

MEDICINE SUPPLY MANAGEMENT SYSTEM

GROUP DELTA

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REFINED TOPIC

An intelligent Pharmacy Supply Management System for Uganda using Machine Learning driven Forecasting, Predictive Analytics and Data Visualization to reduce medicine stockouts and Wastage due to Expiry.

This research focuses on developing an intelligent pharmacy supply management system that integrates machine learning, predictive analytics and interactive dashboards to forecast medicine demand, monitor inventory and support timely distribution between facilities. The system aims to minimize stockouts and wastage, ensuring equitable access to essential medicines across Uganda.

JUSTIFICATION

Uganda's health sector experiences inefficiencies in medicine supply management including, frequent stockouts, wastage from expiries, poor inventory management. These issues are rooted in weak data utilization and manual tracking systems which make it difficult to forecast demand accurately or respond quickly to shortages. By integrating machine learning for forecasting, automated alerts for low or expiring stock, and smart redistribution of medicines between facilities, the system will ensure better medicine availability, minimize losses, and improve patient care.

Integrating machine learning, predictive analytics and visualizations tools directly aligns with the Computer Science thematic areas promoting a data-driven, intelligent and automated health logistics framework. The project supports Uganda's Vision 2040 which prioritizes technological innovation for better healthcare delivery by providing a practical solution for reducing drug stockouts and wastage in the healthcare industry, and SDG 3: Good Health and Well-being, by enhancing continuous access to medicines through predictive and automated decision making.

PROBLEM STATEMENT

Uganda's medicine supply across pharmacies experiences frequent stockouts of medication and high rates of drug expiries resulting in medication inaccessibility and wastage of resources. Approximately **4–9%** of medicines are wasted annually from overstocking and expiry, with expired medicines at national stores valued around **UGX 316.65 billion** as of financial year **2023/2024**. These challenges extend beyond human medicine to the veterinary sector, where **88%** of drug outlets experience expiries. The problems stem from inadequate demand forecasting, and poor coordination between suppliers and facilities.

PROPOSED SOLUTION

The proposed solution is an intelligent pharmacy supply chain system that uses machine learning to forecast medicine demand, ensuring accurate and timely procurement. It also includes an automated alert system that notifies staff of low or expiring stock, and a redistribution engine that identifies facilities with low stock and those with surplus to recommend medicine transfer. Together, these features reduce wastage, prevent stockouts, and promote efficient, data-driven medicine management across Uganda.

SUMMARY OF MAIN LITERATURE

Medicine expiry is a growing crisis in Uganda's pharmaceutical supply chain. The latest Auditor General's report shows that drugs worth UGX 316.65 billion expired in 2023/2024, a massive 859% increase from the previous year's UGX 33 billion [1]. This huge waste included essential supplies like COVID-19 vaccines, antiretrovirals, and test kits, caused mainly by poor demand forecasting, overstocking, and delayed distribution [1]. Past studies confirm this ongoing problem, showing that 88.1% of medicine outlets have experienced expiries, while only 24.4% use electronic inventory systems [2], [3]. Poor demand forecasting has been identified as the main cause across multiple research studies [1], [2], [3], [4], but there is a major research gap: even though the problem is well-documented, very few practical machine learning or predictive analytics solutions have been developed specifically for Uganda's pharmaceutical supply chain [3], [4], [5]. While researchers agree that better forecasting and information systems are needed [5], there are no working frameworks for machine learning-based demand prediction that can handle Uganda's unique challenges like seasonal changes, disease patterns, and supply chain coordination. This gap is especially serious because 74% of Ugandans leave public hospitals without needed medicines while billions of shillings worth of drugs expire unused [4]. This situation highlights the urgent need for advanced forecasting technology to better manage resources and improve healthcare access.

RESEARCH OBJECTIVES

1. Develop a machine learning model that accurately forecasts medicine demand based on historical usage and seasonal disease trends.
2. Design an automated alert system that minimizes medicine expiries and stockouts through real-time monitoring and notifications.
3. Implement a redistribution engine that facilitates efficient transfer of surplus medicines between health facilities.

RESEARCH QUESTIONS

1. How effectively can a machine learning model predict future medicine demand in Ugandan pharmacies using historical and seasonal data?
2. What impact does an automated alert system have on reducing medicine wastage and preventing stockouts in pharmacies?
3. How can a redistribution engine optimize the allocation of medicines across health facilities to improve availability and reduce waste?

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