

Optimizing Aid Supply Chain with Local Insights in Uganda

Technical Specifications for AI Framework for Supply Chain Optimization in Humanitarian Settings

Gideon Abako, Principal Investigator | Elrha Humanitarian Innovation Fund

International Foundation for Recovery and Development (IFRAD), Uganda Ministry of Health

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The Problem

Medicine stockouts cripple health delivery in Uganda's humanitarian settings. Current barriers include paper-based tracking, fragmented digital systems (DHIS2, eAFYA, eLMIS) and unreliable

Study Sites

Karamoja Region

- Moroto district
- Amudat district
- 2 Regional referral hospitals
- 4 Lower-level health centers

Southwestern Uganda

- Mbarara district
- Isingiro district
- Refugee settlement clinics
- 4 Lower-level health centers

68%

of Karamoja facilities report regular stockouts

82%

of refugee settlement clinics face medicine shortages

Our Solution

Technical specifications for an AI-enabled supply chain optimization framework designed for offline-first, low-resource humanitarian settings.

The framework provides guidelines for:

- Predictive demand forecasting using historical and seasonal patterns
- Offline-first architecture with asynchronous synchronization
- Interoperability with existing health information systems
- Human oversight mechanisms and ethical safeguards

Methods

Baseline study: 10 facilities (2 regional hospitals, 8 lower-level centers)

Data: 33 surveys + 31 stakeholder interviews

Validation:

✓ Ethics

IRB approved (MUREC)

✓ Technical

Academic review and validation

✓ Operational

Ministry of Health

Key Findings

Storage capacity matters

Facilities with inadequate storage have more stockouts ($r = -0.695$)

Connectivity blocks progress

89% report unreliable internet

Budget visibility missing

Over half lack spending transparency

Staff want integration

Automation must complement existing workflows

Framework Specifications (v0.1)

Data Input → Predictive Engine → Human Review → Action → Offline Sync

Core specifications:

- Demand forecasting algorithms with confidence thresholds
- Manual override protocols when model confidence $<80\%$
- API integration standards for eLMIS, eAFYA, WFP LESS
- Low-literacy interface design with audit trails
- Privacy and equity requirements embedded

Projected Impact

When systems built from this framework are implemented:

40%

reduction in average stockout days per facility

25%

reduction in procurement costs through improved forecasting

Enhanced

accountability and equity across supply chain

Implementation Progress

✓ Baseline complete

(Oct 2025)

→ Technical validation

ongoing (Nov 2025)

→ Deployment roadmaps

in development (Dec 2025)

Lessons Learned

- Offline-first design is essential for digital health inclusion
- Integration with existing systems beats replacement
- Ethical AI in humanitarian contexts requires human oversight from inception

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