

Intelligent Pharmacy Management Dashboard

AI-Augmented Operations for
Singapore Public Healthcare Clusters



Zero-Trust Verification

AI assists; humans dictate high-risk actions.

High-stakes clinical operations require mandatory human sign-off.

Explainable AI

Every prediction exposes its reasoning chain.

No black boxes—only verifiable decision paths (e.g., SHAP values).

Zero Preventable Shortages.
Zero Preventable Waste.

Progressive Disclosure

Information flows logically:

Signal → Evidence → Action.

Prevents cognitive overload during crisis management.

Role-Based Cognition

Tailored cognitive loads.

Seamless perspective shifts from **Ward Pharmacist** (dispensing) to **Supply Chain Director** (macro-inventory).

Mission Control (Tab 0)

INVENTORY HEALTH



8.2x/yr

Cluster average: 7.1x | National target: >6x

DISPENSING ACCURACY



99.7%

Target: 99.5%

SHORTAGE RISKS



3 Critical

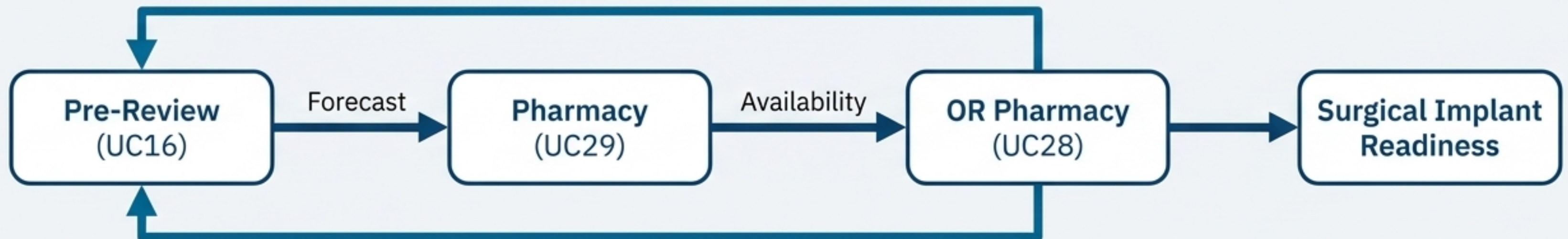
Piperacillin-Tazobactam: 12 days | Oseltamivir: 8 days

COST AVOIDANCE



\$127,340

This month

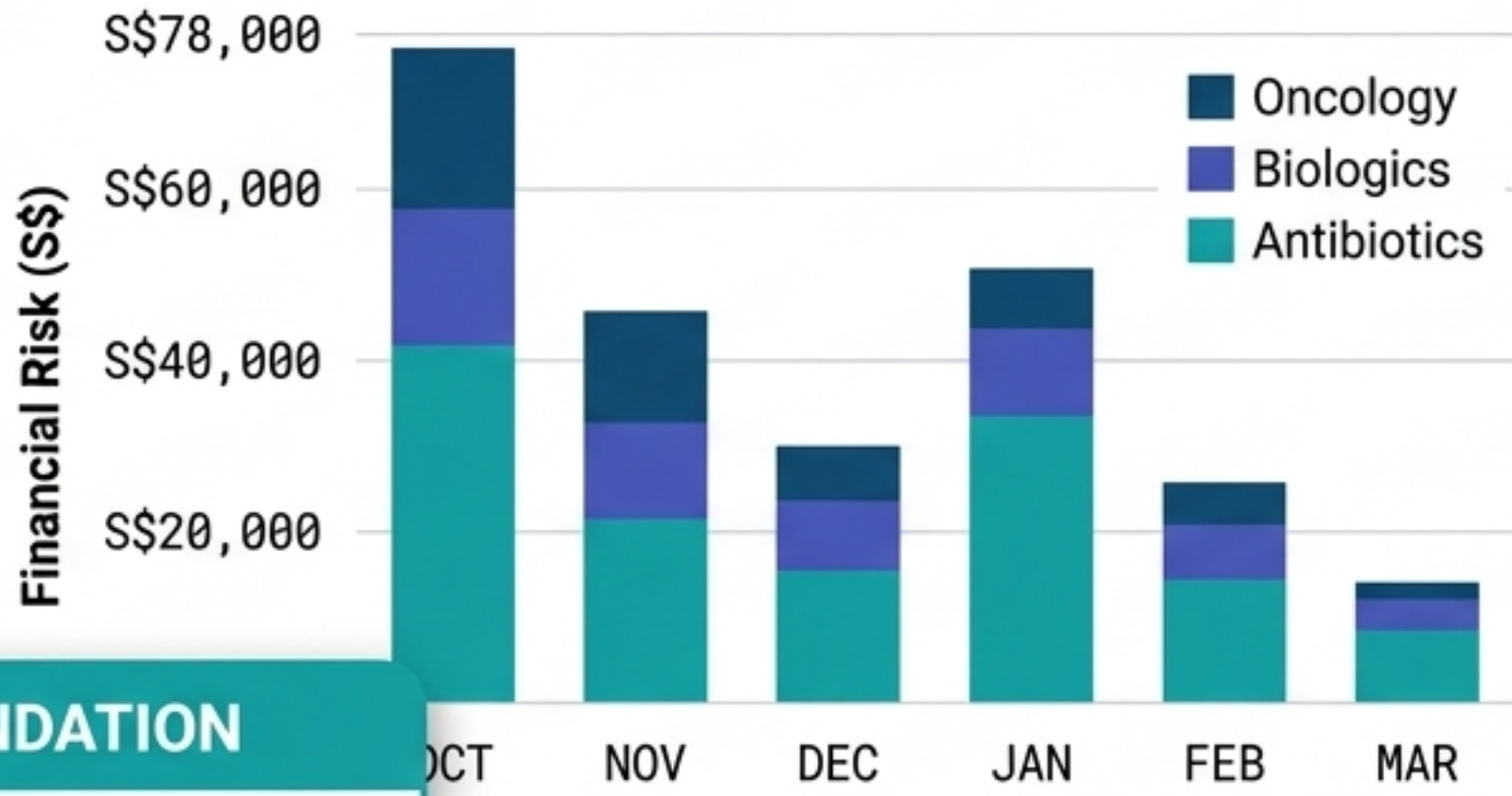


Inventory Command & Expiry Intelligence

Inventory Heatmap

	ICU	Ward 4A	OR
Piperacillin-Tazobactam	8 DOH	45 DOH	12 DOH
Vancomycin	30 DOH	45 DOH	30 DOH
Fentanyl Citrate	30 DOH	14 DOH	12 DOH
Propofol	7 DOH	45 DOH	12 DOH
Ceftriaxone	30 DOH	12 DOH	30 DOH
Insulin Glargine	> DOH	45 DOH	
Enoxaparin Sodium	30 DOH	12 DOH	
Midazolam	7 DOH	7 DOH	
Norepinephrine	8 DOH	7 DOH	
Amiodarone	12 DOH	4 DOH	

Expiry Risk Waterfall



AI RECOMMENDATION

[HIGH IMPACT] Transfer 200 vials Piperacillin-Tazobactam from Ward 4A to ICU.

Rationale: Ward 4A has 45 DOH; ICU has 8 DOH. Both expire in 180 days.

Outcome: Prevents S\$12,000 in potential shortage procurement.

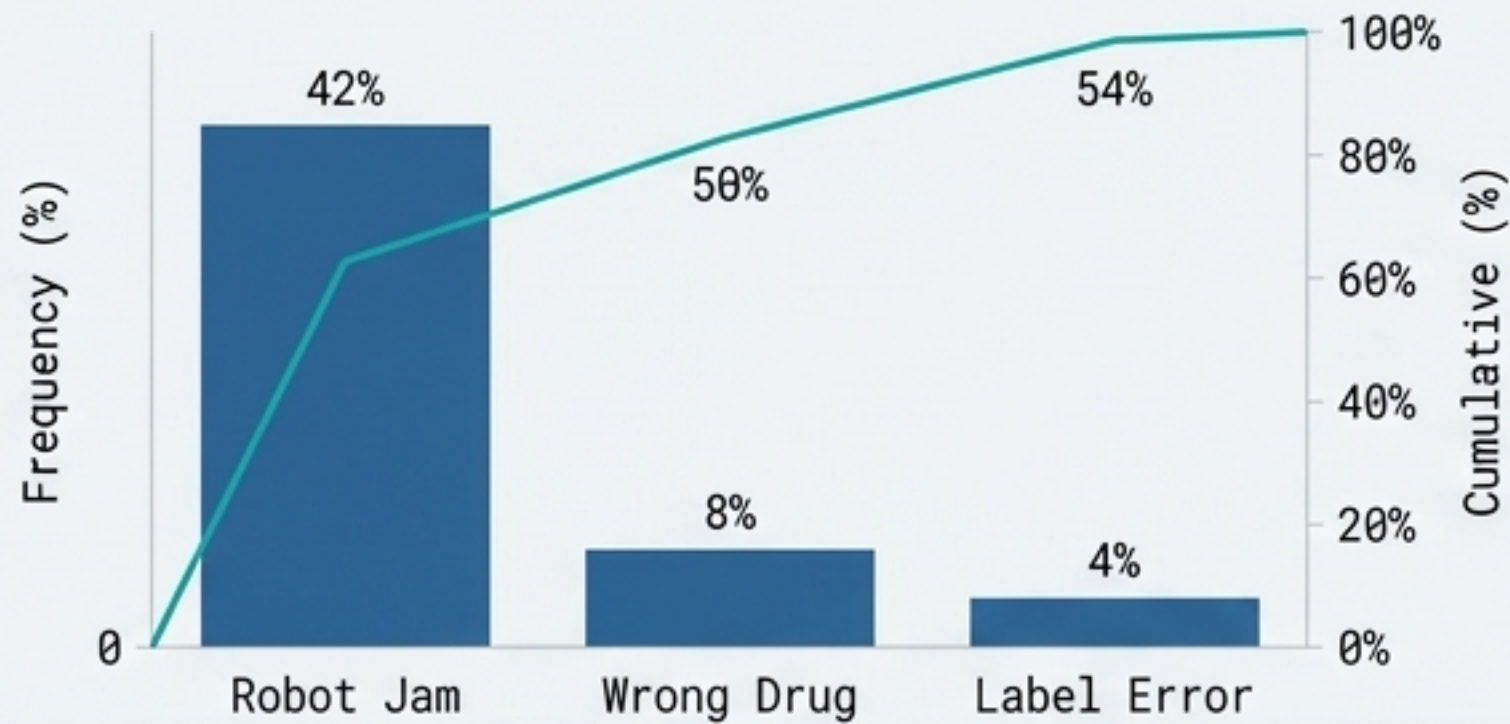
[Approve]

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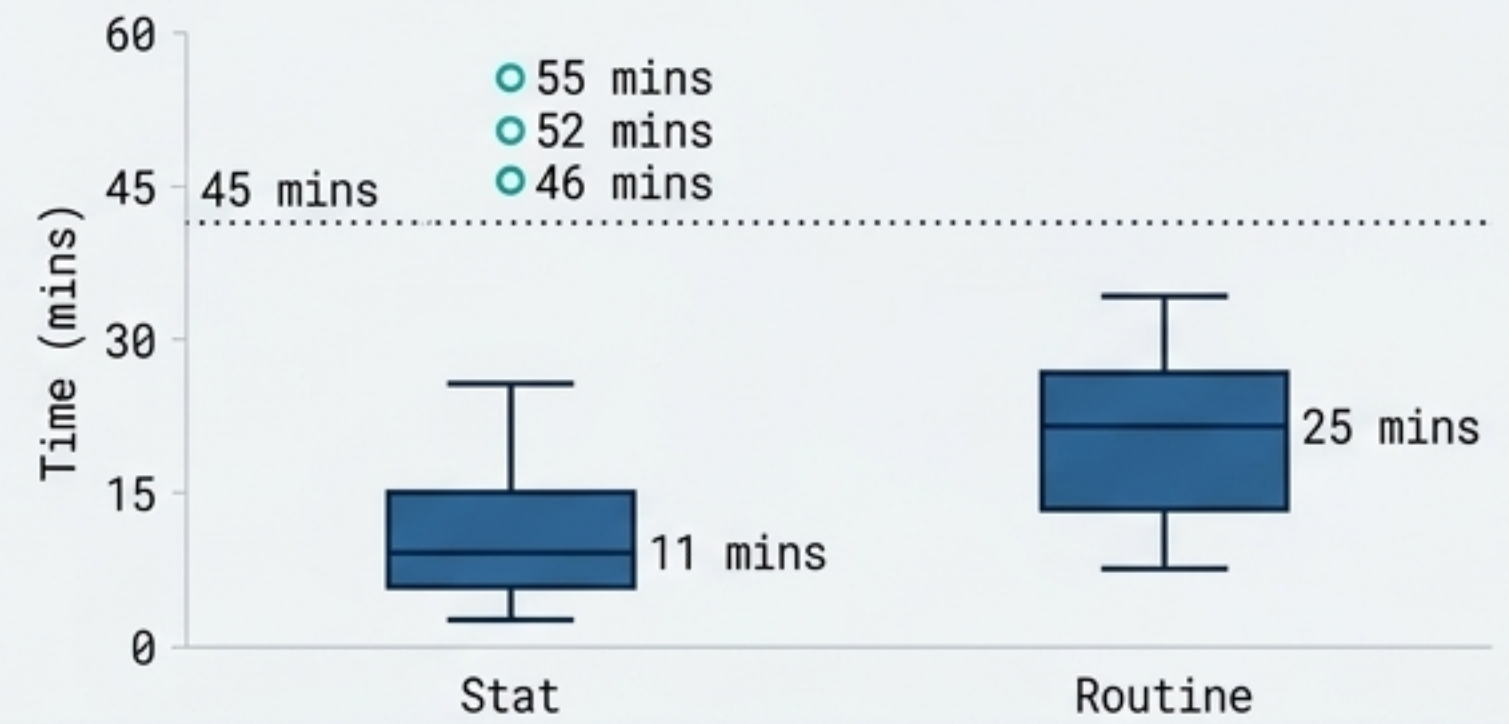
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Dispensing Analytics & Robotic Fail-Safes

Error Pareto Chart



Turnaround Time Box Plot



Lessons Learned

AI DIAGNOSTIC INSIGHT: ROBOT 2

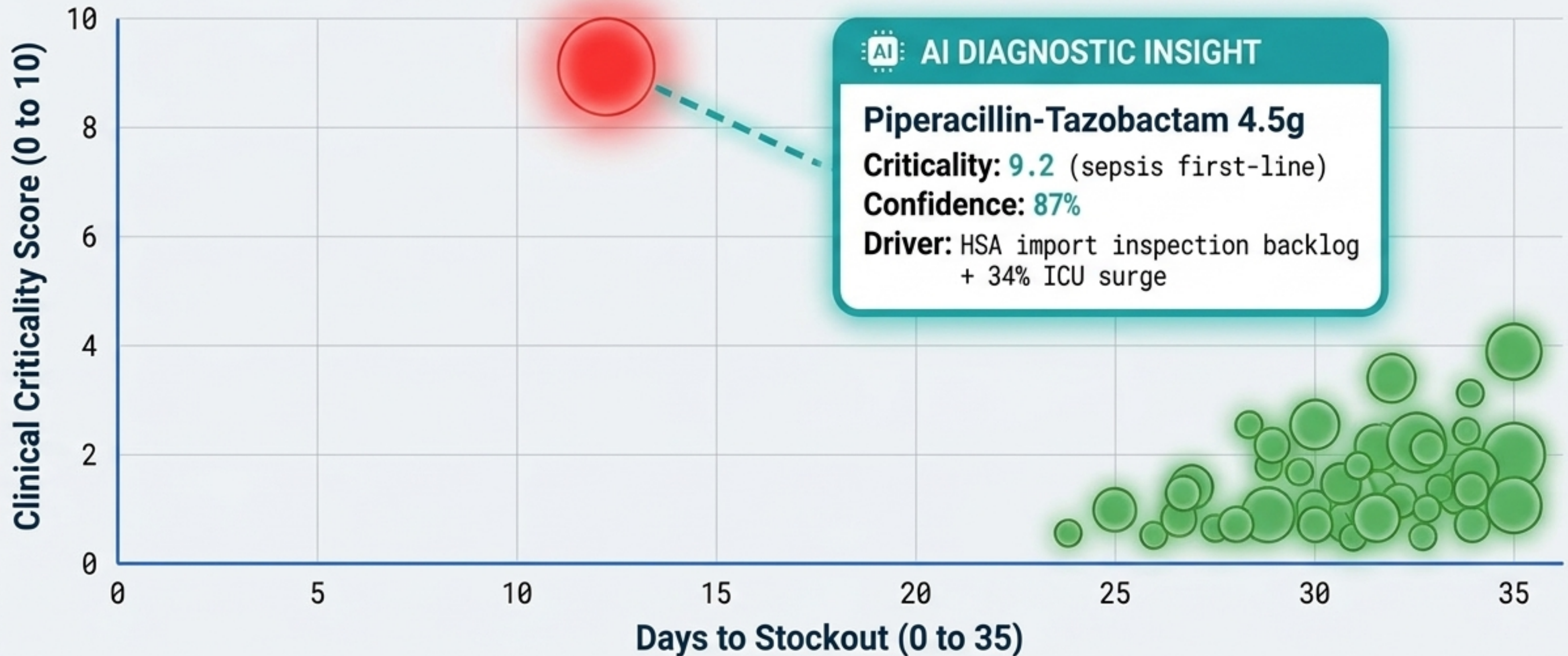
Failure Mode: Spiked by 8 jam incidents today.

System Correlation: AI detects a **0.72 correlation** between label adhesion failures and rising ambient humidity.

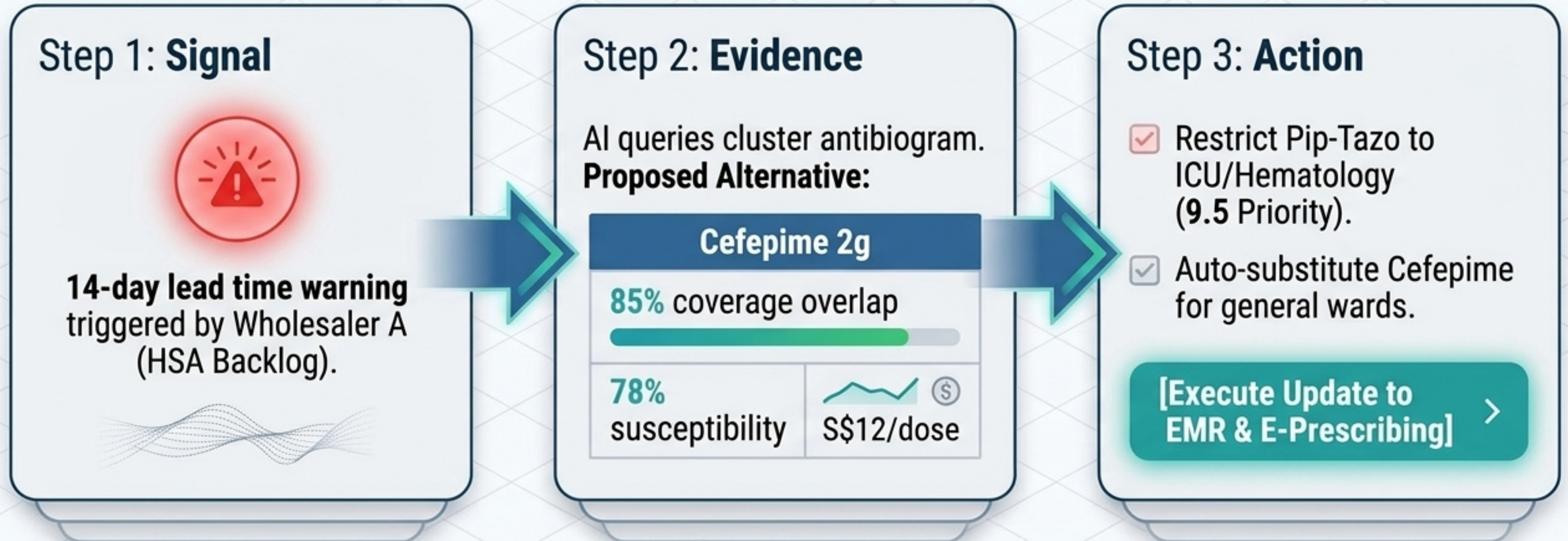
Proactive Response: Automatically triggering **dehumidifier maintenance ticket** before patient impact occurs.

The Shortage Triage Quadrant

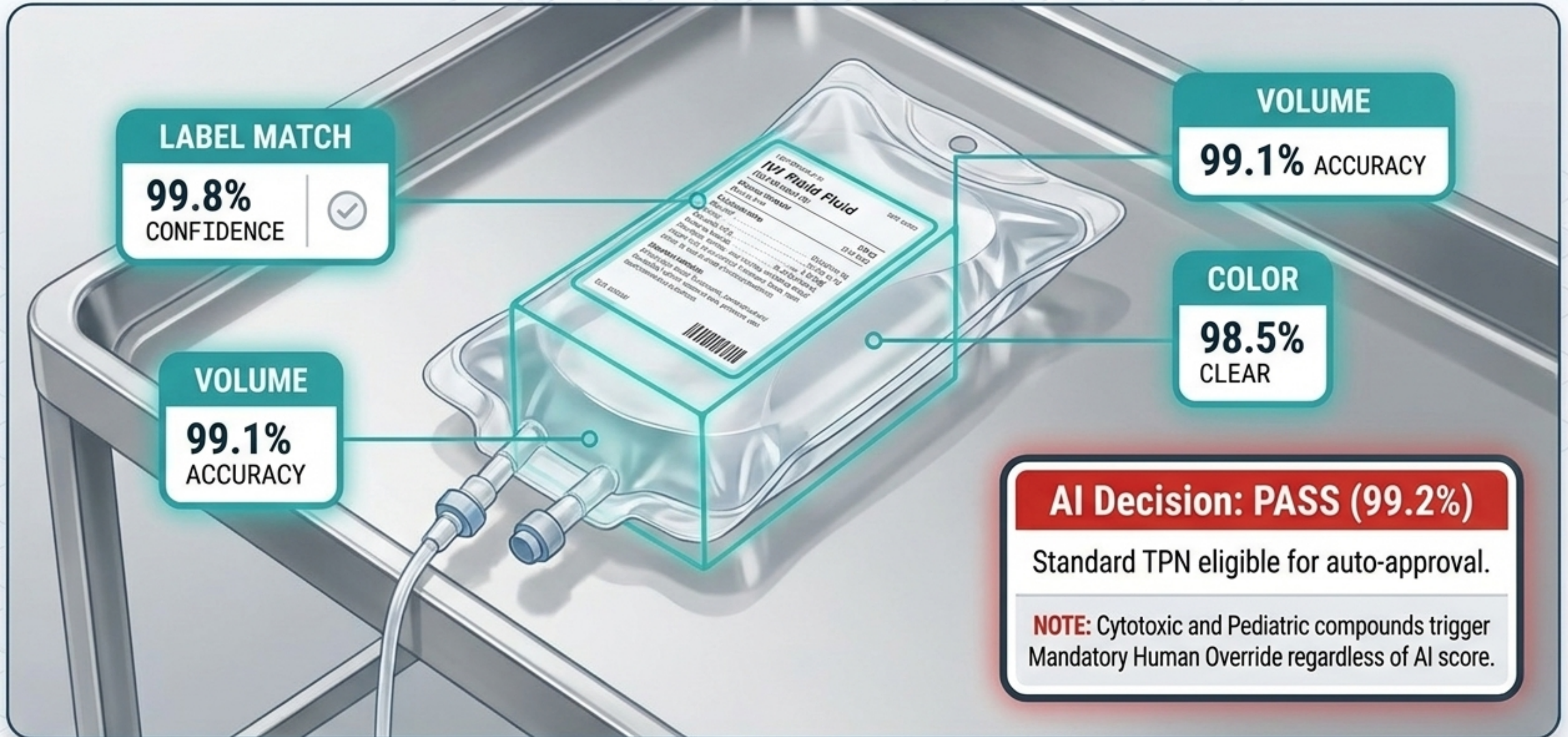
Shortage Triage Quadrant



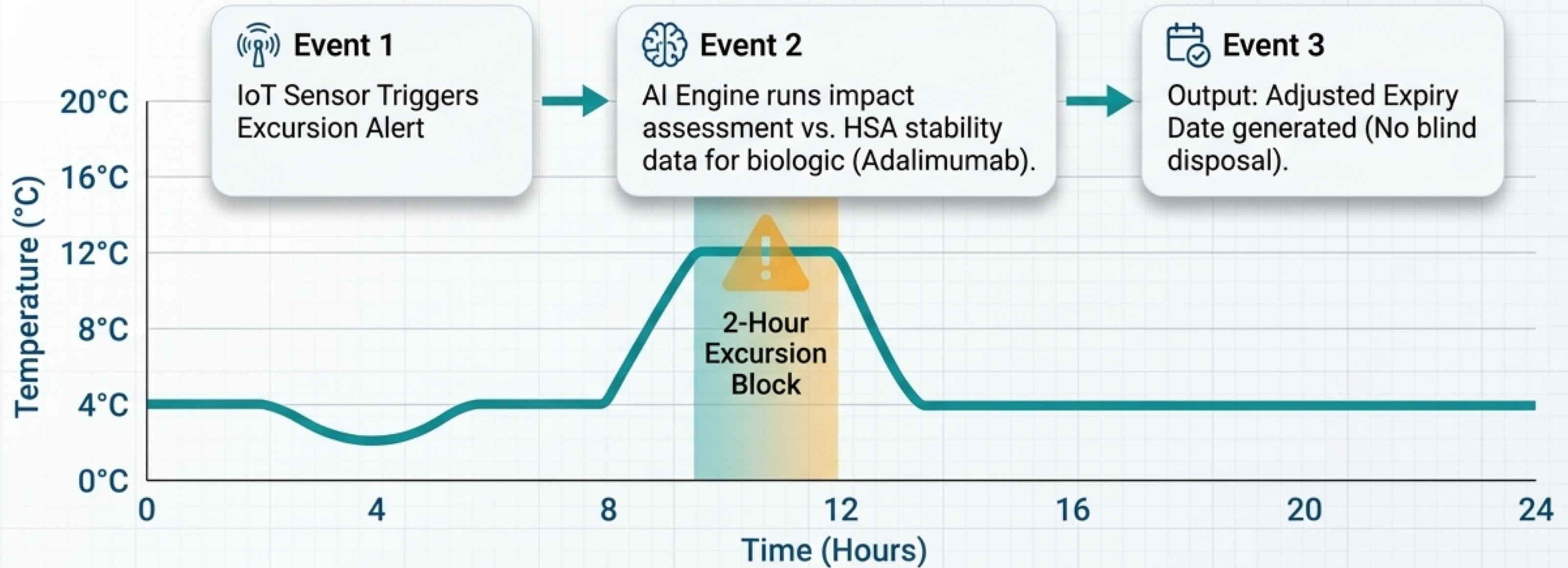
Transparent Allocation & Mitigation



AI Compounding Verification



Cold Chain & Biologics Intelligence



Summary of Action

Original expiry: **15-Dec.** 📅

Adjusted to: **01-Dec** due to 2-hour excursion at 12°C.

✅ Outcome: S\$28K in high-value stock salvaged safely.

Financial Optimization & Compliance

Generic Utilization



⚠ Paediatrics lagging at 79% (Opportunity S\$4,200/mo via taste-masking protocol)

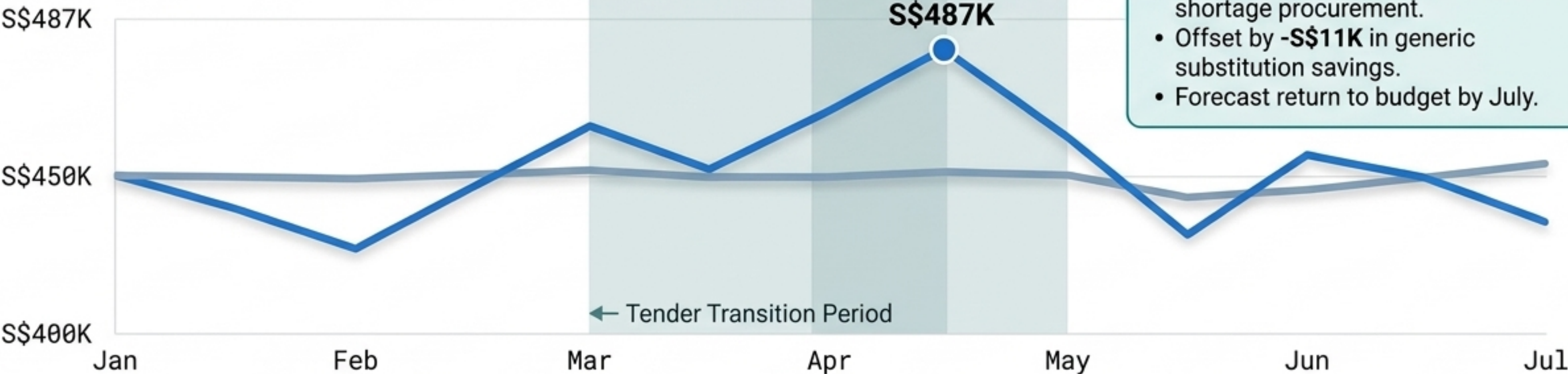
MOH Tender Adherence

99.1%



Cost Trend Chart

— Actual Spend — Budget



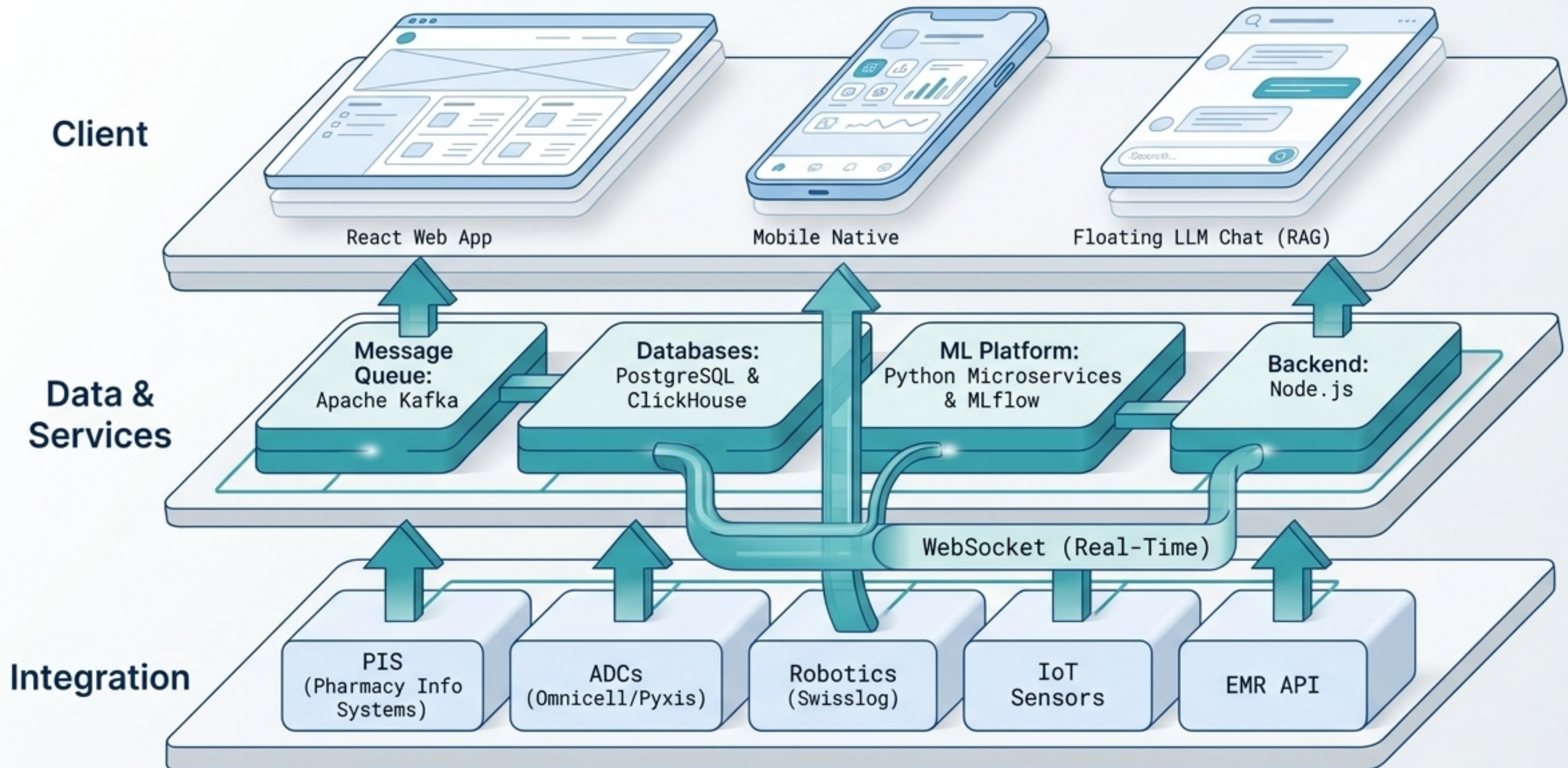
AI Context Box

- Variance **+S\$37K** driven by emergency shortage procurement.
- Offset by **-S\$11K** in generic substitution savings.
- Forecast return to budget by July.

The AI Engine Room

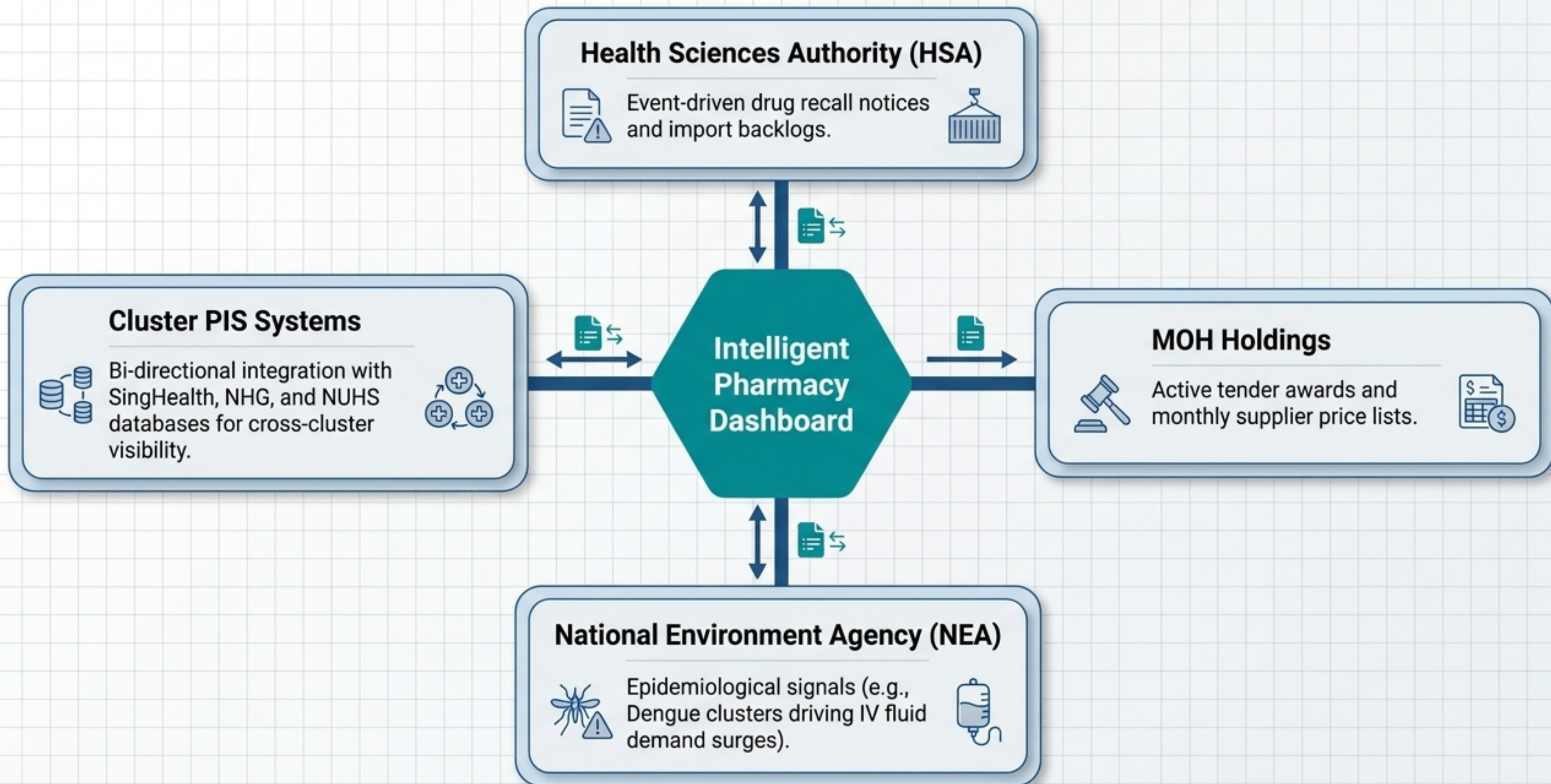
Model Function	Algorithm Architecture	Key Inputs	Output & Explainability Method
Demand Forecasting	Ensemble (Prophet + XGBoost + LSTM)	3-yr history, ward census, flu/dengue signals	30-day forecast. SHAP values show top 5 driving features.
Shortage Prediction	XGBoost + Survival Analysis	Global shortage signals, supplier lead time	Probability of stockout. Decision path visualization.
Compounding Verification	Computer Vision (CNN) + OCR	Live camera feed, Master Formula Record	Confidence scores. Bounding box overlays.
Generic Substitution	Knowledge Graph + Rule Engine	EMR patient context, cluster antibiogram	Ranked alternatives. Explicit contraindication check results.

Technical & Data Architecture Blueprint





Singapore Ecosystem Integration



Governance, Privacy & Zero-Trust



Data Privacy & Security

- AES-256 encryption at rest; TLS 1.3 in transit.
- Patient identifiers are hashed; dashboard operates purely on aggregate data.
- Role-Based and Attribute-Based access control.



AI Governance & Ethics

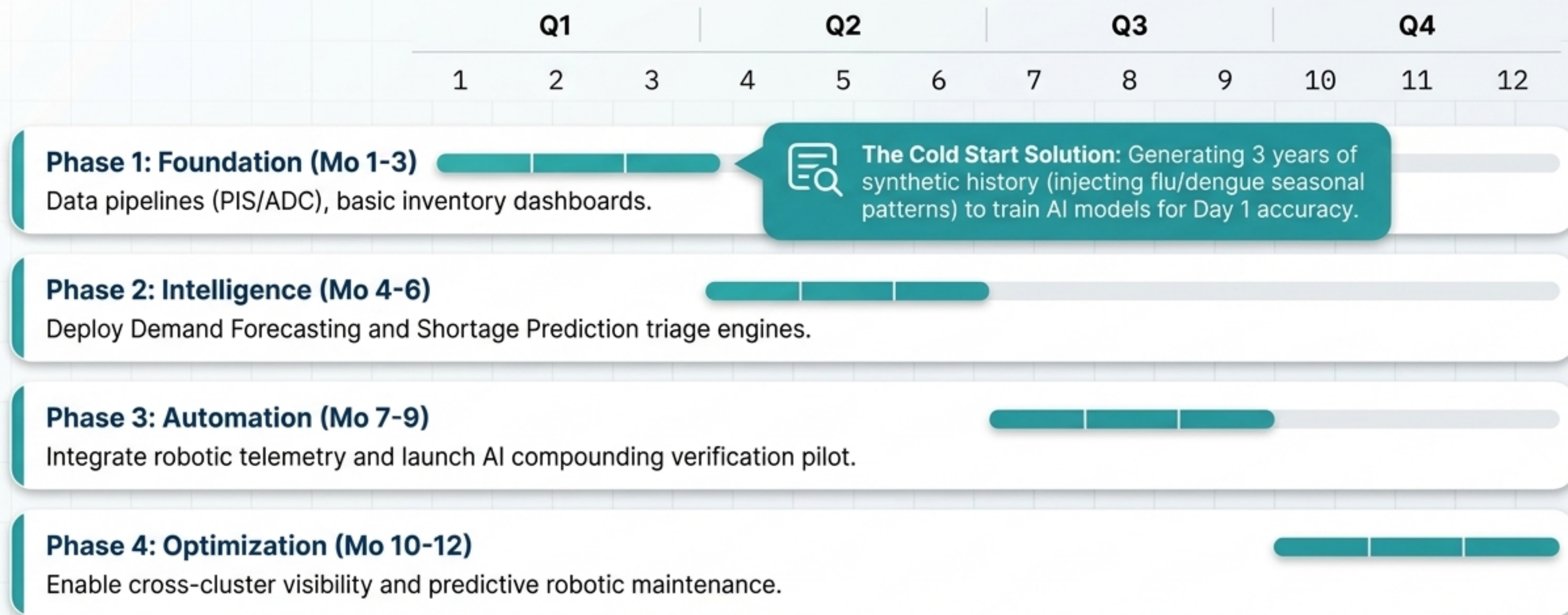
- Continuous model drift detection with monthly reviews.
- Mandatory bias testing across demographics and drug classes.
- Annual review by independent clinical AI ethics board.



Clinical Accountability

- Pharmacists retain absolute override authority.
- Mandatory justifications required for overriding shortage limits.
- Immutable audit trail for every AI recommendation, acceptance, and rejection.

Implementation Roadmap to Predictive AI



**From Reactive Dispensing to
Predictive Mission Control**