MedTrack A Universal KYC-Based Medicine Tracking System

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***Abstract*—The modern healthcare sector is confronted with significant challenges, including unregulated medicine distribution, misuse of prescriptions, and a lack of centralized patient records. These issues compromise patient safety and create inefficiencies within the supply chain. To address these vulnerabilities, we propose MedTrack, a universal, KYC-based medicine tracking system designed to unite patients, doctors, and pharmacies on a single, secure cloud platform. By leveraging Aadhaar/KYC for verification, MedTrack assigns a unique Medical Track ID (MDT ID) to each patient, creating a tamper-proof digital identity for all healthcare interactions. The system facilitates the digitization of prescriptions, enables real- time tracking of the medicine lifecycle from manufacturer to patient, and prevents the over-purchasing or misuse of controlled substances. This paper presents the architecture, core features, and preliminary implementation of the MedTrack system, demonstrating its potential to enhance transparency, accountability, and safety in the pharmaceutical supply chain.**

***Index Terms*—healthcare, KYC, medicine tracking, prescription digitization, supply chain, Aadhaar, data security**

I. INTRODUCTION

The healthcare industry faces persistent challenges that undermine its efficiency and compromise patient safety. Key issues include the unregulated distribution of medicines, the potential for prescription misuse, the fragmentation of medical records, and a general lack of transparency among patients, doctors, and pharmacies. These problems can lead to the circulation of counterfeit drugs, uncontrolled access to addictive medications, and errors in treatment due to incomplete patient histories. To combat these issues, a robust digital infrastructure is necessary. MedTrack is proposed as a comprehensive solution—a universal, KYC-based medicine tracking system built on a secure cloud- powered platform. The fundamental principle of MedTrack is to establish a trusted network by verifying the identity of all stakeholders (patients, doctors, pharmacists) through a government-issued KYC system like Aadhaar. By linking every transaction to a verified digital identity, MedTrack aims to create an accountable and transparent supply chain. The system not only digitizes prescriptions but also tracks medicines throughout their entire lifecycle, offering real-time monitoring capabilities. This paper details the system's objectives, architecture, and innovative features. It also discusses the initial prototype development and outlines the future work required to build a full-fledged digital health ecosystem.

II. LITERATURE SURVEY

The development of MedTrack is informed by existing research in digital healthcare, electronic prescription systems, and secure data management The foundation of a national-level digital health system relies on a unique identifier. The Unique Identification Authority of India (UIDAI) has established a robust framework for e-KYC verification through Aadhaar, providing a specification for secure identity authentication that can be integrated into various platforms. Soman, Srivastava, and Murthy further explored the feasibility of a Unique Health Identifier for India, proposing algorithms and analyzing its implementation on

patient data, underscoring the viability of such a system.

Electronic prescription systems are critical to modernizing healthcare. A scoping review by Vejdani et al. identified the core functional and technical requirements for these systems, highlighting their benefits when implemented effectively. The practical application of such technology has shown positive results. A study by Bhakta et al. on an EHR-integrated mobile dispense tracking technology demonstrated a significant reduction in the redispense rate of medications in a hospital setting. Furthermore, real-time monitoring has been identified as a key factor in improving medication adherence and safety. Faisal et al. found a strong appreciation for real-time adherence monitoring among pharmacists, affirming its value in community pharmacy settings. The integration of digital tools like QR codes has also been shown to enhance service delivery and customer loyalty in retail pharmacies, demonstrating the strategic value of accessible technology

UIDAI's Aadhaar e-KYC specification provides a robust framework for secure digital identity verification in India. This is the foundational technology for MedTrack's KYC-based authentication, allowing the system to establish a trusted network of verified patients, doctors, and pharmacists
The concept of a Unique Health Identifier for India, as explored by Soman, Srivastava, and Murthy, further validates MedTrack's core principle of assigning a single, non-transferable digital identity (MDT ID) to each patient. Their work, which proposes algorithms and analyzes implementation, underscores the feasibility and necessity of such a system for creating unified medical records.

A scoping review on electronic prescription systems by Vejdani et al. identified the core functional and technical requirements needed for successful implementation. MedTrack's design incorporates these findings to ensure its digital prescription repository is not only secure but also effective and user-friendly for healthcare providers.
The practical benefits of such technologies are demonstrated by Bhakta et al., whose study on an EHR-integrated mobile tracking technology showed a significant reduction in medication redispensing errors. This supports MedTrack's goal of improving patient safety and supply chain efficiency through real-time monitoring.
Faisal et al. found that pharmacists have a strong appreciation for real-time medication monitoring, affirming its value in improving patient adherence and safety in community settings. This aligns directly with MedTrack's dedicated Tracking and Monitoring Layer, which provides continuous insight into medicine sales and usage.
The foundation of a national-level digital health system like MedTrack relies on a robust framework for secure identity verification. The Unique Identification Authority of India (UIDAI) has established a comprehensive specification for e-KYC verification through Aadhaar, providing a secure method for authenticating users that can be integrated into various platforms [1]. Building on this, the concept of a Unique Health Identifier for India has been explored, with research demonstrating its feasibility and proposing algorithms for implementation, confirming the viability of a system where each patient has a unique, verifiable digital identity [2].

Modernizing healthcare effectively requires a shift to electronic prescription systems. A scoping review by Vejdani et al. identified the core functional and technical requirements for these systems, emphasizing the significant benefits they offer when implemented correctly, such as reducing errors and improving efficiency [3].

The practical application of such tracking technologies has shown positive results. Studies on EHR-integrated mobile dispense tracking have demonstrated a significant reduction in the redispense rate of medications in hospital settings [4]. Furthermore, research has found a strong appreciation among pharmacists for real-time medication monitoring, affirming its value in improving patient adherence and safety in community pharmacy settings [5]. Finally, the integration of accessible digital tools like QR codes has been shown to enhance service delivery and customer loyalty in retail pharmacies, highlighting the strategic value of leveraging technology to improve the patient experience [6].

III. PROPOSED SYSTEM: MEDTRACK

The MedTrack system is designed to create a secure, transparent, and efficient healthcare ecosystem. Its architecture and features are centered around a KYC-verified digital identity.

A. System Objectives

Secure KYC Verification: To establish a trusted network by authenticating every user patient, doctor, and pharmacist using Aadhaar or other official KYC methods. This mitigates fraud and ensures that only verified individuals can perform transactions.

Unique Medical Track ID (MDT ID): To provide each patient with a single, on- transferable digital identity (MDT ID) that houses a unified, lifelong medical and prescription history Controlled Drug Safety: To prevent the misuse, duplication, and over-purchasing of controlled or addictive substances by linking every prescription and sale to a verified MDT ID

Real-Time Medicine Tracking: To enable end- to-end monitoring of medicines from the manufacturer to the end-user, ensuring supply chain integrity and reducing the risk of counterfeit drugs.

Centralized Prescription Repository: To create a secure, cloud-based digital repository for all prescriptions, accessible only to authorized providers to minimize errors and improve treatment continuity.

B. System Architecture

- Patient Registration: A patient registers on the MedTrack platform using their Aadhaar or other KYC details. Upon successful verification, a unique and non-transferable Medical Track ID (MDT ID) is generated.
- Prescription Issuance: A verified doctor logs into the system and issues a digital prescription, which is securely linked to the patient's MDT ID and uploaded to the MedTrack cloud system.
- Dispensing at Pharmacy: The patient presents their MDT ID at a pharmacy. The pharmacist verifies the ID and retrieves the digital prescription from the cloud. Before dispensing, the system checks for potential duplication or policy violations.
- Centralized Cloud System: The core of the architecture is a secure cloud repository featuring end-to-end data encryption and role-based access control. It stores all medical data, prescription history, and transaction logs.
- Tracking and Monitoring: A dedicated layer tracks all medicine sales in real-time. This data is used to prevent duplicate sales, ensure compliance, and generate reports
- Auditing by Authorities: Regulatory bodies are granted access to audit the system, monitor drug distribution patterns, and ensure public health safety

C. Core Features

Unified Healthcare Ecosystem: It brings patients, doctors, pharmacies, and regulators onto a single digital platform, breaking down existing data silos.

Role-Based Access Control (RBAC): Each type of user has different access levels, ensuring that sensitive patient data is only shared on a need-to- know basis.

Patient Empowerment access: Patients are given access to view their complete prescription and medication purchase history, providing them with transparency and greater control over their health journey.

IV. IMPLEMENTATION AND RESULTS

The initial phase of the MedTrack project has focused on the development of a frontend prototype to demonstrate the core functionalities and user interface.

A. prototype Development

A working frontend prototype has been built using standard web technologies

To validate our framework, we developed MedTrack, a full-stack web application prototype using the MERN (MongoDB, Express.js, React, Node.js) stack. The system uses a client-server architecture to separate the user interface from the backend logic

1) Frontend (Client): The user interface is a Single Page Application (SPA) built with React (v19) and styled using Tailwind CSS. React Router manages navigation, and Axios handles API communication with the server. Data visualization is implemented using Recharts.

2) Backend (Server)

I) Runtime Environment: Node.js: Node.js allows for the use of JavaScript on the server, creating a unified language across the entire stack. Its

asynchronous, non-blocking I/O model makes it highly efficient for handling concurrent requests, which is crucial for a web application.

II) API Framework: Express.js: Define API Routes: The server/routes directory maps HTTP endpoints (e.g., /api/patients/prescriptions, /api/doctors/search) to specific controller functions.

3) Security (JWT and Bcrypt):

JWT: The stateless nature of JWT is highly scalable for web applications. The server doesn't need to store session information. Each token is self-contained and digitally signed, ensuring its integrity.

Bcrypt: This password-hashing function is industry-standard. It integrates a "salt" (a random string) with each password before hashing and is computationally intensive, making it highly resistant to brute-force and rainbow table attacks, even if the user database is compromised.

B. Preliminary Results

The prototype successfully demonstrates the core user journey, from KYC-based registration to accessing a personalized medical dashboard. The user interface was designed to be clean and intuitive, ensuring ease of use for non-technical users. The registration and login forms (as shown in the project documentation) validate the concept of using a unique ID as the primary key for all user interactions. The dashboard provides a clear, at-a- glance view of a patient's medication history, fulfilling the objective of patient empowerment

C. Figures and Tables

a) In the proposed system, a universal Medical Track ID (MDT ID) is generated for each patient after successful Know Your Customer (KYC) verification. This ID serves as a unique, non-transferable digital identity for all healthcare interactions.

As shown in Fig. 1, the patient registers with the system and obtains an MDT ID, which is then used by doctors to issue and upload digital prescriptions. These prescriptions are stored securely in the MedTrack Cloud System, which provides end-to-end encryption, secure cloud storage, and role-based access control.

Pharmacies verify both the MDT ID and the digital prescription before dispensing medicines, thereby reducing the risk of counterfeit or duplicate transactions. A dedicated Tracking and Monitoring Layer continuously records prescription usage and medicine sales in real time, ensuring compliance and transparency. Finally, regulatory authorities are able to audit the system, monitor for drug misuse, and generate compliance reports to improve public health safety.

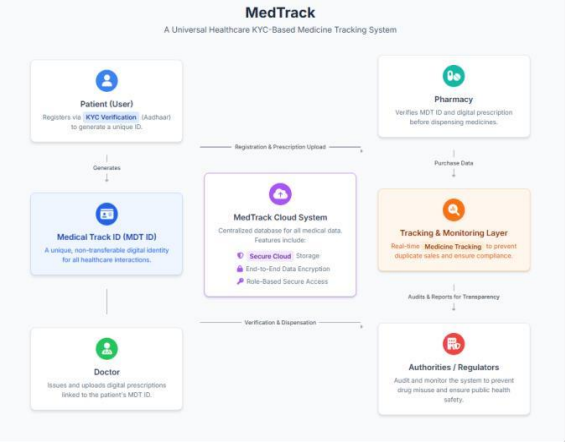

Fig. 1. MedTrack system architecture and workflow.

This workflow ensures secure identity management, controlled medicine distribution, and transparent reporting, while integrating patients, doctors, pharmacists, and regulators into a single digital healthcare ecosystem

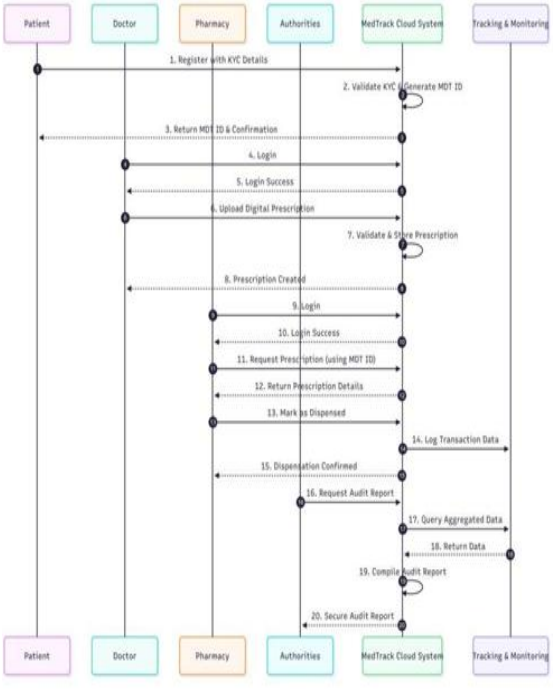

Fig. 2. A sequence diagram

System Interaction and Data Flow

This sequence diagram details the chronological interactions between the primary actors—Patient, Doctor, Pharmacy, and Authorities—and the system's backend components, which are the MedTrack Cloud System and the Tracking & Monitoring layer. The entire process can be logically divided into four main phases: patient registration, prescription creation, medication dispensation, and auditing

1. Patient Registration: A patient registers with KYC details, and the Cloud System validates them to generate and return a unique Medical Track ID (MDT ID).
2. Prescription Creation: A doctor logs in, uploads a digital prescription, and the Cloud System validates and stores it, confirming its creation.
3. Medicine Dispensation: A pharmacy logs in, requests the patient's prescription using their MDT ID, and marks it as dispensed. The system logs this transaction and confirms it with the pharmacy.
4. Auditing: Authorities request an audit report. The Cloud System gathers data from the tracking component and provides a secure report back to the authorities.

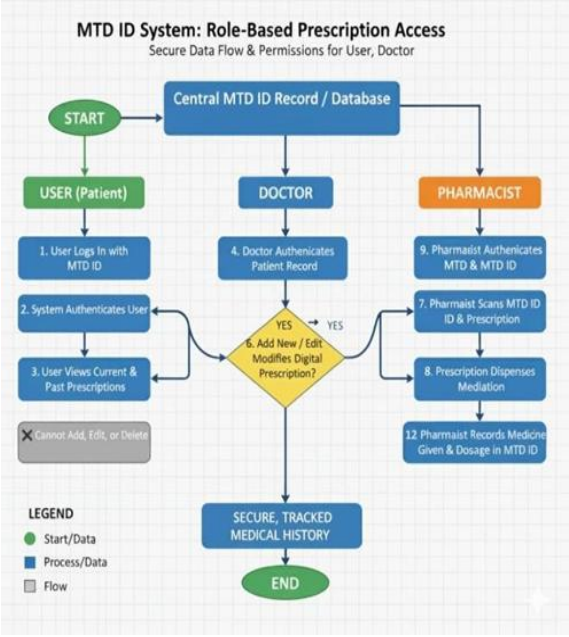

Fig 3. Flowchart For MED-TRACK System

D. Limitations

Dependent on Aadhaar/KYC infrastructure: The system relies on Aadhaar-based KYC verification; users without valid Aadhaar or network access cannot register or use the platform.

Requires internet connectivity: As MedTrack is a cloud-based application, it cannot function offline. Continuous internet access is necessary for all operations.

Limited to registered users: Only verified patients, doctors, and pharmacists can access the platform.

Unregistered healthcare providers or unverified users are excluded.

No integration with external health databases (currently): The system operates independently and is not yet integrated with national health databases such as Ayushman Bharat Digital Mission (ABDM) or hospital ERP systems.

Limited analytics capability: The current version provides basic statistical dashboards. Advanced analytics like AI-driven fraud detection or predictive reporting are planned for future development.

No mobile application: MedTrack currently functions only as a web-based system and lacks Android/iOS mobile app support.

E. Future Scope and Enhancements

Mobile Application Development: The current web-based system can be extended with dedicated native mobile applications for both Android and iOS. This will provide healthcare providers with a more intuitive and accessible interface, allowing for seamless prescription management and patient interaction from mobile devices. The mobile apps will be optimized for offline functionality, with data synchronization to ensure continuity of care even in areas with limited connectivity.

Government Health Portal Integration: To align with national digital health initiatives, future development will include a direct API integration with the Ayushman Bharat Digital Mission (ABDM) and other relevant government health portals.

Blockchain for Enhanced Security: To ensure the integrity and immutability of digital health records, a blockchain integration is proposed. Each prescription generated will be recorded as a transaction on a private or consortium blockchain network. This will create a tamper-proof and transparent log of all prescriptions, eliminating the possibility of fraudulent activities such as prescription forgery or unauthorized modifications. This approach will significantly enhance the security and trust in the digital healthcare ecosystem.

AI-Driven Analytics for Clinical Decision Support: The platform's data can be leveraged for advanced analytics and machine learning. Future enhancements include implementing an AI-driven module for fraud detection and prescription analytics

Multi-Language Support for Pan-India Adoption: To ensure the platform is accessible to a diverse user base across India, multi-language support will be developed. The user interface, alerts, and key information will be translated into multiple regional languages. This will break down language barriers and promote wider adoption of the digital health solution, especially in rural and non-English-speaking regions.

Strategic API Integrations A dedicated API integration with WhatsApp will be implemented to send automated alerts and notifications to both doctors and patients. This will include appointment reminders, prescription refill alerts

REFERENCES

[1] Risk and UCON-Based Access Control Model for Healthcare Big Data/Authors: Gan Lin, J. Li, et al/ July 10, 2023 / DOI: 10.1186/s40537-023-00783-8 / ISSN (Online): 2196-1115

[2] Journal of Economics, Finance and Management Studies/ISSN (print): 2644- 0490, ISSN (online): 2644-0504/Volume 08 Issue 02 February 2025//Article DOI: 10.47191/jefms/v8-i2-16, Impact Factor: 8.317

[3] Afzal I, Parah SA, Hurrah NN, Song O. Secure patient data transmission on resource constrained platform. Multimed Tools Appl. 2020.https://doi.org/10.1007/s11042- 020- 09139-3.

[4] UIDAI, "Aadhaar e-KYC API Specification – Version 2.5," Unique Identification Authority of India, New Delhi, India, Aug. 2015.

[5] Alomar MJ, Ahmad S, Moustafa Y, Alharbi LS. Reducing missed medication doses in intensive care units: a pharma cist-led intervention. J Res Pharm Pract. 2020;9(1):36-43. doi: 10.4103/jrpp.JRPP_19_95.

[6] Unique Health Identifier for India: An Algorithm and Feasibility Analysis on Patient Data / Authors: Sumit Soman, Praveen K. Srivastava, Dr. B.K. Murthy / September 30, 2015 / ISSN: Print – 2165-758X | eISSN –2165-7598

[7] M. Vejdani, M. Varmaghani, M. Meraji, J. Jamali, E. Hooshmand, and A. Vafaee-Najar, "Electronic prescription system requirements: A scoping review," BMC Med. Inform. Decis.Mak., vol. 22, no. 231, pp. 1–13, 2022

[8] Alomar MJ, Ahmad S, Moustafa Y, Alharbi LS. Reducing missed medication doses in intensive care units: a pharma cist-led intervention. J Res Pharm Pract. 2020;9(1):36-43. doi: 10.4103/jrpp.JRPP_19_95.

[9] C. M. S. Tulinao and N. C. Bool, "QR Code Integration in Retail Pharmacy: A Service Quality Framework Analysis using PLS-SEM on Customer Outcomes," Finance and Management Studies (JEFMS), vol. 8, no. 2, Feb. 2025. doi: 10.47191/jefms/v8-i2-16

[10] S. Faisal, J. Ivo, K.-A. Prior, C. McMillan, and T. Patel, "Implementation of a Real-Time Medication Intake Monitoring Technology Intervention in Community," Pharmacy, vol. 9, no.2, 2021.doi: 10.3390/pharmacy9020105.

[11] S. Bhakta, N. Deyhim, N. Zafar, and G. Abbasi, "Implementation and Evaluation of an EHR-Integrated Mobile Dispense Tracking Technology in a Large Academic Tertiary Hospital," American Journal of Health-System Pharmacy, vol. 79, 2022. doi: 10.1093/ajhp/zxac154.

[12] S. Soman, P. K. Srivastava, and B. K. Murthy, "Unique Health Identifier for India: An Algorithm and Feasibility Analysis on Patient Data," Journal of Pharmacy Technology, vol. 38, no. 2, 2022. doi: 10.1177/87551225211069001.

[13] G. M. Vejdani et al., "Electronic Prescription System Requirements: A Scoping Review," BMC, 2022. doi: 10.1186/s12911- 022-01948-w.