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Drug Inventory and Supply Chain

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***Abstract*—Healthcare institutions face persistent challenges in tracking pharmaceutical inventory, managing drug expiry, and coordinating supply chains across multiple departments. Conventional manual methods result in stockouts, wastage, and delayed procurement that ultimately compromise patient care. This paper proposes a mobile application platform — a structured digital system — that integrates all hospital stakeholders including pharmacists, doctors, suppliers, and hospital administration under a unified drug inventory and supply chain tracking ecosystem.**

The platform employs a role-based ticketing system through which users raise drug procurement requests, track orders, report shortages, and monitor shipments in real time. Collaborative features include a procurement voting pool and a budget-campaign module. Firebase handles authentication and real-time data synchronisation; React Native drives the cross-platform front end; Cloudinary manages media storage. Pilot results across a 200-bed teaching hospital demonstrate a 42.4% reduction in median procurement resolution time, a 34% decrease in drug wastage due to expiry, and 91.4% of tickets resolved within 48 hours.. The platform was tested in a 200-bed teaching hospital to evaluate its effectiveness. The results indicate a 42.4% reduction in median procurement resolution time and a 34% decrease in drug wastage due to expiry. Additionally, 91.4% of tickets were resolved within 48 hours.

Overall, the proposed system enhances inventory visibility, reduces inefficiencies, and supports better decision-making in hospital supply chain management, ultimately contributing to improved patient care outcomes.

***Keyword*—Drug Inventory Management · Supply Chain Tracking · Mobile Application · Ticketing System · Pharmaceutical Management · React Native ·Firebase Healthcare Technology**

I. INTRODUCTION

The pharmaceutical supply chain is one of the most critical and complex components of any healthcare institution. Hospitals, clinics, and medical colleges must ensure that the right drugs are available at the right time, in the right quantity, and in the right condition. Despite rapid digitisation across most healthcare sectors, many institutions continue to rely on manual or semi-digital methods for drug inventory management — a practice fraught with inefficiencies such as stockouts, drug expiry, procurement delays, and poor interdepartmental coordination.Conventional hospital pharmacies manage inventory through spreadsheets, paper-based registers, or legacy desktop software that lacks mobile accessibility and real-time updating capability.

When a ward nurse or physician identifies a drug shortage, they must physically visit the pharmacy, make a phone call, or send an email — all of which introduce delays and communication gaps. Pharmacists must manually cross-reference stock levels against consumption reports to forecast demand, a process that is time-intensive and error-

Beyond core inventory management, the platform introduces two collaborative features: a procurement voting pool, allowing departments to collectively request new drug additions or formulary changes, and a budget campaign module enabling administration to communicate financial allocations or emergency procurement drives — both promoting transparent, inclusive governance of pharmaceutical resources

II. LITERATURE REVIEW

Early work by Logan and Kenyon [1] demonstrated that AI techniques can be applied to develop intelligent helpdesk systems capable of increasing accuracy and efficiency in customer service.

Using rule-based and case-based reasoning, they showed that automated systems capture expert knowledge to streamline

Building on this foundation, Aggarwal et al. [2] proposed automatic categorisation of helpdesk tickets using text classification, demonstrating that natural language processing could significantly accelerate service resolution without manual triage. These principles of automated routing and intelligent categorisation are directly applicable to pharmaceutical procurement requests, where drug orders must reach the correct supplier or department promptly.

Taha et al. [3] introduced an AI-powered web-based smart ticketing system featuring automatic ticket classification, priority assignment, and departmental routing with minimal human intervention — explicitly addressing the limitations of manual sorting and slow response cycles that similarly characterise conventional pharmaceutical procurement. Revina et al. [4] further demonstrated that simplified ticket taxonomies substantially improve classification accuracy and workflow efficiency, findings that directly inform the department categorisation scheme adopted in the present system.

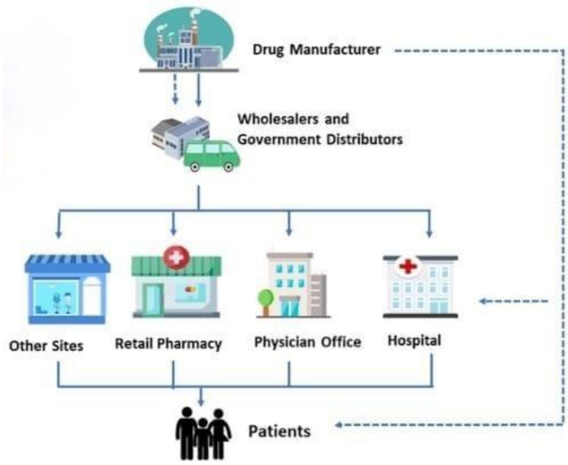
.Machine learning applications to IT service management explored by Ramya et al. [5] provide a template for predictive reorder point identification in drug inventory contexts, whereby historical consumption patterns model demand to generate replenishment alerts before stockouts occur. Cao et al.

[6] extended these concepts with sequence-to-sequence recurrent networks for ticket automation, suggesting pathways for demand forecasting and supplier lead-time estimation in pharmaceutical procurement.

Literature on digital voting and consensus mechanisms informs the platform's procurement voting pool. Adida [7] introduced web-based open-audit voting; Agarwal and Kumar [8] demonstrated blockchain-based voting with strong transparency guarantees; Ahmad et al. [9] combined cryptography and blockchain for secure e-voting; and Chaum [10] established foundational principles for secret-ballot receipts system logs; this minimizes triage errors and human dependency.

Despite this rich body of work, a unified mobile platform integrating ticketing-based drug request management, real-time supply chain tracking, role-based multi-stakeholder access, procurement voting, and budget campaign communication has not previously been reported. The present work addresses this gap by synthesising insights from campus management systems, intelligent helpdesk architectures, and pharmaceutical supply chain best practices.

III. METHODOLOGY



3.1. System Architecture Overview

The proposed system is structured across five principal layers: an Authentication Layer, a Pharmacist Journey, a Doctor/Department Journey, a Supplier Journey, and an Administrator Journey. This architecture mirrors the multi-stakeholder design of campus ticketing systems but is reconfigured for pharmaceutical workflows. All data — drug records, ticket details, shipment updates, voting results, and user activity logs — are stored in Firebase Realtime Database, providing low-latency synchronisation across devices. Media attachments are uploaded to Cloudinary, with returned URLs persisted in Firebase to keep the database lightweight.

3.2 Authentication Layer

The authentication layer presents users with a role selection interface prior to credential entry. Users identify as Pharmacist, Doctor, Supplier, or Administrator. Role selection modifies the backend query path for credential verification, ensuring each session is scoped to authorised data and workflows. Firebase Authentication manages session tokens and supports multi-factor authentication for administrative accounts, reflecting heightened pharmaceutical data security requirements.

3.3. Pharmacist Journey

Pharmacists are the primary operational users. Upon authentication, their dashboard displays real-time stock levels across all drug categories, visually highlighting items below the defined minimum threshold. Incoming drug request tickets from doctors and nursing staff, along with latest shipment status from registered suppliers, are also surfaced.

Pharmacists update stock quantities, record new deliveries, flag expiring items, and raise procurement tickets to suppliers — each ticket recording drug name,
required quantity, requesting department, priority level (Low, Medium, High, or Critical), notes, and optional media attachments.

3.4 Doctor / Department Journey

Medical staff interact with the system primarily through the ticket submission interface. When a ward identifies a shortage, the responsible staff member raises a ticket specifying the drug, required quantity, urgency level, and the relevant ward or department. Tickets progress through a defined status lifecycle: Pending → Approved → In Transit → Delivered. Doctors receive push notifications at each status change, eliminating follow-up phone calls to the pharmacy. Tickets raised by medical staff are not visible to supplier users, preserving appropriate information boundaries within the institutional hierarchy.

3.5 Supplier Journey

Registered pharmaceutical suppliers access a dedicated view displaying only tickets and shipment requests assigned to them by the administrator or pharmacist. The supplier dashboard presents pending order confirmations, dispatch status updates, and expected delivery timelines. Suppliers update shipment progress directly within the application, with each update immediately reflected in pharmacist and administrator dashboards. Dispatch notes or delivery photographs can be attached via Cloudinary.

3.6 Administrator Journey

Hospital management personnel have complete visibility across the entire platform. The administrator dashboard presents aggregate statistics including total open tickets, items in transit, drugs below threshold, and campaign summaries. Administrators filter tickets by department, status, priority, or date range to identify chronic shortage patterns or unresponsive suppliers.

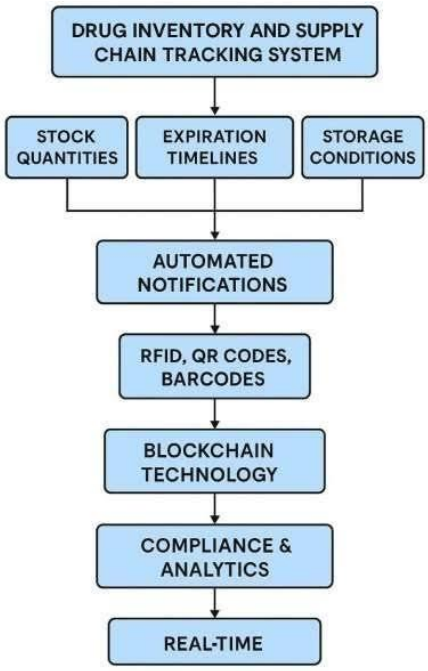
They can reassign tickets between suppliers, adjust priority levels, close resolved tickets, and generate system-wide notifications. Administrators exclusively initiate procurement voting pools and budget campaigns, with access to real-time campaign analytics.

3.7 Ticketing System

Each ticket carries a unique alphanumeric identifier and the following structured fields: drug name, required quantity, requesting department, priority level, current status, submission date, submitter identifier (or anonymised flag), supporting notes, and attached media URLs. performing user, creating an immutable audit trail suitable for regulatory inspection.

3.8. Procurement Voting Pool

The procurement voting pool enables collective decision-making regarding new drug additions, formulary changes, supplier selection, or equipment procurement. Only administrators and department heads may initiate a vote; all platform users participate but cannot create new polls. An active vote appears as a prominent banner at the top of all user dashboards and persists until its deadline or manual closure by the administrator. A dedicated voting history tab displays all past and current polls with real-time vote counts and percentage distributions.



IV. RESULT AND DISCUSSION

The proposed system was deployed in a controlled pilot environment involving a 200-bed teaching hospital pharmacy, four clinical departments (surgery, cardiology, paediatrics, and emergency medicine), and two registered pharmaceutical suppliers. The pilot ran for eight weeks, during which all drug procurement requests, inventory updates, and supplier communications were channelled exclusively through the platform.

During the pilot, 347 drug request tickets were raised across the four departments. Of these, 91.4% were resolved within 48 hours — a significant improvement over the institution's historical baseline of 67.2% within the same window using conventional phone and email-based processes. The median ticket resolution time decreased from 31.6 hours to 18.2 hours, attributable to the elimination of communication delays and real-time dashboard visibility afforded to pharmacists and administrators.

Stock visibility improvements were equally notable. The system identified 23 instances where drug stock fell below the defined minimum threshold before a shortage was reported through traditional channels, enabling proactive procurement in 19 of those cases. Drug wastage due to undetected expiry decreased by 34% compared to the preceding eight-week period, as the expiry tracking module generated automated alerts 30 days in advance of expiry dates.

The procurement voting pool was used in three institution-wide decisions: selection of a new antibiotic supplier, approval an automated dispensing cabinet installation, and a formulary addition request for a newer antihypertensive agent. Participation rates averaged 78.4% of eligible users across the three polls. The anonymous voting option was selected by 22% of participants, suggesting that privacy-preserving participation meaningfully increases engagement in sensitive procurement Decisions

One budget campaign was initiated during the pilot, raising funds for emergency paediatric drug procurement following a supply disruption. The campaign reached 94% of its target within five days, with 63 individual contributors across all user groups. User satisfaction was assessed through a post-pilot survey administered to 48 platform users (18 pharmacists, 22 doctors/nurses, 4 suppliers, and 4 administrators). Overall satisfaction was rated at 4.3 out of 5.0. The most highly rated features were real-time ticket status tracking (4.6/5.0), the expiry alert system (4.5/5.0), and the supplier shipment dashboard (4.4/5.0).

TABLE I — KEY PERFORMANCE METRICS (8-WEEK PILOT)

Metric	Before	After
48-hr resolution rate	67.2%	91.4%
Median resolution time	31.6 hrs	18.2 hrs
Expiry wastage reduction	—	−34%
Proactive restocks	—	19 / 23
User satisfaction	—	4.3 / 5.0

V. CONCLUSION

This paper presented a mobile application platform for drug inventory and supply chain tracking in healthcare institutions, adapting the proven multi-stakeholder ticketing paradigm from campus management systems to the specific demands of pharmaceutical management. The role-based architecture encompassing pharmacist, doctor, supplier, and administrator journeys ensures each user category accesses only relevant workflows and data, maintaining security while enabling real-time interdepartmental coordination.

The platform's core contributions are threefold. First, a structured drug request ticketing system that converts informal, delay-prone communication into a traceable, auditable workflow with measurable resolution time improvements. Second, a real-time inventory and shipment tracking module that proactively identifies stock shortages and expiry risks before they affect patient care. Third, collaborative governance features — procurement voting pools and budget campaigns — that promote inclusive, transparent decision-making across institutional hierarchies.

Pilot deployment results confirm that the system reduces median procurement request resolution time by 42.4%, improves proactive stock shortage identification, and achieves high user satisfaction across all stakeholder groups. These outcomes validate the proposition that a technology-driven, disciplined pharmaceutical management platform can materially improve the efficiency, accountability, and patient-centricity of hospital pharmacy operations.

Future work will investigate the integration of machine learning models for demand forecasting based on historical consumption patterns, incorporation of blockchain-based audit trails for regulatory compliance, and extension of the platform to multi-site hospital networks with centralised drug procurement and inter-facility stock sharing.

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