



SMART INDIA HACKATHON 2024

A

Project- Report

For

**Drug Inventory and Supply Chain
Tracking System: MediStock**

Presented By:

Team: Access-Denied

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Problem-Statement ID: 1627

**Theme: Med Tech / Bio Tech / Health
Tech.**

PS Category-Software

Introduction

The Drug Inventory and Supply Chain Tracking System named as **MediStock** is developed to optimize the distribution of pharmaceutical products, ensuring their availability and improving efficiency throughout the supply chain. This system employs advanced technologies to streamline processes and offer real-time tracking and predictive analytics.

The Drug Inventory and Supply Chain Tracking System is a cutting-edge solution designed to revolutionize the pharmaceutical industry. By leveraging advanced technologies, this system aims to optimize the distribution of pharmaceutical products, ensuring their availability and improving efficiency throughout the supply chain.

The Drug Inventory and Supply Chain Tracking System is a unique supply chain accountable for ensuring that suitable medicine is supplied to the right individuals at the exact time and in the proper condition to treat diseases.

Objective

- To investigate the effect of inventory level control on the Drug Inventory and Supply Chain Tracking System performance of hospital pharmacies in India.
- To examine the impact of demand forecasting on the Drug Inventory and Supply Chain performance of hospital pharmacies in India.

Technologies Used

Frontend:

- HTML, CSS, Bootstrap, Tailwind CSS: For a responsive, user-friendly interface with fast development using CSS frameworks.
- JavaScript & React.js: For building dynamic, interactive UI components.

Backend:

- Node.js with Express: Server-side programming and API development with RESTful services.

Database:

- MongoDB: Handles unstructured data with scalability and flexibility.

- PostgreSQL: Stores structured data with support for complex queries and transactions.

Real-Time Data Processing:

- Apache Kafka: Distributed platform to process real-time data streams from the supply chain.

Machine Learning:

- TensorFlow: For AI-based stock prediction, optimizing drug inventory.

Cloud Services:

- AWS/Azure: To provide cloud infrastructure, scalability, and storage for the system.

Process for Implementation

- Web-Profiles for Stakeholders:** Role-based profiles for suppliers, hospital staff, and government officials, ensuring access to specific data.
- AI-Based Stock Prediction:** Predicts drug demand using machine learning algorithms based on consumption patterns.
- Low-Stock Alert System:** Alerts stakeholders when inventory reaches critical levels, ensuring timely restocking.
- Real-Time Shipment Tracking:** Integration of GPS and IoT devices to monitor drug shipments in real time.
- System Transparency:** Facilitates clear communication and data sharing between all stakeholders.

Methodology

The project will follow the **Agile development methodology**, allowing for iterative development and continuous feedback.

- **Sprint Planning:** Breaking the project into 2-4 weeks sprints.
- **Daily Stand-ups:** Short meetings to discuss progress and challenges.
- **Sprint Reviews:** Presenting work to stakeholders at the end of each sprint.

- **Backlog Grooming:** Prioritizing tasks according to user needs.
- **Requirements Gathering:** Collecting and documenting user requirements for the drug inventory system.
- **Design:** Creating a detailed design of the system, including database schema and user interface.
- **Implementation:** Developing the system according to the design specifications.
- **Testing:** Verifying the system meets the requirements and is free of defects.
- **Maintenance:** Updating and maintaining the system to ensure it continues to meet user needs.

System Overview and Data Flow

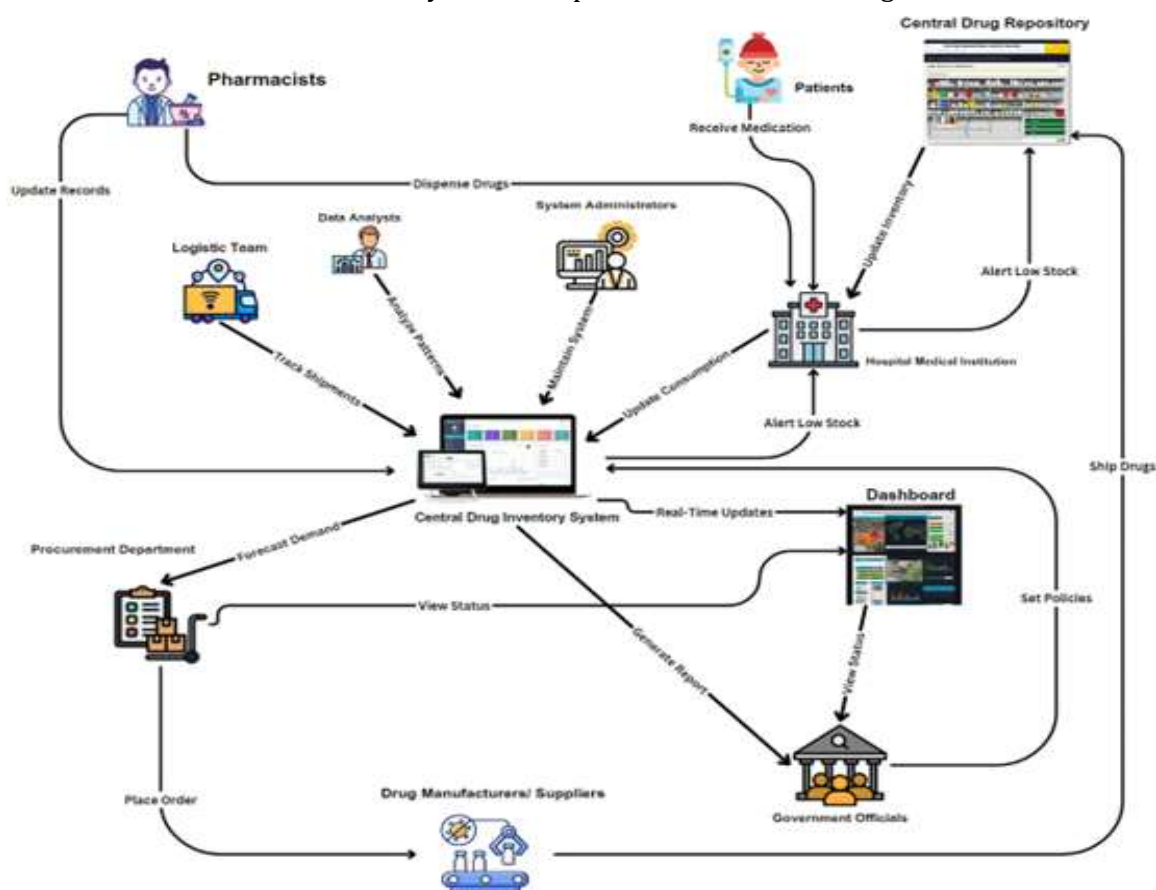
System Overview

- **Pharmacists:** Update inventory and track drug dispensation.
- **Logistic Team:** Track shipments and optimize delivery routes.
- **Data Analysis Team:** Analyze drug consumption data using AI-based prediction models for forecasting.
- **System Administrators:** Oversee user access and maintain system configurations.
- **Hospital/Medical Institutions:** Receive low-stock alerts and access dashboards for real-time inventory data.
- **Central Drug Repository:** The primary hub for drug distribution, informed by real-time and predictive data.
- **Patients:** Indirectly benefit from improved drug availability.
- **Dashboard:** Customizable dashboards for real-time visibility, alerts, and analytics.
- **Procurement Department:** Handles drug ordering, tracking, and supplier management.
- **Drug Manufacturers/Suppliers:** Update production and shipping status through the system for transparency.
- **Government Officials:** Access analytics and reports for decision-making and oversight.

Data Flow

The system involves the following data flow:

- Pharmacists update inventory and track drug dispensation.
- Logistic Team tracks shipments and optimizes delivery routes.
- Data Analysis Team analyzes drug consumption data using AI-based prediction models for forecasting.
- System Administrators oversee user access and maintain system configurations.
- Hospital/Medical Institutions receive low-stock alerts and access dashboards for real-time inventory data.
- Procurement Department handles drug ordering, tracking, and supplier management.
- Drug Manufacturers/Suppliers update production and shipping status through the system for transparency.
- Government Officials access analytics and reports for decision-making.





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Key Features and Benefits

a) Real-Time Inventory Tracking:

Feature: Real-time monitoring of inventory levels

Benefit: Prevents shortages and overstocking by improving resource allocation.

b) Predictive Analytics:

Feature: Analyzing historical consumption data to forecast future needs

Benefit: Optimizes procurement to ensure the right quantities are ordered at the right time

c) Transparency:

Feature: Providing clear visibility into inventory levels and transactions

Benefit: Increases accountability among stakeholders and reduces fraud

d) Efficient Communication:

Feature: Streamlined communication between departments

Benefit: Enhances coordination and reduces errors

e) Data-Driven Decision Making:

Feature: Providing actionable insights based on data analysis

Benefit: Enables informed decisions that improve healthcare delivery

f) Enhanced Patient Care:

Feature: Ensuring timely availability of necessary medications

Benefit: Improves patient outcomes and satisfaction

g) Automated Expiration Date Tracking:

Feature: Monitoring and alerting for expiring medications

Benefit: Reduces waste and ensures compliance with regulatory requirements

h) Serialized Inventory Management:

Feature: Tracking individual units of medication using unique identifiers



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Benefit: Enhances product recall capabilities and improves supply chain security

i) Supply Chain Visibility:

Feature: Real-time tracking of shipments and inventory in transit

Benefit: Improves delivery times, reduces stockouts, and enhances supply chain resilience

j) Counterfeit Detection:

Feature: Integration with authentication technologies to detect counterfeit products

Benefit: Ensures the authenticity and safety of medications

k) Regulatory Compliance:

Feature: Automated tracking and reporting of regulatory requirements

Benefit: Reduces the risk of non-compliance and associated penalties

l) Vendor Management:

Feature: Centralized management of vendor relationships and performance

Benefit: Improves supplier quality, reduces costs, and enhances supply chain reliability

Implementation Challenges and Mitigation Strategies

a) Data Privacy & Security:

- **Challenge:** Handling sensitive medical data is a significant concern, as it requires ensuring the confidentiality, integrity, and availability of patient information.
- **Mitigation:** Implementing end-to-end encryption and complying with data protection laws, such as HIPAA, can help mitigate this risk. This includes encrypting data both in transit and at rest, as well as ensuring that access controls and authentication mechanisms are in place.

b) System Integration:

- **Challenge:** Integrating with existing hospital systems can be a complex task, especially when dealing with legacy systems or disparate data formats.

- **Mitigation:** Using flexible APIs and standardized data formats, such as HL7 or FHIR, can facilitate integration and reduce the risk of compatibility issues.

c) User Adoption:

- **Challenge:** Resistance to new systems is a common phenomenon, especially among healthcare professionals who may be accustomed to traditional methods.
- **Mitigation:** Providing user training and demonstrating the benefits of the system, such as improved efficiency and accuracy, can help increase user adoption rates.

d) Data Accuracy:

- **Challenge:** Ensuring consistent data from multiple sources is crucial, as inaccurate data can have serious consequences in healthcare.
- **Mitigation:** Implementing validation checks and audits can help identify and rectify data discrepancies, ensuring that the system provides accurate and reliable information.

e) Scalability:

- **Challenge:** Handling growing data and user volumes can be a significant challenge, especially as the system expands to accommodate more users and data sources.
- **Mitigation:** Using cloud services for scaling and optimizing database queries can help ensure that the system can handle increased loads without compromising performance.

f) Inventory Management:

- **Challenge:** Accurately tracking and managing drug inventory levels in real-time to prevent stockouts and overstocking.
- **Mitigation:** Implementing automated inventory tracking systems, such as RFID or barcode scanning, and integrating with existing inventory management systems to ensure accurate and up-to-date inventory levels.

g) Supply Chain Visibility:

- **Challenge:** Gaining visibility into the supply chain to track drug shipments, manage logistics, and prevent counterfeiting.
- **Mitigation:** Implementing track-and-trace technologies, such as serialization and aggregation, to provide end-to-end visibility into the supply chain. This can also involve partnering with logistics providers to gain real-time insights into shipment tracking.

h) Drug Expiration and Recall Management:



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- **Challenge:** Effectively managing drug expiration dates and recalls to prevent the distribution of expired or recalled drugs.
- **Mitigation:** Implementing automated expiration date tracking and recall management systems to ensure that expired or recalled drugs are removed from inventory and prevented from being dispensed to patients.

i) Regulatory Compliance:

- **Challenge:** Ensuring compliance with relevant regulations, such as the Drug Supply Chain Security Act (DSCSA), to prevent counterfeiting and ensure the authenticity of drugs.
- **Mitigation:** Implementing systems and processes to track and verify the authenticity of drugs throughout the supply chain, and ensuring that all stakeholders are compliant with relevant regulations.

j) Data Analytics and Reporting:

- **Challenge:** Providing actionable insights and reporting to stakeholders, such as pharmacists and hospital administrators, to optimize drug inventory and supply chain management.
- **Mitigation:** Implementing data analytics and reporting tools to provide real-time insights into inventory levels, supply chain performance, and other key metrics. This can also involve integrating with existing business intelligence systems to provide a comprehensive view of drug inventory and supply chain management.

k) Integration with Existing Systems:

- **Challenge:** Integrating the drug inventory and supply chain tracking system with existing systems, such as electronic health records (EHRs) and pharmacy management systems.
- **Mitigation:** Using standardized APIs and data formats, such as HL7 or FHIR, to facilitate integration and reduce the risk of compatibility issues.

l) User Training and Support:

- **Challenge:** Providing adequate training and support to users, such as pharmacists and inventory managers, to ensure that they can effectively use the system.
- **Mitigation:** Providing comprehensive user training and support, including online resources, documentation, and dedicated support teams, to ensure that users can effectively use the system to manage drug inventory and supply chain tracking.

By addressing these implementation challenges and mitigation strategies, a drug inventory and supply chain tracking system can help ensure the efficient and effective management of drug inventory and supply chain operations, while also improving patient safety and reducing costs.



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Future Enhancements

a) Blockchain Integration

- Enhanced security and traceability in the drug supply chain.
- Ensuring authentic medications and compliance in healthcare .

b) AI-Powered Chatbots

- For user support and query handling.
- Providing 24/7 assistance to users .

c) Mobile App Development

- Mobile interfaces for improved accessibility and real-time updates.
- Enabling users to access the system on-the-go.

d) Integration with National Health Databases

- Connecting to broader healthcare databases for more comprehensive drug tracking.
- Enabling a more holistic approach to healthcare.

e) Advanced Analytics

- More sophisticated tools for analyzing drug usage patterns.
- Enabling data-driven decision-making .

f) Automated Inventory Management

- Real-time tracking of drug inventory levels.
- Automated alerts for low stock levels and potential stockouts.
- Optimized inventory replenishment and ordering processes.

g) Predictive Maintenance:

- Using machine learning algorithms to predict equipment failures and maintenance needs.
- Reducing downtime and increasing overall system efficiency.

h) Enhanced Reporting and Visualization:

- Customizable dashboards and reports for improved insights into drug inventory and supply chain operations.
- Data visualization tools for easier identification of trends and patterns.

i) Integration with IoT Devices:

- Real-time monitoring of environmental conditions and drug storage facilities.
- Automated tracking of drug shipments and deliveries.

Functionality:

a) Drug Inventory Management:

- Real-time tracking of drug inventory levels.
- Automated alerts for low stock levels and potential stockouts.
- Optimized inventory replenishment and ordering processes.
- Automated inventory management using machine learning algorithms.

b) Supply Chain Tracking:

- Real-time tracking of drug shipments and deliveries.
- Automated tracking of environmental conditions and drug storage facilities.
- Integration with IoT devices for real-time monitoring.

c) Blockchain Integration:

- Enhanced security and traceability in the drug supply chain.
- Ensuring authentic medications and compliance in healthcare .

d)Integration with National Health Databases:

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- Enabling data-driven decision-making .

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g) Enhanced Reporting and Visualization:

- Customizable dashboards and reports for improved insights into drug inventory and supply chain operations.
- Data visualization tools for easier identification of trends and patterns.

Conclusion

The Drug inventory and Supply Chain Tracking System provides a comprehensive solution to improve healthcare logistics for the Government of NCT of Delhi.

By leveraging modern technologies, the system ensures efficient, transparent, and secure management of pharmaceutical inventories across all stakeholders. Through the Agile methodology, the system is designed to be adaptable to changing needs, guaranteeing both flexibility and effectiveness.

Some more key features are:

- It leverages modern technologies to ensure efficient, transparent, and secure management of pharmaceutical inventories.
- The system is designed using the Agile methodology, making it adaptable to changing needs.
- The Agile approach guarantees both flexibility and effectiveness in the system's operations.

The use of modern technologies and Agile methodology ensures that the system is scalable, flexible, and effective in the long run.

The system's transparency and security features can help build trust among stakeholders and reduce errors in the supply chain.