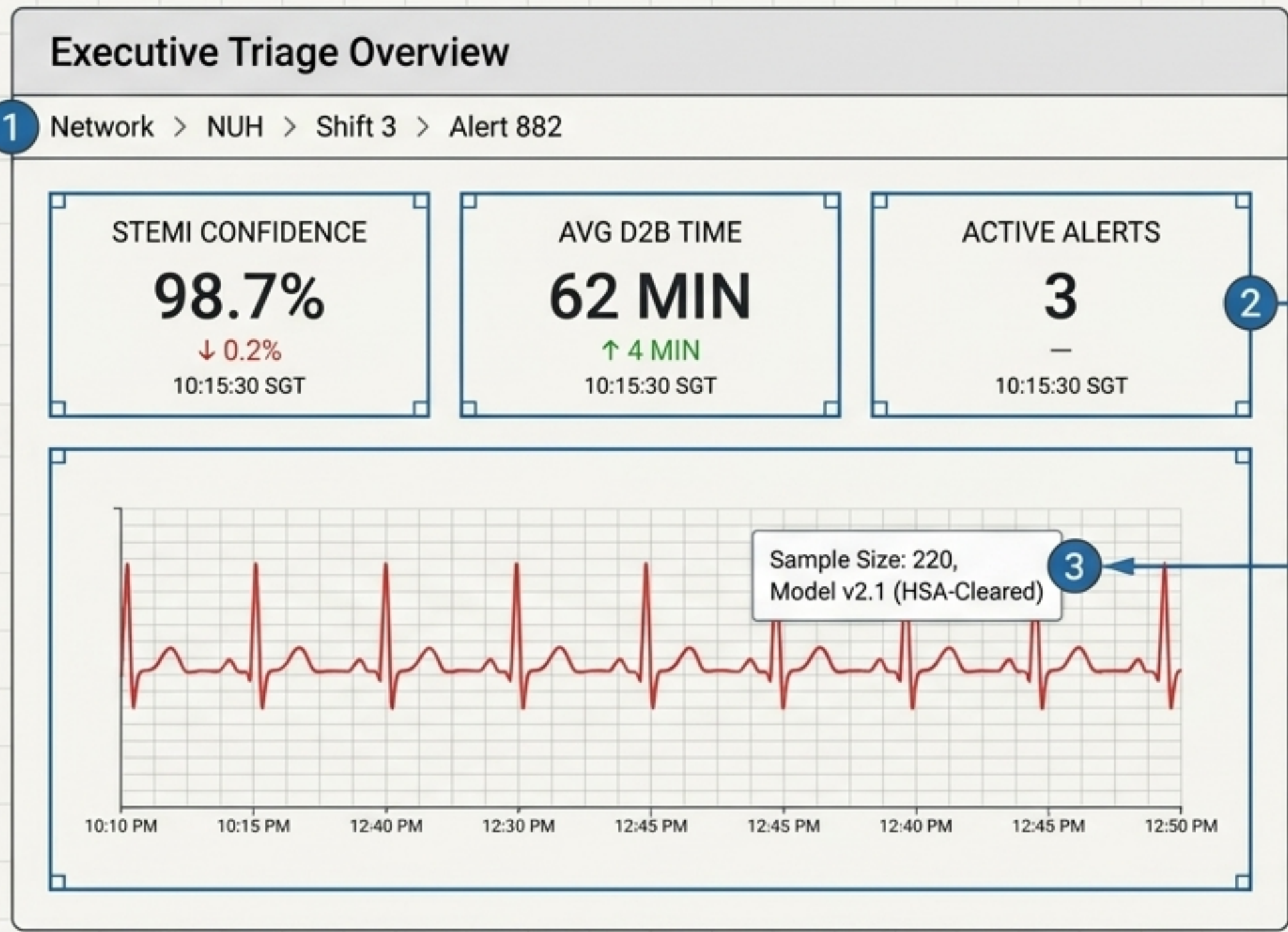
Agent Fleet Directory

A1		Alert Triage UUID: 8f7e-4b2a	Detects STEMI patterns and routes alerts to the correct on-call roster. ● RUNNING
A2		Performance Analyst UUID: 3c9d-1f4b	Continuously tracks network D2B bands (90m/60m) in real-time. ● RUNNING
A3		Forecaster UUID: 7e2a-9c5d	Predicts volume surges based on historical data, weather patterns, and seasonality. ● RUNNING
A4		Recommender UUID: 5b1d-8e4f	Suggests workflow optimizations and identifies systemic bottlenecks. ● RUNNING
A5		Chatbot UUID: 2a8c-6d3e	Enables natural language querying of network data for superintendents. ● RUNNING

The executive interface delivers definitive clinical context in under five seconds



Drill-Down Architecture
Interactive topology supports infinite drill-down:
Network -> Hospital -> Shift -> Individual Alert.



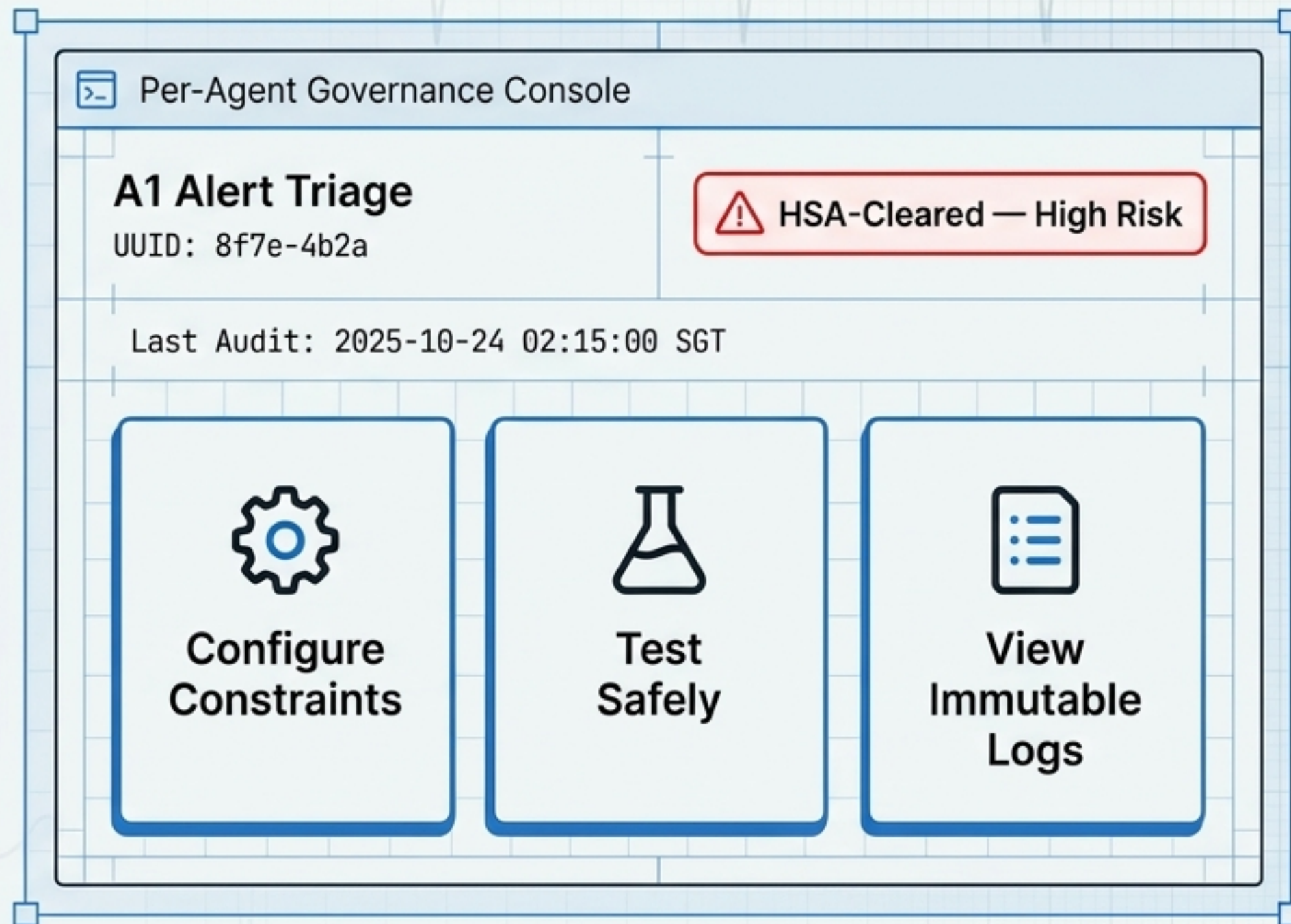
KPI Context Cards
Every metric displays absolute value, delta vs. previous period, benchmark band, and a live data-freshness timestamp.

First-Class AI Provenance
Hover tooltips on every chart reveal sample size, data origin, and specific model version (e.g., v2.1 HSA-Cleared).

Regulatory compliance and observability are embedded directly into agent administration

The Governance Philosophy

- Security is not an external audit; it is a first-class dashboard feature.
- Every agent operates under an immutable UUID and strict audit timestamps.
- The interface restricts all interaction to three auditable pathways.



Agent modifications require multi-signature approval and adversarial testing



HARD RULE: The “Run” protocol remains **cryptographically disabled** until multi-signature consensus (Clinical Lead, CISO, Privacy Officer) is logged.

Configuration Ruleset



Scheduling & Routing



RBAC Security (PII Redaction, LLM Firewalls)



Knowledge Config (Versioned Prompts, RAG)



Guardrails & Risk Tiers



Multi-Sig Approvals (Pending)

Pre-Flight Testing Sandbox

> Test Scenario: Adversarial Prompt Injection
> Result: BLOCKED (LLM Firewall Active)
> Compliance Flags: None (PII Redacted)
> Latency: 340 ms



RUN: DISABLED (Pending Multi-Sig Approval)

Immutable audit trails and two-tier memory ensure systemic evolution

Audit-Grade Logging

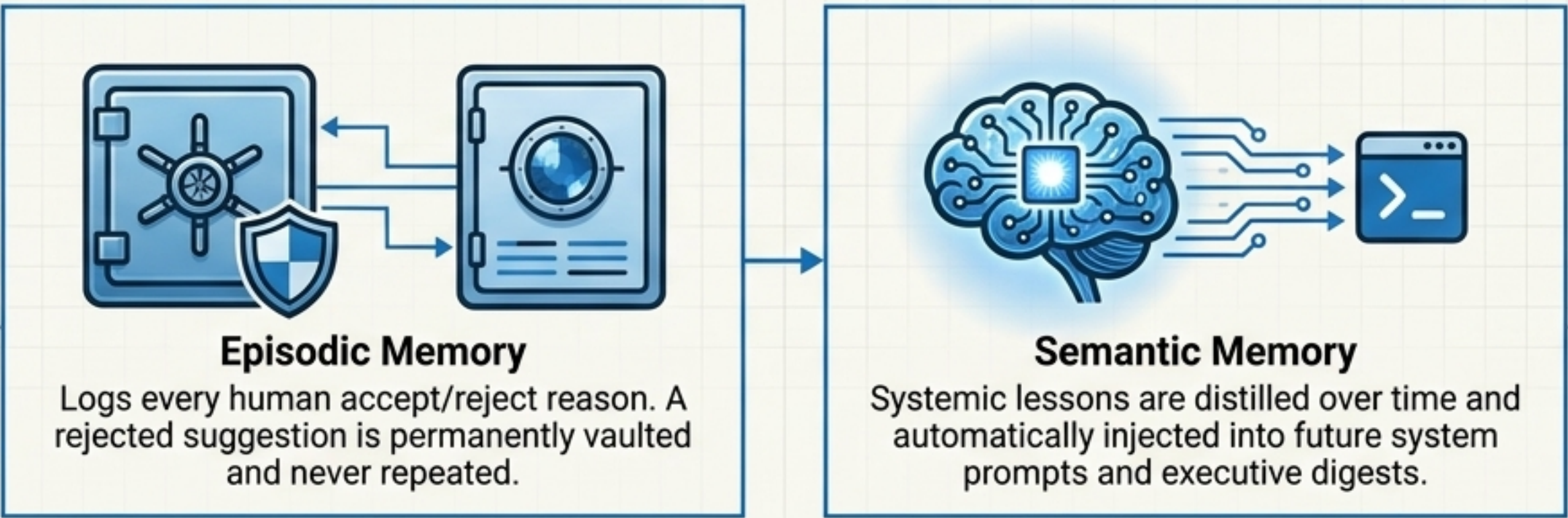
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{
  "timestamp": "2025-10-24T14:23:09Z",
  "action": "alert_routed",
  "agent_uuid": "8f7e-4b2a-...",
  "pii": "REDACTED",
  "priority": "HIGH",
  "outcome": "PENDING_REVIEW",
  "signature_hash": "e4d9...",
  "doc_id": "SYS_AUDIT_V7.2"
}
```



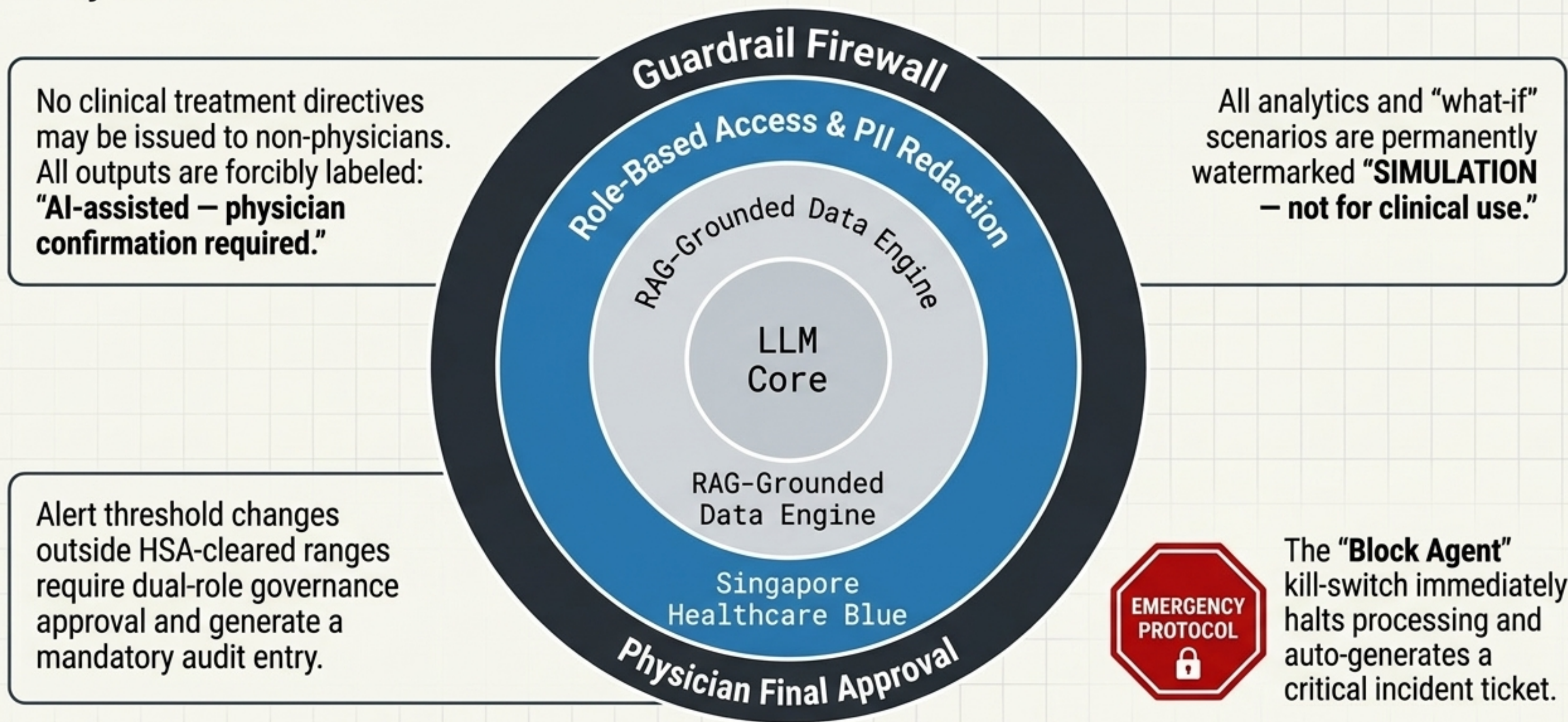
SHA-256 Integrity Hash

PDPA-aligned data minimization.
PII is redacted/hashed by default.
Exportable to hospital SIEMs.

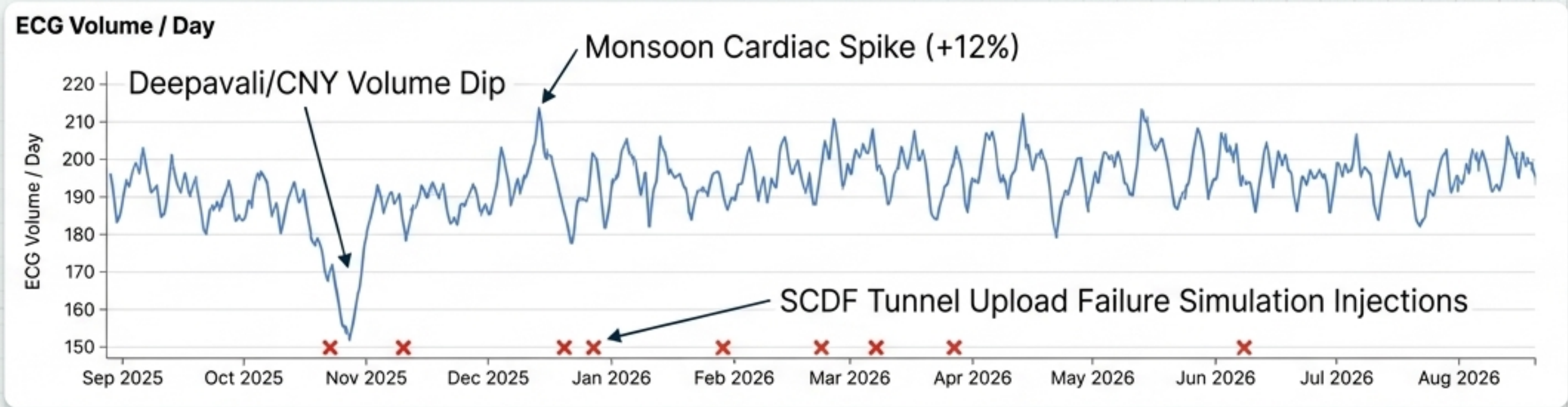
The Two-Tier Memory Brain



Uncompromising clinical guardrails govern all systemic behavior



The data engine is stress-tested against the chaotic reality of clinical operations



Singapore-Tuned Realities	Adversarial Robustness
- Site Mix: SGH 30%, NUH 22%, TTSH 20%, CGH 15%, KTPH 8%. - Scales SCDF EMS pre-hospital routing from 5% to 15%. - Accurately models MOHH on-call roster shifts & Monday peaks.	- Injects 3-5% data-transfer tunnel failures. - Injects missing-value corruption. - Overlays 8% arrhythmias (AFib, LBBB) to verify stability.

Superintendents interrogate the network using natural language

The Query

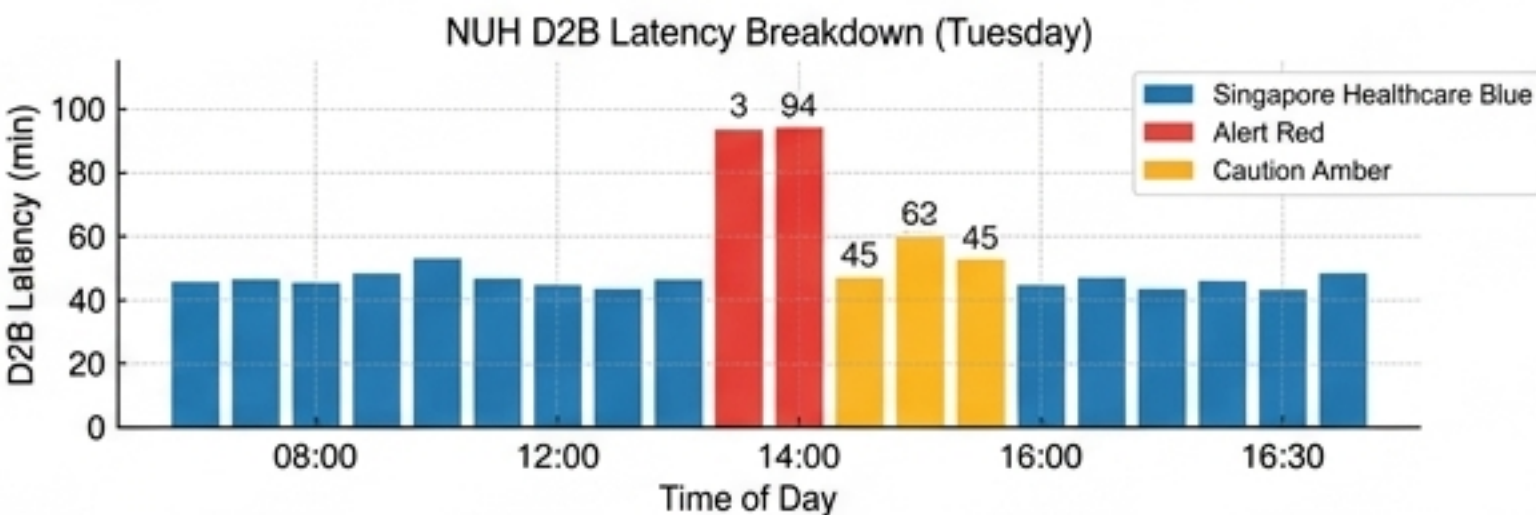
Why did NUH D2B times spike last Tuesday?

Designed for operational oversight without complex query languages.

Explicitly deflects requests for individual clinical advice.

The Grounded Output

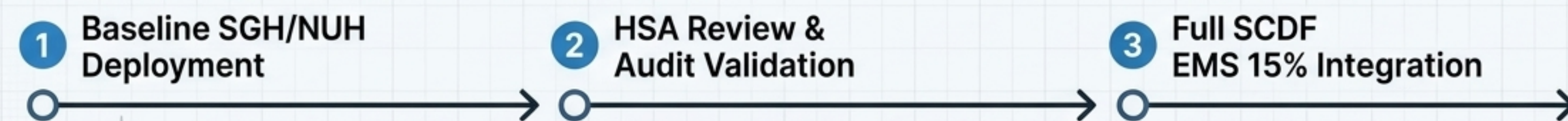
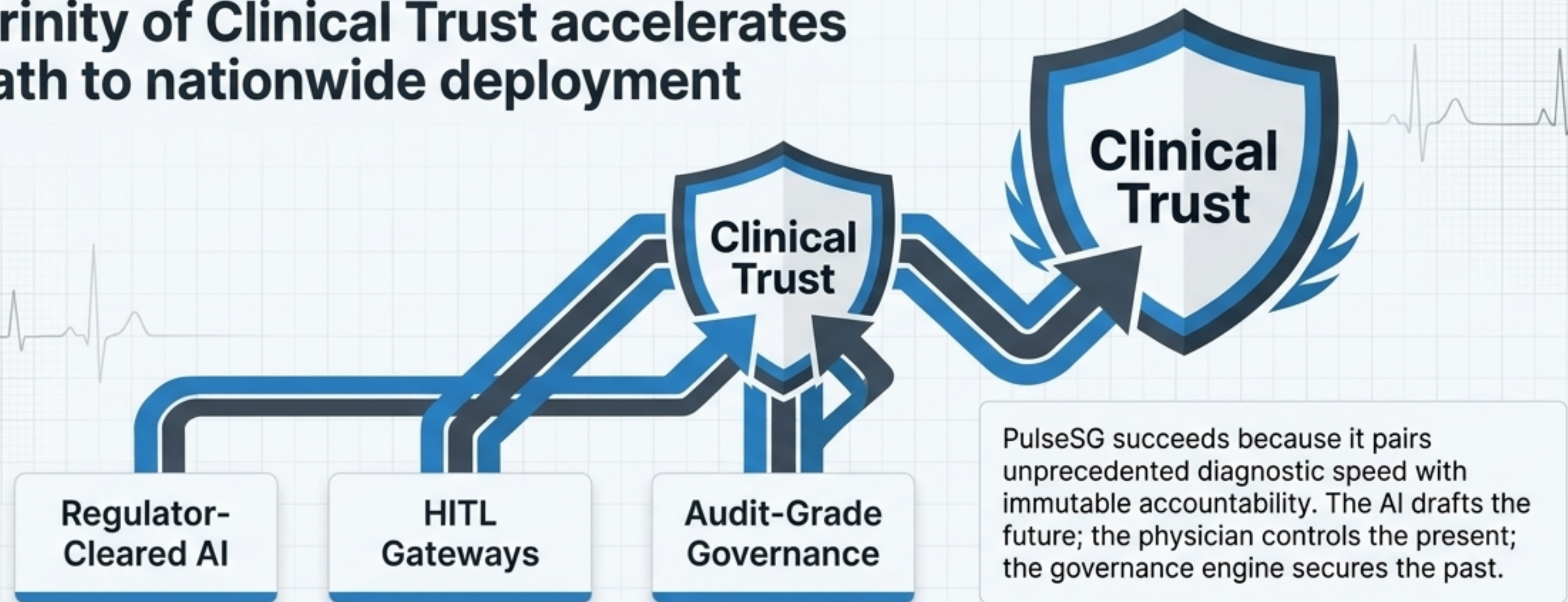
PII MASKED. RAG-GROUNDED TO PLATFORM METRICS ONLY.



NUH D2B latency on Tuesday experienced a temporary spike to 94 minutes, exceeding the 90-minute threshold, attributed to 3 cases delayed by simultaneous STEMI presentations at 14:00. Response times returned to baseline (45 minutes) by 16:30. Full audit trails are available.

Capable of drafting complex weekly quality reports in seconds, with full data traceability.

The Trinity of Clinical Trust accelerates the path to nationwide deployment



Status: Dashboard architecture, agent prompt datasets, and QA testing matrices are finalized and ready for regulatory submission.

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