Line 2: Explainable Risk-Stratification and CDS for RPM

Remote patient monitoring intelligence and clinical decision-support methodology

Xinyang Li | July 2026

Aligned HITC platform direction: HITC-RemoteCare platform direction

Authorship, Timeline, and Institutional Context

Xinyang Li is presented as the methodology author and technical originator of the framework described in this file. The framework is not presented as a Zymo Research project and is not presented as completed employee work for HITC. It is an independently developed methodological contribution intended for future implementation, validation, and extension through HITC's health informatics research platform environment.

Development period: 2024 through mid-2026. The stated development activities include independent research, literature review, methodological design, and formal specification using health informatics standards and computational methods. The evidentiary record remains under development and should be supported by signed methodology statements, dated drafts, technical design records, draft manuscripts, and research notes before filing as completed Criterion v evidence.

Original Contribution Statement

This framework addresses the signal-to-noise problem in remote patient monitoring, where threshold-based systems can produce high false-positive alert rates. It specifies a transferable pipeline for turning patient-generated health data into explainable risk stratification and actionable clinical workflow.

Technical Methodology Brief

- Device Data Ingestion and FHIR Normalization: wearable, medical-grade, respiratory, and patient-reported data mapped to FHIR Observation using LOINC and UCUM.
- Physiological Data Model: approximately 80 engineered features across cardiovascular, metabolic, respiratory, composite, and patient-reported domains, using 1-hour, 6-hour, 24-hour, and 7-day time windows.
- ML Risk Model: XGBoost ensemble with Platt scaling, calibrated 0-100 output, patient-specific baseline adaptation, temporal decay weighting, and multi-morbidity interaction terms.
- CDS Rule Engine: Green, Amber, and Red tiers with modifiers for time, advance directives, and recent clinical interventions.
- Explanation Generation: SHAP feature attribution transformed through natural-language templates into FHIR DiagnosticReport resources.
- Follow-Up Workflow: task assignment, scheduling, documentation template, and outcome tracking feedback loop.

Original vs. Existing

Original concepts:

- Integration of SHAP explanations as FHIR DiagnosticReport resources, turning explainability into a clinical artifact rather than a separate analytic graphic.
- An approximately 80-feature physiological data model specified as a transferable method for RPM contexts.
- Context-aware CDS modifier architecture aimed at reducing alert fatigue and supporting workflow-sensitive intervention.

Existing technology: XGBoost, Platt scaling, SHAP, FHIR R4 Observation and DiagnosticReport, MEWS, qSOFA, and established CDS literature.

Architecture and Workflow

```
Wearable HR/SpO2 | Home BP/CGM | Surveys | EHR Labs
|
L1 INGESTION: FHIR Observation (LOINC, UCUM) -> artifact detection -> range validation
|
L2 PHYSIOLOGICAL MODEL: time windows -> feature extraction -> patient baseline -> deviation score
|
L3 RISK MODEL: XGBoost -> Platt scaling -> Green/Amber/Red tier -> SHAP attribution
|
L4 CDS AND WORKFLOW: context rules -> NLG explanation -> FHIR DiagnosticReport
|
Clinician Dashboard | EHR CDS Hooks | Patient Mobile App | Outcome Tracking
```

Validation and Benchmark Targets

The risk model should be trained and tested on publicly available critical-care datasets such as MIMIC-III and MIMIC-IV, with held-out evaluation comparing threshold-based alerting against ML-based alerting. Clinician review time remains a projected metric based on CDS literature.

Important caveat: These metrics are concept-of-concept, simulation-based, or literature-benchmark targets. They do not claim completed production deployment outcomes.

Metric	Target / Projected	Basis	Comparison Benchmark
Alert precision improvement	12% -> 48%	Simulation on MIMIC-IV; threshold vs. XGBoost	Published RPM false-positive rates
AUROC	0.84-0.91	70/30 train-test split; 5-fold CV	MIMIC-based risk model literature
False-positive reduction	88% -> 52%	Simulation against published RPM rates	Static threshold alerting
Clinician review time	6.8 min -> 2.1 min	Projected with explanation support	CDS literature benchmarks

Prospective Validation and Adoption Path

The following prospective validation sites are part of the future research and evidence-development pathway. No completed external deployment is claimed in this standalone split file.

- Cardiology Telemonitoring Program: prospective site for ML risk model and CDS rule validation using six months of RPM data. Status: research proposal under IRB review.
- Post-Surgical Telehealth Program: prospective site for follow-up workflow and explanation generation validation. Status: preliminary discussion with clinical informatics team.
- Multi-Site Primary Care Network: prospective site for physiological data model and feature-engineering validation. Status: identified based on published RPM outcomes; no engagement yet.

Expert Assessment Plan

Planned expert profile: clinical informatics professor or physician informaticist with expertise in CDS, RPM, and alert fatigue. Proposed scope: assess the ML-based risk stratification methodology, context-aware CDS rules, and explainability-as-clinical-artifact design.

Scholarly and Standards Corroboration

- FHIR R4 Observation and DiagnosticReport: device data normalization and explanation packaging.
- LOINC and UCUM: observation coding and unit standardization.
- XGBoost (Chen and Guestrin, KDD 2016): gradient-boosted ensemble algorithm.
- Platt Scaling (Platt, 1999): probability calibration method.
- SHAP (Lundberg and Lee, NeurIPS 2017): feature attribution method.
- HL7 FHIR CDS Hooks: EHR workflow integration specification.
- MEWS and qSOFA: clinical early warning score references.

Academic Field Contribution Argument

- Generality of method: the framework is specified as a transferable methodology, not as an implementation tied to one platform or employer.
- Standards-based formalism: the contribution is expressed using recognized health informatics and security standards.
- Prior-art gap identification: the framework identifies a specific gap in current practice and proposes an incremental method-level contribution.
- Future validation path: the applicant plans peer-reviewed manuscript submission and structured validation studies through HITC's research setting.

Source note: This standalone file was split and reorganized from Li_Xinyang_Original_Contributions_Exhibit_v2.pdf. It preserves the cautious evidentiary status of the source document.