Medvault: A Decentralized Medical Record Storage System with Provenance Awareness

[1]Abhinav Babu, [2]Abhinav Shaji, [3]Abhishek K, [4]Anirudh Babu, [5]Silja Varghese

[1]Student, [2]Student, [3]Student, [4]Student, [5]Assistant Professor (CSE)
Computer Science and Engineering Department,
Nehru College of Engineering and Research Centre (NCERC), Thrissur, India

---***---

Abstract - This report presents a decentralized medical record storage system with provenance awareness to address challenges in healthcare data management. Traditional centralized systems face data breaches and inefficiencies, limiting patient control. The proposed system leverages blockchain for secure, decentralized storage, eliminating single points of failure and enhancing privacy. A Directed Acyclic Graph (DAG) structure ensures transparency by tracking the complete history of each record. A dynamic access control mechanism grants permissions based on data lineage, improving efficiency. To prevent misuse, an auditing feature based on Nash equilibrium incentivizes proper reporting. Smart contracts automate key processes, reducing intermediaries and ensuring seamless transactions. This approach empowers patients with greater control over their health data while enabling secure and efficient sharing among healthcare providers. The system lays the foundation for improved data management and potential AI integration for future advancements.

Key Words: decentralized, blockchain, data privacy, DAG, smart contracts

1.INTRODUCTION

Effective management of medical records is crucial for high-quality healthcare. However, existing systems often face significant challenges, especially in terms of data security, privacy, and accessibility. Traditional centralized models store patient information in a single location, making them vulnerable to data breaches, system failures, and unauthorized access. Additionally, these systems often result in fragmented patient data spread across multiple platforms, leading to inefficiencies in accessing complete medical histories. This hinders timely and accurate diagnosis, ultimately affecting patient outcomes [4].

To address these issues, there is a growing need for decentralized solutions that can provide secure, efficient, and patient-controlled management of health data [2]. Blockchain technology has emerged as a promising tool for decentralized data management, offering features such as tamper-proof storage, transparency, and enhanced data security. By leveraging blockchain, healthcare systems can reduce the risks of single points of failure and ensure that medical records are securely shared across different entities.

This report proposes a decentralized medical record storage system with provenance awareness. The system utilizes a Directed Acyclic Graph (DAG) structure to organize and track the complete history (provenance) of medical records, ensuring that all interactions with patient data are transparent and traceable. This allows patients to have greater control over their information, deciding who can access their data[1]. Additionally, a dynamic access control mechanism streamlines data-sharing processes, granting automatic permissions based on data lineage and reducing the need for manual intervention [7].

The system also incorporates an auditing mechanism based on Nash equilibrium principles, encouraging fair and honest reporting of data access to prevent misuse. Smart contracts further automate key processes, ensuring seamless, secure, and efficient transactions. This decentralized approach aims to enhance data security, patient empowerment, and interoperability in healthcare, laying a foundation for improved healthcare outcomes and the potential integration of advanced technologies such as artificial intelligence (AI).

2. LITERATURE REVIEW

[1] MedRec is a blockchain-based system designed to improve electronic health record (EHR) management by enhancing data access, interoperability, and patient control. Traditional EHR systems suffer from fragmentation and security risks. MedRec addresses these issues by using blockchain to store metadata that points to off-chain medical records. This immutable ledger ensures data integrity and provides a transparent way to track patient-provider interactions. Patients can grant or revoke access permissions, ensuring they retain control over their medical information. MedRec integrates with existing EHR infrastructures, allowing healthcare providers to adopt it without overhauling their systems. The system aggregates patient records from multiple providers, creating a comprehensive medical history. To sustain the blockchain network, MedRec incentivizes participants, such as researchers, by granting access to anonymized data in exchange for network validation. By leveraging blockchain, MedRec enhances data security, privacy, and interoperability, reducing breaches and improving patient outcomes. Its decentralized model sets a foundation for future healthcare blockchain applications, improving trust and efficiency in medical data management.

[2] Blockchain Distributed Ledger Technologies for Biomedical and Healthcare Applications explores blockchain’s potential in healthcare, particularly for electronic health records (EHR) and biomedical data management. Traditional healthcare systems suffer from fragmentation, security vulnerabilities, and poor interoperability. Blockchain offers a decentralized and immutable ledger to ensure data integrity, transparency, and secure access. Every transaction, including updates and access to medical records, is permanently recorded, preventing tampering and unauthorized modifications. The paper highlights how blockchain facilitates secure data sharing among healthcare providers while

maintaining patient privacy. Through smart contracts, data-sharing agreements and access control mechanisms can be automated, eliminating intermediaries and streamlining processes. The study also discusses broader applications such as clinical trials, drug supply chains, and patient consent management. While blockchain presents advantages, challenges like scalability, cost, and regulatory compliance remain. The authors conclude that blockchain could revolutionize healthcare data management by improving security, transparency, and efficiency. Future research should focus on overcoming existing barriers to enable widespread adoption in healthcare settings.

[3] Blockchain for Secure EHR Sharing in Mobile Cloud-Based E-Health Systems examines the role of blockchain in improving the security and efficiency of electronic health record (EHR) sharing in mobile cloud-based e-health systems. Centralized healthcare databases are vulnerable to breaches, unauthorized access, and interoperability challenges. The proposed blockchain-based solution ensures secure data transactions, preventing tampering and unauthorized modifications. The system integrates blockchain with cloud storage, storing medical data off-chain while keeping immutable access logs on-chain. This hybrid approach enhances scalability while ensuring security and transparency. Smart contracts automate access control, enabling patients to grant or revoke permissions seamlessly. The study also addresses common challenges such as latency, computational costs, and blockchain scalability. By using a combination of on-chain and off-chain storage, the system efficiently manages large-scale EHRs. The authors conclude that integrating blockchain with mobile cloud platforms provides a secure and efficient solution for EHR management. This approach improves data privacy, interoperability, and secure sharing among healthcare providers, leading to better healthcare delivery.

[4] Medical Blockchain: Data Sharing and Privacy-Preserving EHRs Using Smart Contracts introduces a blockchain-based framework to enhance the security and privacy of electronic health records (EHRs). Current EHR systems suffer from breaches, unauthorized access, and lack of interoperability. The proposed framework employs smart contracts for automated access control, ensuring that only authorized entities can access sensitive health data. Encryption techniques further safeguard data during storage and transmission. The decentralized structure prevents tampering, maintaining the integrity of patient information. The system also promotes interoperability by enabling seamless data exchange among healthcare providers while upholding privacy standards. Simulations comparing the framework with traditional systems indicate improvements in security, efficiency, and scalability. The decentralized approach reduces dependency on centralized authorities, minimizing security risks. The authors conclude that blockchain technology can revolutionize EHR management, making data sharing more secure and efficient. Further research is recommended to refine the system and explore real-world applications.

[5] A Novel Blockchain-Based Electronic Health Record Automation System presents a blockchain-based electronic health record (EHR) automation system to address healthcare data fragmentation and security concerns. Traditional EHR systems often rely on centralized databases, making them vulnerable to breaches and inefficiencies. The proposed system uses a Modified Merkle Tree structure to store immutable patient data securely. Cryptographic hash functions ensure integrity and prevent unauthorized alterations. Blockchain's decentralized nature enhances data security by eliminating single points of failure. The system facilitates real-time data exchange among healthcare providers, improving interoperability and emergency response. Performance trials indicate reduced delays, enhanced data privacy, and increased efficiency in sharing patient records. The authors advocate for further research to refine scalability and practical implementation. If adopted, this solution could set a new standard for secure, patient-centric healthcare data management.

[6] BPDAC: A Blockchain-Based Provenance-Enabled Dynamic Access Control Scheme proposes BPDAC, a blockchain-based access control scheme that improves security and flexibility over traditional static models like ACL, RBAC, and ABAC. These conventional models suffer from single points of failure and limited scalability. BPDAC integrates blockchain with smart contracts to enable decentralized, dynamic access control based on user behavior and data lineage. The system uses a quick lookup table for efficient access evaluation, reducing computational overhead. A prototype built on Hyperledger Fabric demonstrates improved scalability and performance. The approach enhances data integrity, privacy, and transparency, particularly in cloud-based environments. The study concludes that BPDAC can significantly improve security, efficiency, and trust in modern distributed systems.

[7] ZeeStar is a blockchain-based system designed to enhance privacy in smart contracts using homomorphic encryption and zero-knowledge proofs (ZKP). While existing privacy solutions, like zkay, secure on-chain data, they fail to allow operations on encrypted foreign data. ZeeStar overcomes this by enabling encrypted computations using homomorphic encryption while maintaining privacy guarantees with ZKP. The system simplifies privacy enforcement by using a dedicated language and compiler. Implemented on Ethereum, ZeeStar ensures efficient privacy-preserving smart contracts with practical gas costs. The study highlights its potential for confidential transfers and multi-party computations, making blockchain transactions more secure and privacy-compliant.

[8] Smart Contract-Based Access Control for Cloud Smart Healthcare Systems presents a blockchain-based access control framework for managing electronic medical records (EMRs) in cloud healthcare systems. Traditional centralized cloud solutions pose risks of breaches and unauthorized access. The proposed system leverages smart contracts for user verification, access authorization, misbehavior detection, and access revocation. Data is encrypted with Elliptic Curve Cryptography (ECC) and stored in the cloud, while hashes are recorded on-chain for integrity. Performance evaluations indicate reduced network congestion, improved access efficiency, and lower latency. Future research could explore edge computing integration for further performance enhancements.

[9] Secure EHR Sharing with IoT-Based Hyperledger Blockchain explores integrating IoT with Hyperledger blockchain to enhance the secure sharing of electronic health records (EHRs). Smart contracts automate access control and

ensure only authorized personnel can interact with patient data. Encryption techniques safeguard data confidentiality, while blockchain ensures integrity. Performance analysis demonstrates improved scalability and efficiency compared to traditional systems. IoT integration enables real-time patient data monitoring, enhancing care quality. The study suggests potential applications in telemedicine and remote monitoring, contributing to a more secure and efficient healthcare ecosystem.

[10] Blockchain-Based Electronic Healthcare Record System for Healthcare 4.0 examines the role of blockchain in integrating IoT and AI for healthcare data management. Traditional EHR systems suffer from security and interoperability issues. The proposed decentralized model enhances data integrity and patient control while facilitating secure data exchange among providers. Blockchain's transparency and immutability foster trust in healthcare ecosystems. The study emphasizes patient-centered healthcare models, advocating for further research to optimize scalability and real-world adoption. Blockchain's role in securing smart healthcare systems is highlighted as a transformative solution for the future of healthcare.

3. PROBLEM STATEMENT

The healthcare industry faces major challenges in medical record management due to vulnerabilities in centralized systems, making them prime targets for cyberattacks and data breaches [2]. Unauthorized access can lead to identity theft, fraudulent claims, and privacy violations. Additionally, the lack of clear provenance tracking raises accountability concerns, affecting data accuracy and patient safety [1]. Fragmented records further hinder timely access to critical patient information, delaying diagnoses and reducing patient control over their health data [7]. Moreover, weak auditing mechanisms allow unauthorized modifications to go undetected. These issues highlight the need for a decentralized medical record system that enhances security, ensures traceability, empowers patients, streamlines access, and strengthens auditing capabilities to safeguard sensitive healthcare data.

4. MedVault: THE PROPOSED SYSTEM

Efficient and secure medical record management is crucial in modern healthcare. Traditionally, centralized systems facilitated hospital data storage and sharing but are vulnerable to data breaches, unauthorized access, and inefficiencies. These risks, including data fragmentation, single points of failure, and limited patient control, make centralized databases unsuitable for safeguarding sensitive health information.

To mitigate these issues, the proposed system leverages blockchain technology and provenance awareness to create a decentralized medical record storage solution. By distributing records across multiple nodes, the system enhances security, minimizes unauthorized access, and prevents data loss. Provenance tracking via a Directed Acyclic Graph (DAG) ensures transparent logging of all interactions with medical data, providing a verifiable history of record creation, access, and modification [1]. This system aims to improve data privacy, transparency, and patient autonomy. Key objectives include:

- Preventing unauthorized access and breaches through tamper-proof decentralized storage.
- Maintaining a transparent audit trail of all medical record activities.
- Empowering patients with full control over their data access permissions.
- Enabling efficient and secure medical record sharing among healthcare providers via smart contracts and dynamic access control.

This paper presents a detailed overview of MedVault: A Decentralized Medical Record Storage System With Provenance Awareness outlining its key modules. They are given below:

1. Registration and Login Module: This entry point allows both patients and doctors to register with the system, storing their details on-chain. It likely prompts MetaMask connection for authentication and redirects to the appropriate dashboard (patient or doctor) upon successful registration. The page ensures only registered users proceed.
2. Patient Dashboard Module: This serves as the central hub for patients, displaying their profile details (e.g., name, contact, DOB, blood group). It likely includes options to sign out or delete their account and provides navigation to other patient-specific modules. The interface uses a clean layout with a sidebar and action buttons.
3. View Medical Records Module: Patients can view his/her medical records stored on the blockchain. The page likely features a table listing records (e.g., IPFS hashes, doctor names, visit dates) with options to view details or download files.
4. Upload Medical Records Module: Patients use this module to upload new medical records to the blockchain with details like IPFS hash, doctor name, and visit dates. It includes a form with file upload functionality, progress indicators, and a recent uploads list, styled consistently. The page supports related visit fields for linking records, enhancing data organization.
5. Grant Access to Doctor Module: Patients manage doctor access to their records here, calling AccessControl.grantAccess or revokeAccess to update permissions stored in the doctorAccess mapping. The interface likely lists registered doctors (from MedVault) and provides buttons to grant or revoke access, with immediate blockchain updates. It ensures only patients can modify access, maintaining privacy and control over their data.
6. Access Log Module: Patients monitor who has accessed their records through this module. It displays a filterable table with details like doctor name, hospital, record type, timestamp, and status (authorized/unauthorized). The page enhances transparency, allowing patients to track access attempts and verify permissions.
7. Doctor Dashboard Module: Doctors access this module to view their profile (e.g., name, license number, hospital) from MedVault and manage patient interactions. The design would mirror the patient dashboard's sidebar and layout for consistency.
8. Access Medical Records Module: This page allows doctors to search for a patient's records who've granted

them access, with clickable links to see detailed records. Upon searching for a patient, it displays a table of records (e.g., IPFS hash, visit date, reason), with each access attempt logged. Styled similarly to the patient's View Medical Records Module, it includes buttons for viewing or downloading files, restricted to authorized records only.

9. Add Medical Records Module: A dedicated page for doctors to add new medical records for patients who've granted them access. It features a form similar to Upload Medical Records Module (file upload, doctor name, reason, visit date. Only doctors registered in MedVault can submit records, ensuring data integrity.

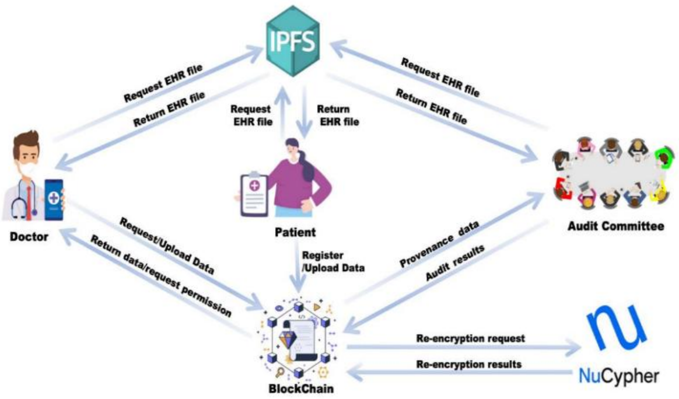
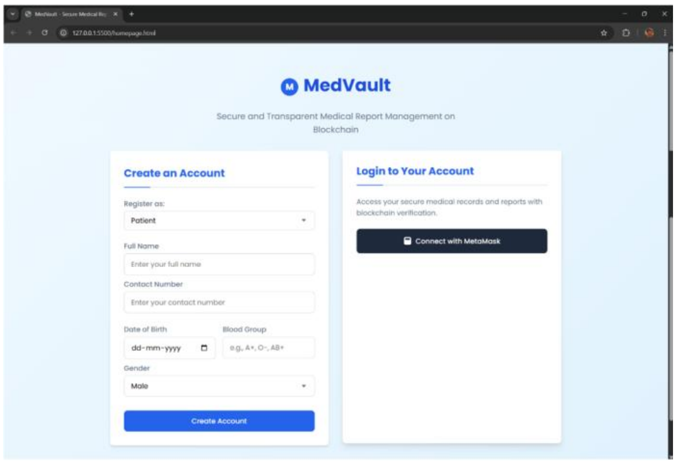


Fig 1: The main components of MedVault

5. RESULTS AND DISCUSSION

MedVault leverages blockchain, smart contracts, and decentralized storage to enhance medical record security, efficiency, and reliability. It ensures tamper-proof data storage, Ethereum-based identity verification, and IPFS integration for encrypted off-chain records. Smart contracts enable precise access control, while MetaMask facilitates secure transactions. A web-based portal provides real-time access logs, patient record status, and medical data volume. MedVault minimizes administrative costs, enhances patient privacy, reduces data errors, and ensures long-term sustainability by eliminating paper-based records. Real-time oversight and decentralized technologies make it resilient to unauthorized access while optimizing healthcare data management. By leveraging blockchain's transparency and security, MedVault strengthens trust in medical records, ensuring that healthcare providers and patients have a secure and efficient system for managing sensitive information. Its adoption reduces operational costs while reinforcing the integrity of healthcare data. MedVault sets a new standard for secure, transparent, and efficient medical record management in the digital age.


MedVault

Secure and Transparent Medical Report Management on Blockchain

Create an Account

Register as: Patient

Full Name: Enter your full name

Contact Number: Enter your contact number

Date of Birth: dd-mm-yyyy

Blood Group: e.g., A+, O-, AB+

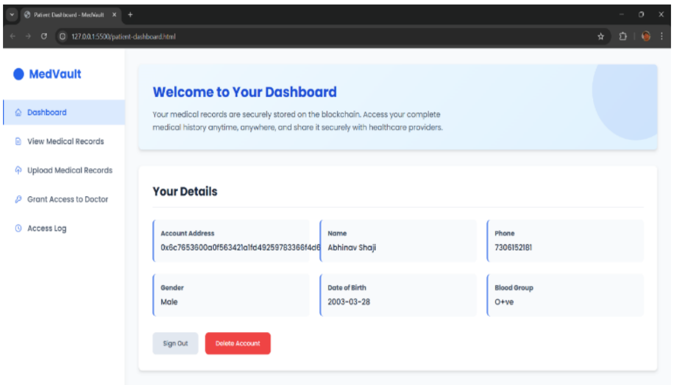
Gender: Male

Login to Your Account

Access your secure medical records and reports with blockchain verification.

Fig 2: Login Page

The login page screenshot showcases a clean, user-friendly interface designed to authenticate users securely into the MedVault system. It likely features input fields for credentials and a MetaMask integration button, reflecting the blockchain-based authentication mechanism central to the platform.



Welcome to Your Dashboard

Your medical records are securely stored on the blockchain. Access your complete medical history anytime, anywhere, and share it securely with healthcare providers.

Your Details

Account Address: 0x6c7653600a0f563421a1fd49259783366f4d6

Name: Abhinav Shaji

Phone: 7306152181

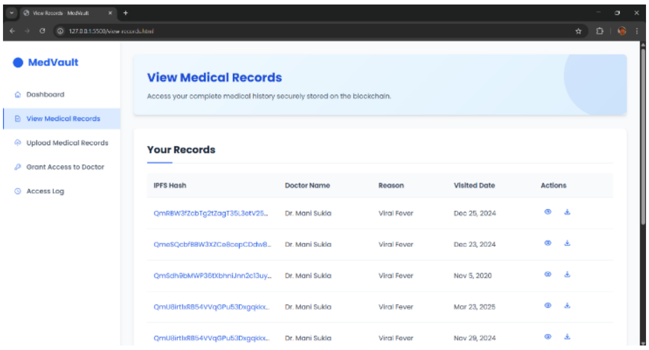
Gender: Male

Date of Birth: 2003-03-28

Blood Group: O+ve

Fig 3: Patient's Dashboard

The patient dashboard screenshot displays a streamlined interface, presenting key personal details like Ethereum address, name, and medical information retrieved from the blockchain. It includes a "Copy Address" button for easy sharing with healthcare providers, emphasizing usability and secure data management within the MedVault system.



View Medical Records

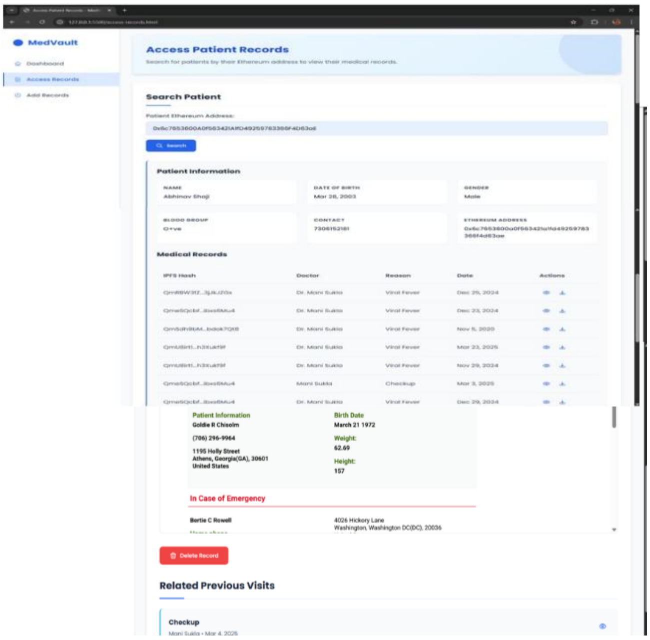
Access your complete medical history securely stored on the blockchain.

Your Records

IPFS Hash	Doctor Name	Reason	Visited Date	Actions
QmRBW3fZcbTg2tZagT35L3etV25...	Dr. Mani Sukla	Viral Fever	Dec 25, 2024	👁 ⤓
QmeSQcbfB8W3XZCe8capCDdw8...	Dr. Mani Sukla	Viral Fever	Dec 23, 2024	👁 ⤓
QmSdh9bMWP36tXbhniJnn2cl3uy...	Dr. Mani Sukla	Viral Fever	Nov 5, 2020	👁 ⤓
QmU8irtlxR854VVqGPu53Dxgqkkx...	Dr. Mani Sukla	Viral Fever	Mar 23, 2025	👁 ⤓
QmU8irtlxR854VVqGPu53Dxgqkkx...	Dr. Mani Sukla	Viral Fever	Nov 29, 2024	👁 ⤓

Fig 4: View Medical Records

The view records page screenshot reveals a structured layout, listing the patient's medical history retrieved securely from the Ethereum blockchain. It likely features a table or card design with details such as dates, diagnoses, and treatments, ensuring easy access and readability for users within the MedVault platform.



127.0.0.1:5500/access-records.html

MedVault

- Dashboard
- Access Records
- Add Records

Access Patient Records

Search for patients by their Ethereum address to view their medical records.

Search Patient

Patient Ethereum Address:
0x6c7653600A0f563421AffD49259783366F4D63a6

Search

Patient Information

NAME Abhinav Shaji	DATE OF BIRTH Mar 28, 2003	GENDER Male
BLOOD GROUP O+ve	CONTACT 7306152181	ETHEREUM ADDRESS 0x6c7653600a0f563421affd49259783366f4d63ae

Medical Records

IPFS Hash	Doctor	Reason	Date	Actions
QmRBW3fZ...3jJkJZGx	Dr. Mani Sukla	Viral Fever	Dec 25, 2024	
Qme5Qcbf...8bx6Mu4	Dr. Mani Sukla	Viral Fever	Dec 23, 2024	
QmSdh9bM...bdok7Q8	Dr. Mani Sukla	Viral Fever	Nov 5, 2020	
QmUBirt1...h3Xukf9f	Dr. Mani Sukla	Viral Fever	Mar 23, 2025	
QmUBirt1...h3Xukf9f	Dr. Mani Sukla	Viral Fever	Nov 29, 2024	
Qme5Qcbf...8bx6Mu4	Mani Sukla	Checkup	Mar 3, 2025	
Qme5Qcbf...8bx6Mu4	Dr. Mani Sukla	Viral Fever	Dec 29, 2024	

Patient Information
Goldie R Chisolm
(706) 296-9964
1195 Holly Street
Athens, Georgia(GA), 30601
United States

Birth Date
March 21 1972
Weight:
62.69
Height:
157

In Case of Emergency

Bertie C Rowell
4026 Hickory Lane
Washington, Washington DC(DC), 20036

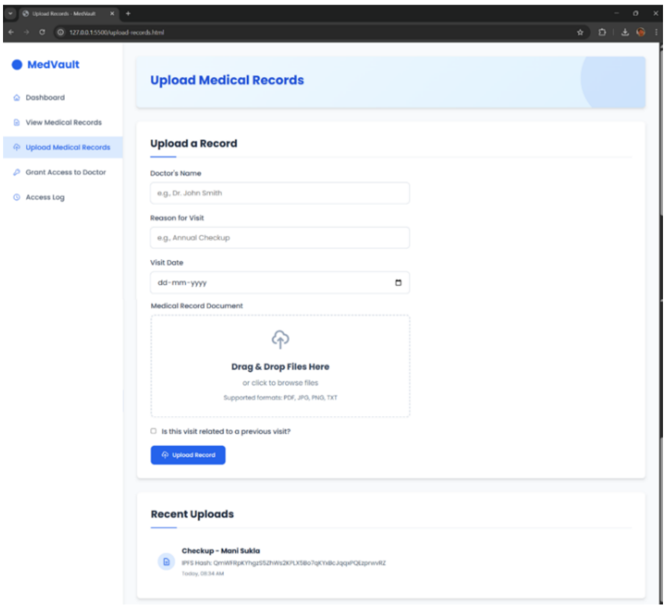
Delete Record

Related Previous Visits

Checkup
Mani Sukla • Mar 4, 2025

Fig 5: Record Details

The record details screenshot for the patient highlights a detailed view of a specific medical record, pulled from the blockchain, with fields like date, doctor's name, diagnosis, and treatment notes. This page within MedVault ensures patients can review comprehensive, tamper-proof record information in an organized and accessible format.



Upload Records - MedVault
127.0.0.1:5500/upload-records.html

MedVault

- Dashboard
- View Medical Records
- Upload Medical Records
- Grant Access to Doctor
- Access Log

Upload Medical Records

Upload a Record

Doctor's Name
e.g., Dr. John Smith

Reason for Visit
e.g., Annual Checkup

Visit Date
dd-mm-yyyy

Medical Record Document
Drag & Drop Files Here
or click to browse files
Supported formats: PDF, JPG, PNG, TXT

□ Is this visit related to a previous visit?

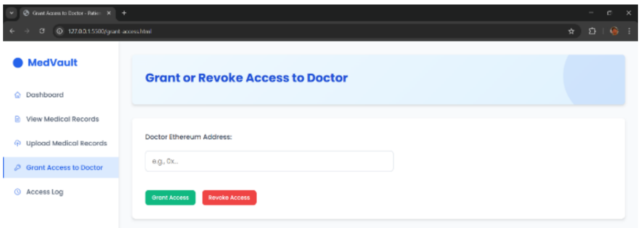
Upload Record

Recent Uploads

Checkup - Mani Sukla
IPFS Hash: QmWFRpKYhgzS5ZhWs2KPLX5Bo7qKYxBcJqqxPQEzprwvRZ
Today, 08:34 AM

Fig 6: Upload Medical Record

The upload medical record screenshot illustrates a straightforward interface where patients can input and submit new medical data to be stored on the Ethereum blockchain. It likely includes fields for details like date, description, and file attachments, ensuring secure and efficient record addition within the MedVault system.



Grant Access to Doctor - Patien
127.0.0.1:5500/grant-access.html

MedVault

- Dashboard
- View Medical Records
- Upload Medical Records
- Grant Access to Doctor
- Access Log

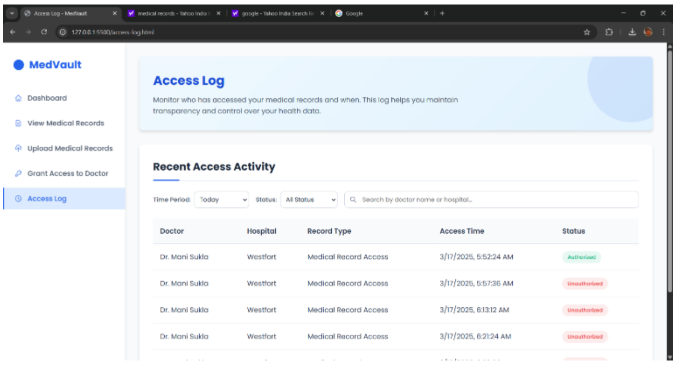
Grant or Revoke Access to Doctor

Doctor Ethereum Address:
e.g., 0x...

Grant Access Revoke Access

Fig 7: Grant/ Revoke Access to Doctor

The grant/revoke access to doctor screenshot showcases an intuitive interface where patients can manage permissions by entering a doctor's Ethereum address and toggling access rights. This MedVault feature, linked to the smart contract, ensures secure, patient-controlled authorization for doctors to view or modify medical records.



Access Log - MedVault | medical records - Yahoo India | google - Yahoo India Search Re | Google
127.0.0.1:5500/access-log.html

MedVault

- Dashboard
- View Medical Records
- Upload Medical Records
- Grant Access to Doctor
- Access Log

Access Log

Monitor who has accessed your medical records and when. This log helps you maintain transparency and control over your health data.

Recent Access Activity

Time Period: Today Status: All Status Search by doctor name or hospital...

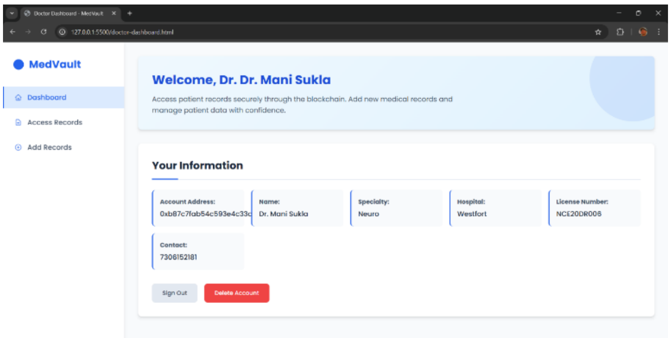
Doctor	Hospital	Record Type	Access Time	Status
Dr. Mani Sukla	Westfort	Medical Record Access	3/17/2025, 5:52:24 AM	Authorized
Dr. Mani Sukla	Westfort	Medical Record Access	3/17/2025, 5:57:36 AM	Unauthorized
Dr. Mani Sukla	Westfort	Medical Record Access	3/17/2025, 6:13:12 AM	Unauthorized
Dr. Mani Sukla	Westfort	Medical Record Access	3/17/2025, 6:21:24 AM	Unauthorized

Fig 8 : Access Log

The access log screenshot presents a clear, chronological list of interactions with the patient's medical records, detailing who accessed them and when, as recorded on the blockchain. This MedVault feature enhances transparency and accountability, allowing patients to monitor and verify all record activities securely.

Fig 9: Doctor's Dashboard

The doctor dashboard screenshot displays a centralized interface where authorized doctors can view a list of patients and their granted access status, retrieved from the Ethereum blockchain. It likely includes options to access or add records, providing a secure and efficient workspace within the MedVault system for managing patient care.



Doctor Dashboard - MedVault
127.0.0.1:5500/doctor-dashboard.html

MedVault

- Dashboard
- Access Records
- Add Records

Welcome, Dr. Dr. Mani Sukla

Access patient records securely through the blockchain. Add new medical records and manage patient data with confidence.

Your Information

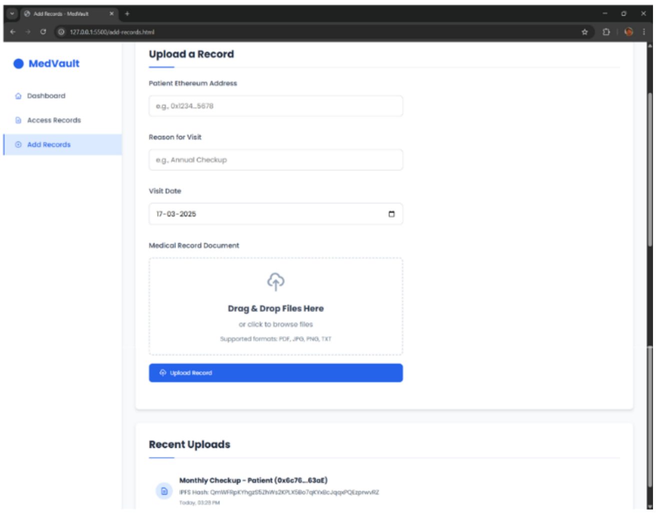
Account Address: 0xb87c7fab54c593e4c33c	Name: Dr. Mani Sukla	Specialty: Neuro	Hospital: Westfort	License Number: NCE20DR006
Contact: 7306152181				

Sign Out Delete Account

Fig 10: Access Patient Records

The access patient records screenshot illustrates a detailed view for doctors, showcasing a patient's medical history retrieved from the blockchain after access is granted. This MedVault page likely organizes records by date and type, enabling doctors to review critical health information securely and efficiently.

Fig 11: Add Records



Upload a Record

Patient Ethereum Address: e.g., 0x1234...5678

Reason for Visit: e.g., Annual Checkup

Visit Date: 17-03-2025

Medical Record Document

Drag & Drop Files Here
or click to browse files
Supported formats: PDF, JPG, PNG, TXT

Upload Record

Recent Uploads

Monthly Checkup - Patient (0x6c76...63aE)
IPFS Hash: QmWFRpKYhgzS5ZhWs2KPLX5Bo7qKYxBcJqqxPQEzprwvRZ
Today, 03:28 PM

The add records screenshot depicts a user-friendly form where doctors can input new medical data, such as diagnoses or treatments, for a patient with granted access, to be stored on the Ethereum blockchain. This MedVault feature ensures that authorized doctors can securely update patient records, maintaining data integrity and continuity of care.

6. CONCLUSION

The decentralized medical record storage system enhances healthcare data management by addressing security risks, inefficiencies, and limited patient control. Utilizing blockchain, it securely distributes records across a network, minimizing unauthorized access and tampering. A key feature is provenance tracking via a Directed Acyclic Graph (DAG), ensuring transparent logging of all data interactions [1]. This fosters accountability and trust while improving data accuracy. Dynamic access control automates permissions, allowing seamless provider access, while smart contracts enable secure, intermediary-free data sharing [7]. Patients retain full control over their records, enhancing privacy and autonomy. An audit mechanism based on Nash equilibrium ensures oversight and prevents misuse. This scalable system strengthens security, interoperability, and patient empowerment, facilitating efficient data sharing and integration with AI and machine learning.

REFERENCES

[1] L. Sun, D. Liu, Y. Li and D. Zhou, "A Blockchain-Based E-Healthcare System With Provenance Awareness," in IEEE Access, vol. 12, pp. 110098-110112, 2024, doi: 0.1109/ACCESS.2024.3440170

[2] A. Azaria, A. Ekblaw, T. Vieira, and A. Lippman, ''MedRec: Using blockchain for medical data access and permission management,'' in Proc. 2nd Int. Conf. Open Big Data (OBD), Vienna, Austria, Aug. 2016, pp. 25–30, doi: 10.1109/OBD.2016.11.

[3] T.-T. Kuo, H.-E. Kim, and L. Ohno-Machado, ''Blockchain distributed ledger technologies for biomedical and health care applications,'' J. Amer. Med. Inform. Assoc., vol. 24, no. 6, pp. 1211– 1220, Sep. 2017, doi: 10.1093/jamia/ocx068.

[4] D. C. Nguyen, P. N. Pathirana, M. Ding, and A. Seneviratne, ''Blockchain for secure EHRs sharing of mobile cloud based e-health systems,'' IEEE Access, vol. 7, pp. 66792–66806, 2019, doi: 10.1109/ACCESS.2019.2917555.

[5] J.-S. Lee, C.-J. Chew, J.-Y. Liu, Y.-C. Chen, and K.-Y. Tsai, ''Medical blockchain:Data sharing and privacy preserving of EHR based on smart contract,'' J. Inf. Secur. Appl., vol. 65, Mar. 2022, Art. no. 103117, doi: 10.1016/j.jisa.2022.103117.

[6] U. Chelladurai and S. Pandian, ''A novel blockchain based electronic health record automation system for healthcare,'' J. Ambient Intell. Humanized Comput., vol. 13, no. 1, pp. 693–703, 2022, doi: 10.1007/s12652-021- 03163-3.

[7] L. Sun, D. Zhou, D. Liu, J. Tang, and Y. Li, ''BPDAC: A blockchain based and provenance enabled dynamic access control scheme,'' IEEE Access, vol. 11, pp. 42552–142568, 2023, doi: 10.1109/ACCESS.2023.3340887.

[8] S. Steffen, B. Bichsel, R. Baumgartner, and M. Vechev, ''ZeeStar: Private smart contracts by homomorphic encryption and zero-knowledge proofs,'' in Proc. IEEE Symp. Secur. Privacy (SP), San Francisco, CA, USA, May 2022, pp. 179–197, doi: 10.1109/SP46214.2022.9833732

[9] A. Saini, Q. Zhu, N. Singh, Y. Xiang, L. Gao, and Y. Zhang, ''A smart-contract-based access control framework for cloud smart healthcare system,'' IEEE Internet Things J., vol. 8, no. 7, pp. 5914–5925, Apr. 2021, doi: 10.1109/JIOT.2020.3032997.

[10] S. Velmurugan, M. Prakash, S. Neelakandan, and E. O. Martinson, ''An efficient secure sharingof electronic health records using IoTbased hyperledger block chain,'' Int. J. Intell. Syst., vol. 2024, no. 2024, pp. 1–16, Mar. 2024, doi: 10.1155/2024/6995202.

[11] Tanwar, K. Parekh, and R. Evans, ''Blockchain-based electronic healthcare record system for healthcare 4.0 applications,'' J. Inf. Secur. Appl., vol. 50, Feb. 2020, Art. no. 102407, doi: 10.1016/j.jisa.2019.102407.