



**Problem Statement Title: Grid Block Chain Based - PHR**

**Team Name:**

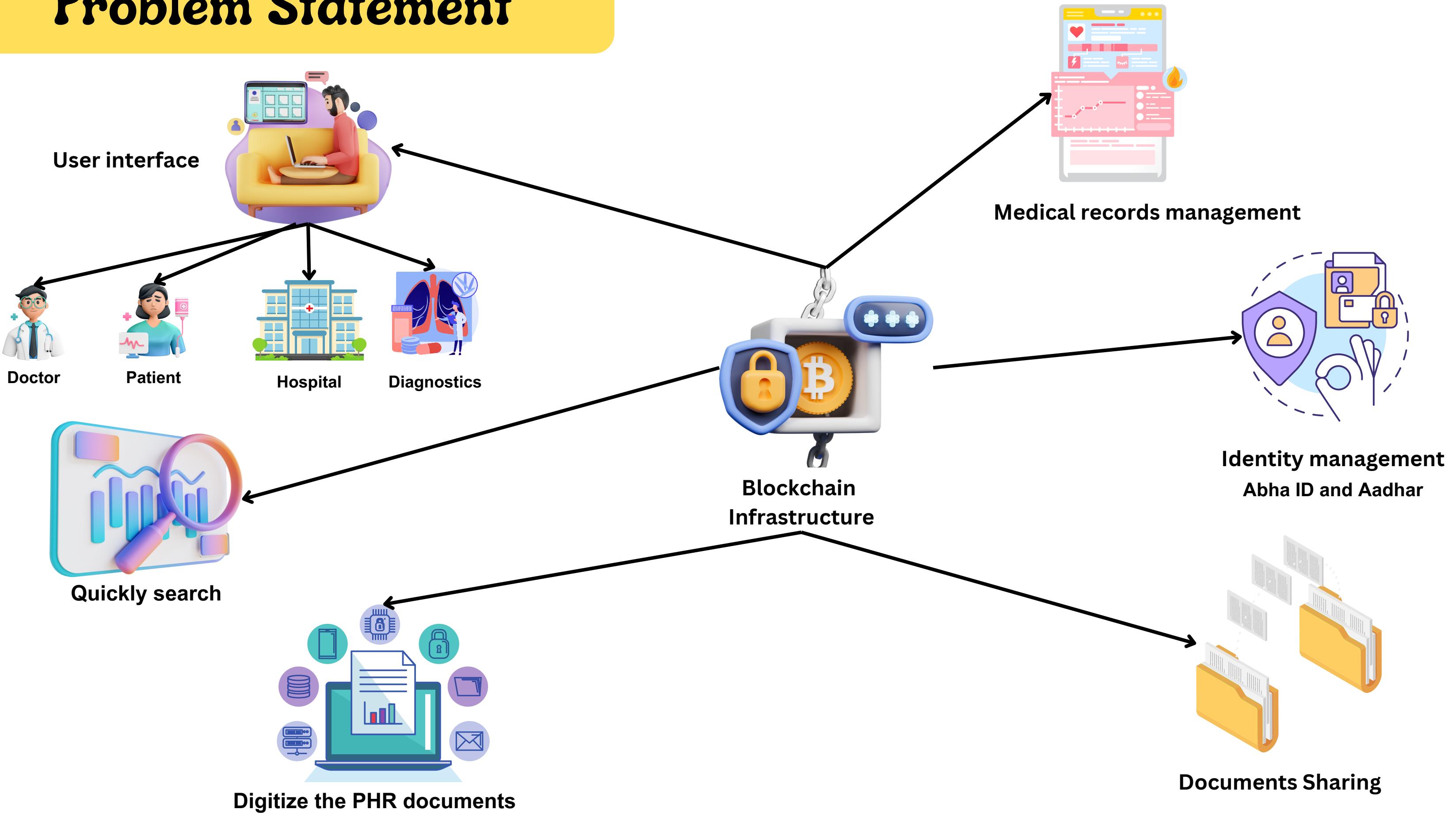
**686250-U1NYW381**

**GITHUB LINK:**[https://github.com/subhamkumarr/FlipKart\\_Grid\\_5.0](https://github.com/subhamkumarr/FlipKart_Grid_5.0)

# Team members details

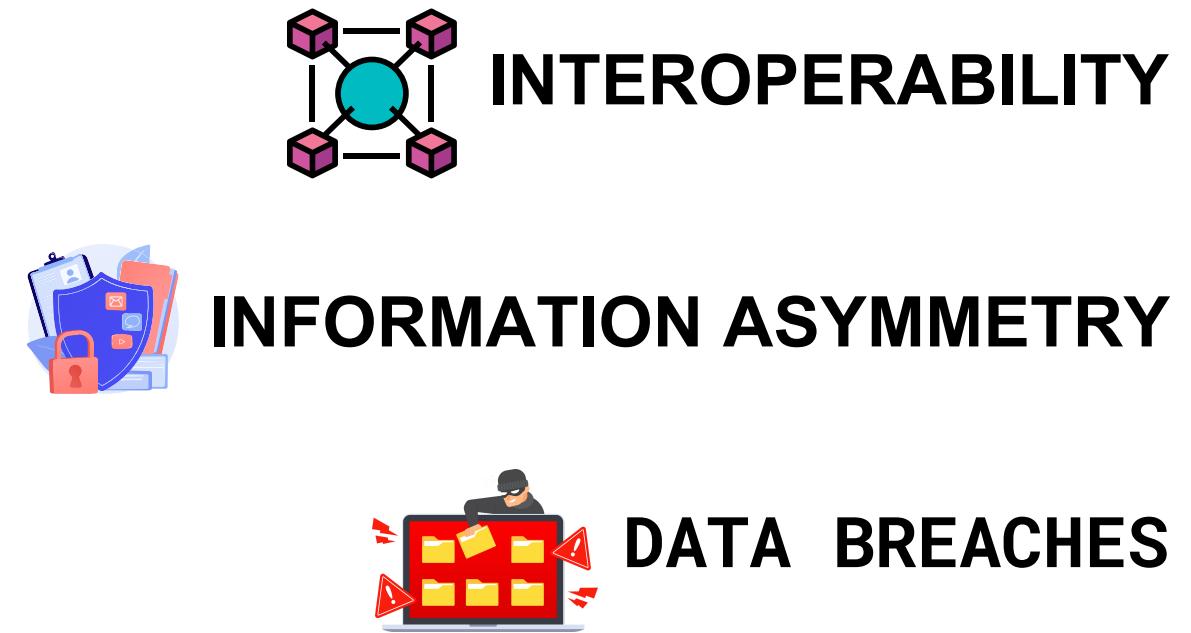
Team Name	<b>686250-U1NYW381</b>		
Institute Name/Names	<b>INDIAN INSTITUTE OF TECHNOLOGY(ISM) DHANBAD</b>		
Team Members	<b>1 (Leader)</b>	<b>2</b>	<b>3</b>
Picture/Name	 <b>JAINENDRA TRIPATHY</b>	 <b>SUBHAM KUMAR</b>	 <b>ADITYA GUPT</b>
Batch	<b>2026</b>	<b>2026</b>	<b>2026</b>

# Problem Statement

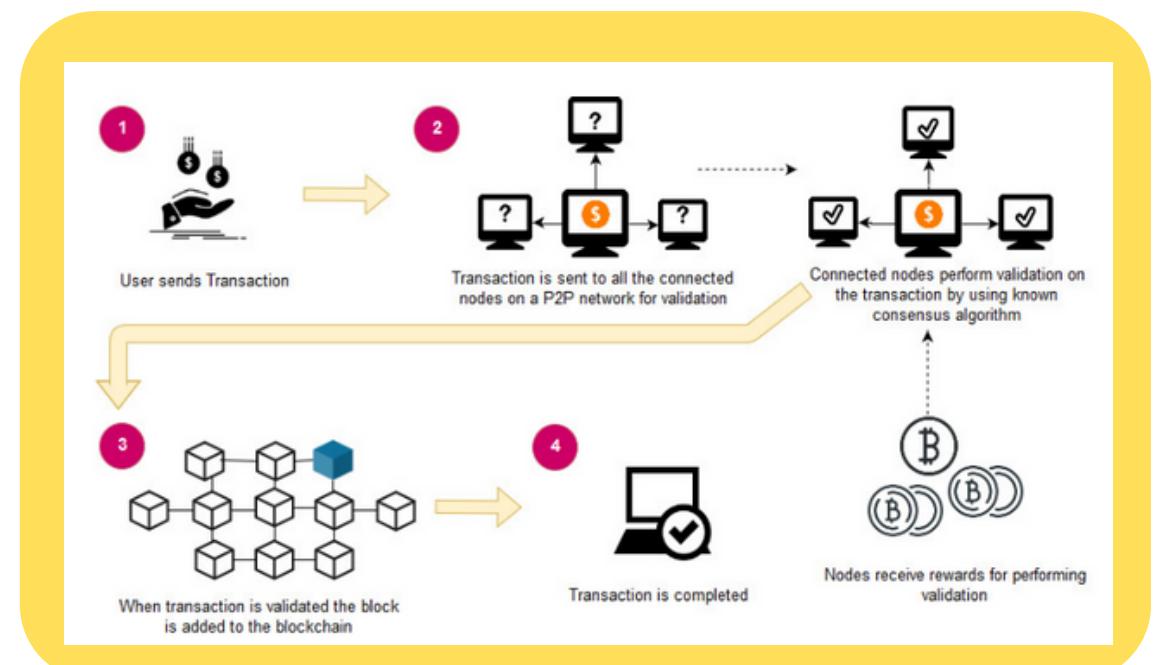


# Why BlockChain For EHR ?

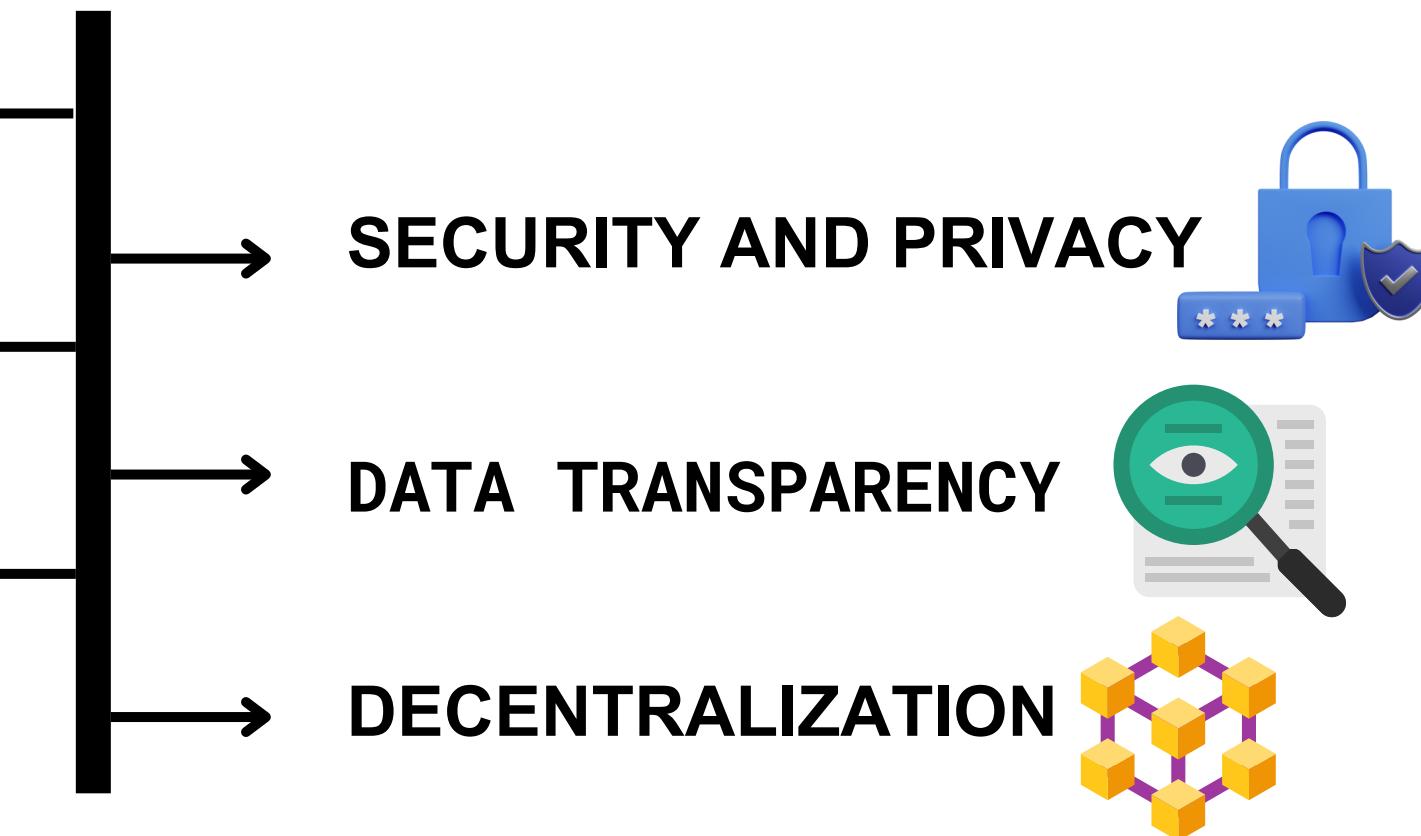
## Existing System Problems



An overview of blockchain architecture.



## Proposed System



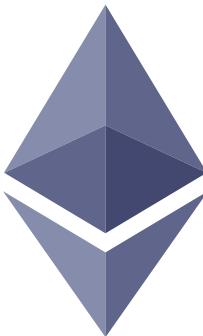
## CHALLENGES FACED BY BLOCKCHAIN TECHNOLOGY



- SCALABILITY AND STORAGE CAPACITY
- LACK OF SOCIAL SKILLS
- LACK OF UNIVERSALLY DEFINED STANDARDS

# Proposed Frameworks

## Fundamental Framework



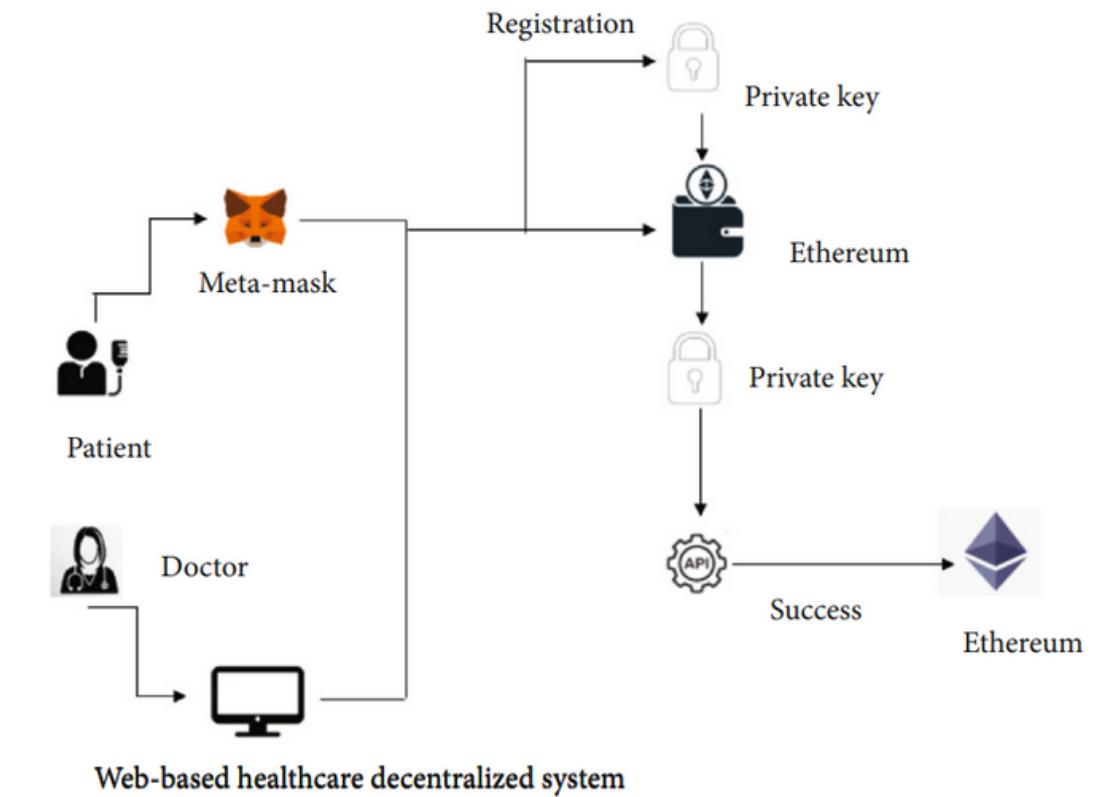
Decentralized Network  
Ethers Cryptocurrency  
Smart Contracts  
Gas Concept  
Transaction Structure



Solidity Programming Language  
Compilation and Deployment  
Implementation Language



Peer-to-Peer Protocol  
Hash Identification  
Data Security  
IPFS Protocol Functionality

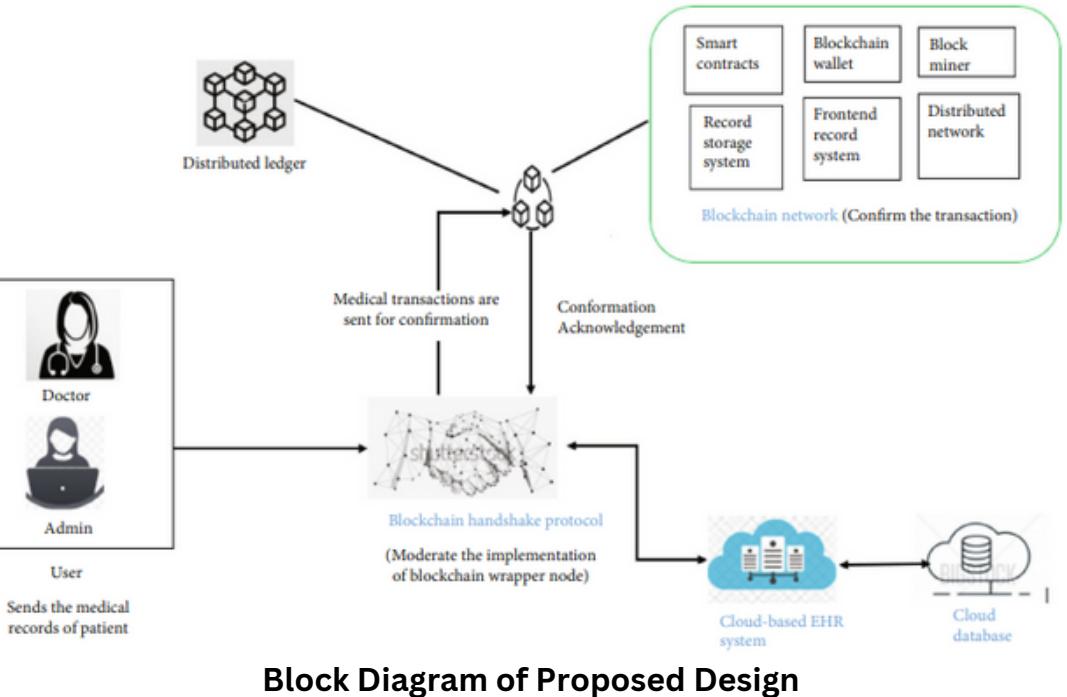


## Protocol Layout

- User Access to Medical Records:** Figure 1 illustrates how patients can view medical records using MetaMask or the healthcare system's decentralized website.
- Automatic Login:** Using the private key from their Ethereum wallet, users are automatically logged in, enhancing security.
- Cold Storage Wallet :**The Ethereum wallet is a cold storage wallet, minimizing compromise risk compared to hot wallets.
- Lost Gadget Replacement:** If a device is lost, patients can easily get a new one without losing medical records.
- Versatile Use:** The wallet serves various purposes like document signing, verification, multiparty patient verification, and role-based access control.
- Emergency Access:** For medical emergencies, a multiparty permission mechanism grants access to patient records.

## Our proposed design

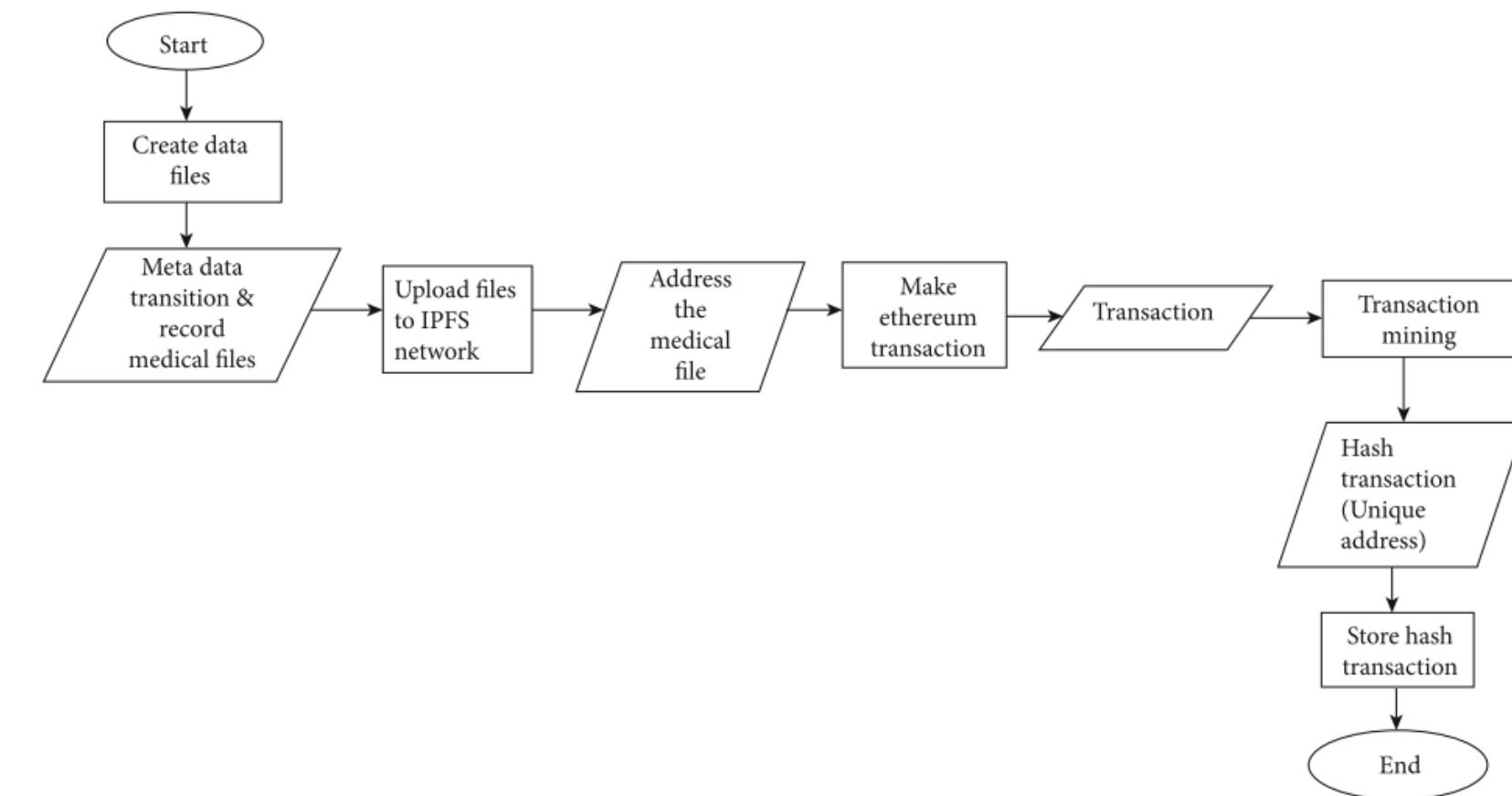
- Four Major Components:** The proposed system includes a user application, blockchain handshake protocol, cloud, and public blockchain network.
- User Application:** Provides access to distinct interfaces for doctors and administrators. Generates initial transactions based on user input.
- Blockchain Handshake Protocol (BH):** Connects database server, blockchain network, and cloud-based health record system. Utilizes Ethereum blockchain.
- Public Blockchain Network:** A distributed ledger connecting blockchain nodes (miners) responsible for updates and transaction authentication.
- Cloud Services:** Offers EHR administration and data storage. Stores health records, processes transactions, and provides data upon user access requests.
- Cloud-Based EHR Administration:** Handles transactions from the BH protocol, performs associated tasks, and stores data in a cloud database.



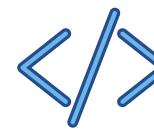
Block Diagram of Proposed Design

# Process of creating a medical record

1. **Creating Medical Record Process:** The Fig. depicts the medical record creation process, starting with the first doctor producing a medical record.
2. **Recording Examination Results:** The doctor then records patient examination results, leading to the processing of metadata transactions for the medical record.
3. **Transaction Metadata:** Metadata, containing transaction details, is appended to transactions after processing, providing comprehensive information regardless of transaction success.
4. **IPFS Network:** Medical files are uploaded to the IPFS network, ensuring efficient transaction completion and content addressing for uploaded files.
5. **Ethereum Transaction:** Ethereum transactions follow, facilitated by Ganache for addresses and private keys, with addresses stored and transactions visible to all.
6. **Ethereum Virtual Machine (EVM):** The EVM processes Ethereum transactions, primarily for smart contract interactions requiring consensus among nodes.
7. **Blockchain History:** Ethereum retains a record of previous transactions and blockchain history, confirmed through consensus and monitored by node operators.
8. **Automated Transaction Processing:** Miners can automate transaction processing upon receipt, functioning as bots for seamless transactions.



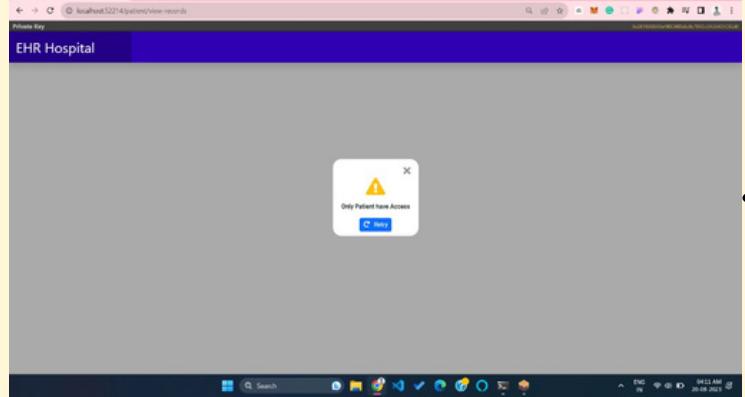
## Software Required

- |   |   |   |  |
|---|---|---|--|
| <br>• <b>Ganache</b> | <br>• <b>Truffle</b>  | <br>• <b>IPFS Kubo</b> | <br>• <b>Language</b> |
| <br>• <b>Web3</b>    | <br>• <b>Metamask</b> | <br>• <b>VS Code</b>   |                       |

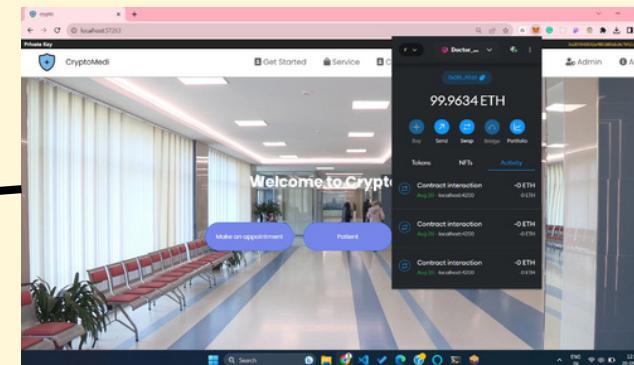


# ACCESS CONTROL

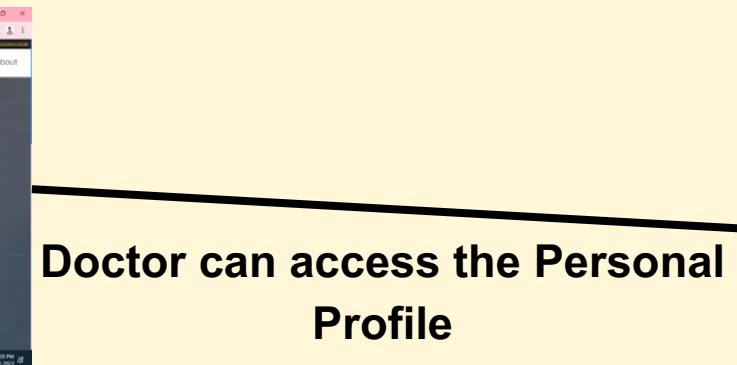
- Using the Role-based access mechanism, this framework makes sure that every entity of the system is assigned a role.
- This system provides a two core security as firstly blockchain technology in itself is secure and secondly our system uses the Role-based access that also only allows the users having defined roles to have access to the system and its functions.



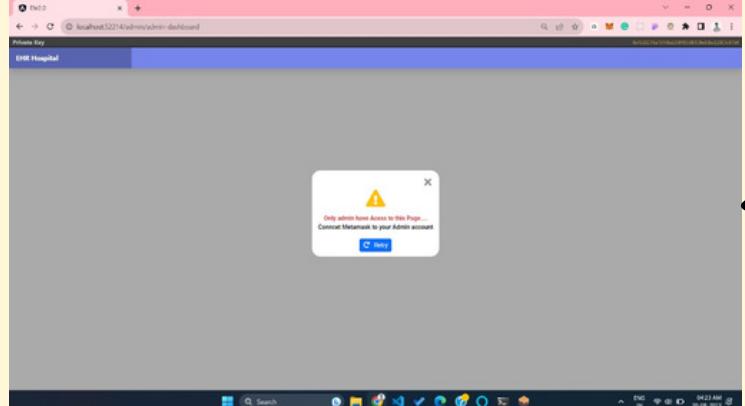
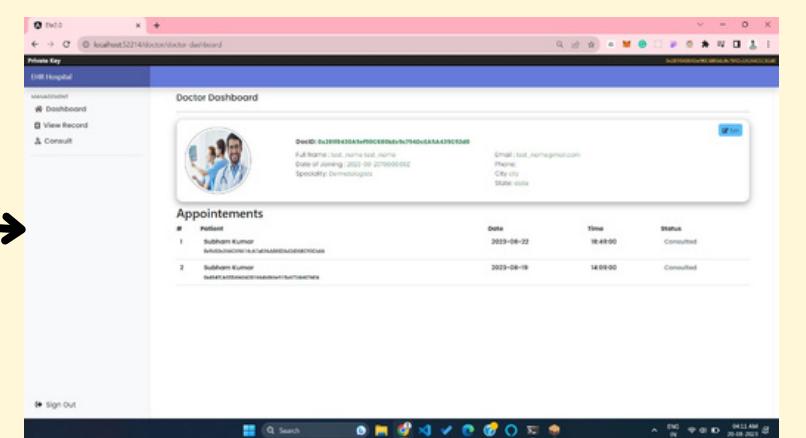
Doctor Cannot access the Patient Data without the access



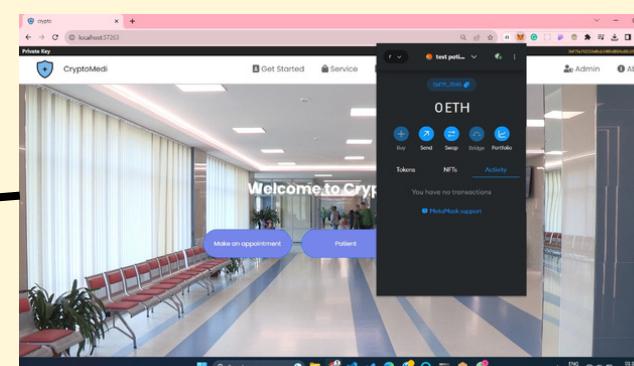
Doctor Granular Acess



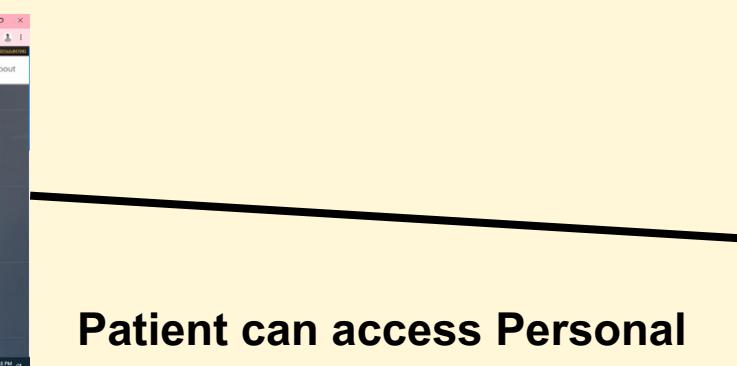
Doctor can access the Personal Profile



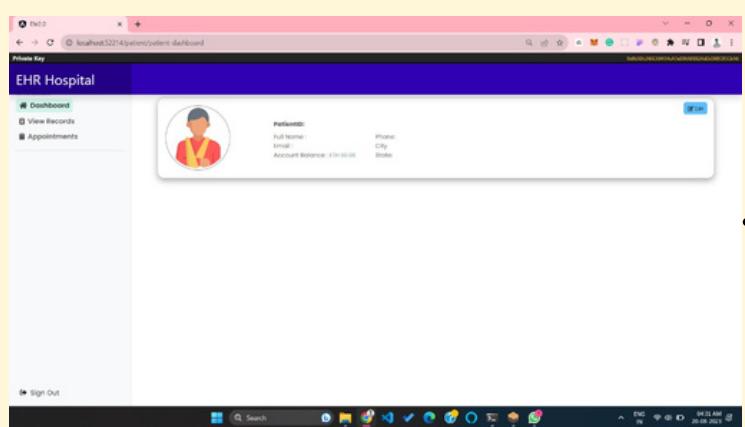
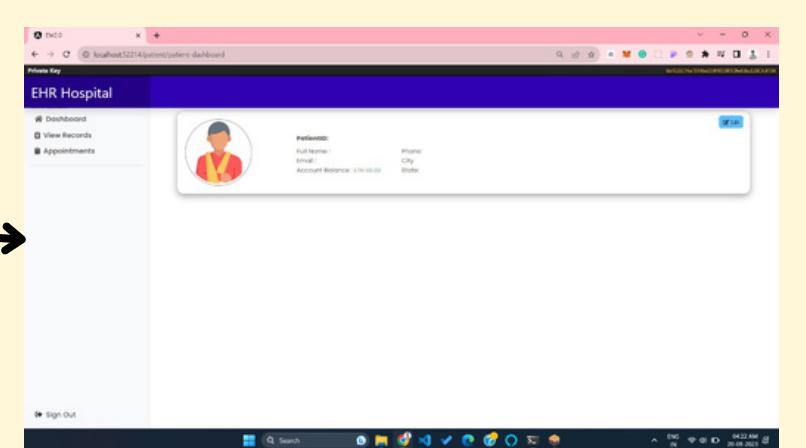
Patient cannot access the Doctor nor the Admin



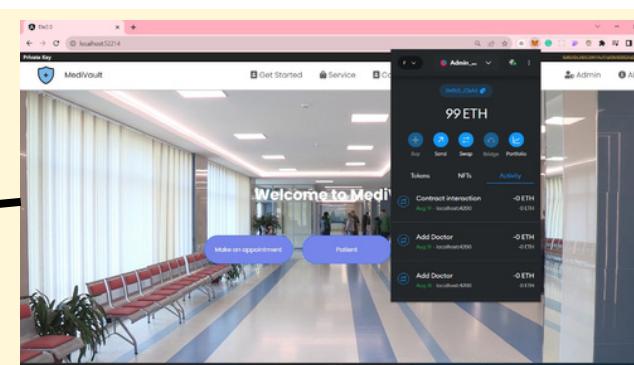
Patient Granular Acess



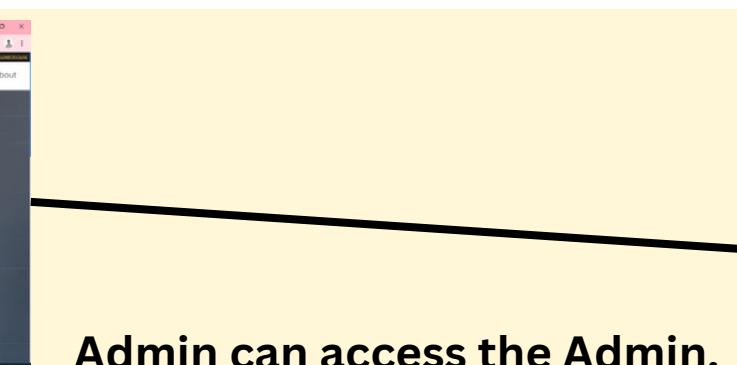
Patient can access Personal Patient Page



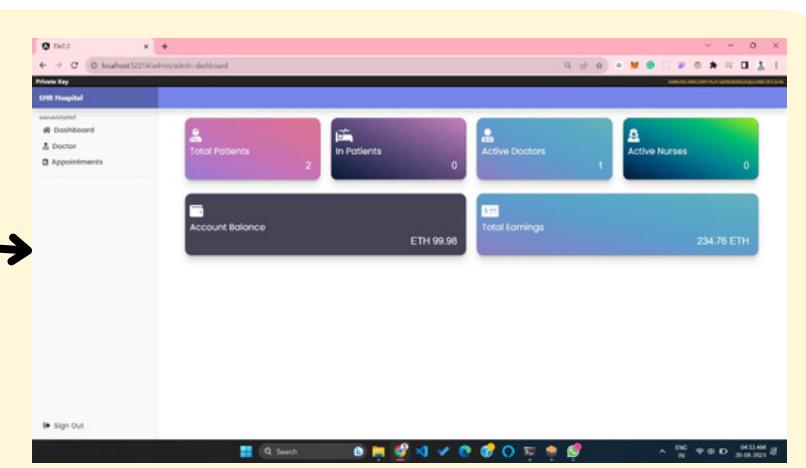
Admin can access the Patient and Doctor



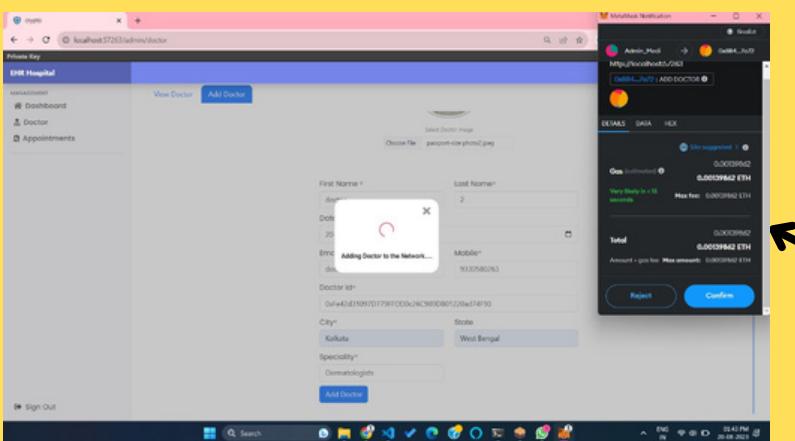
Admin. Granular Acess



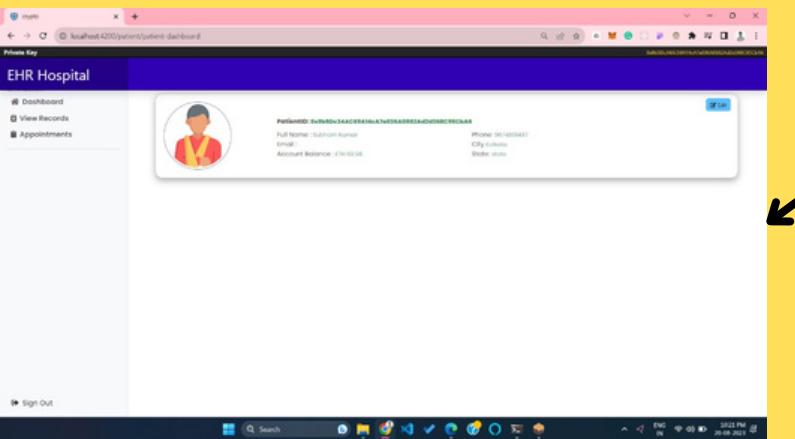
Admin can access the Admin.



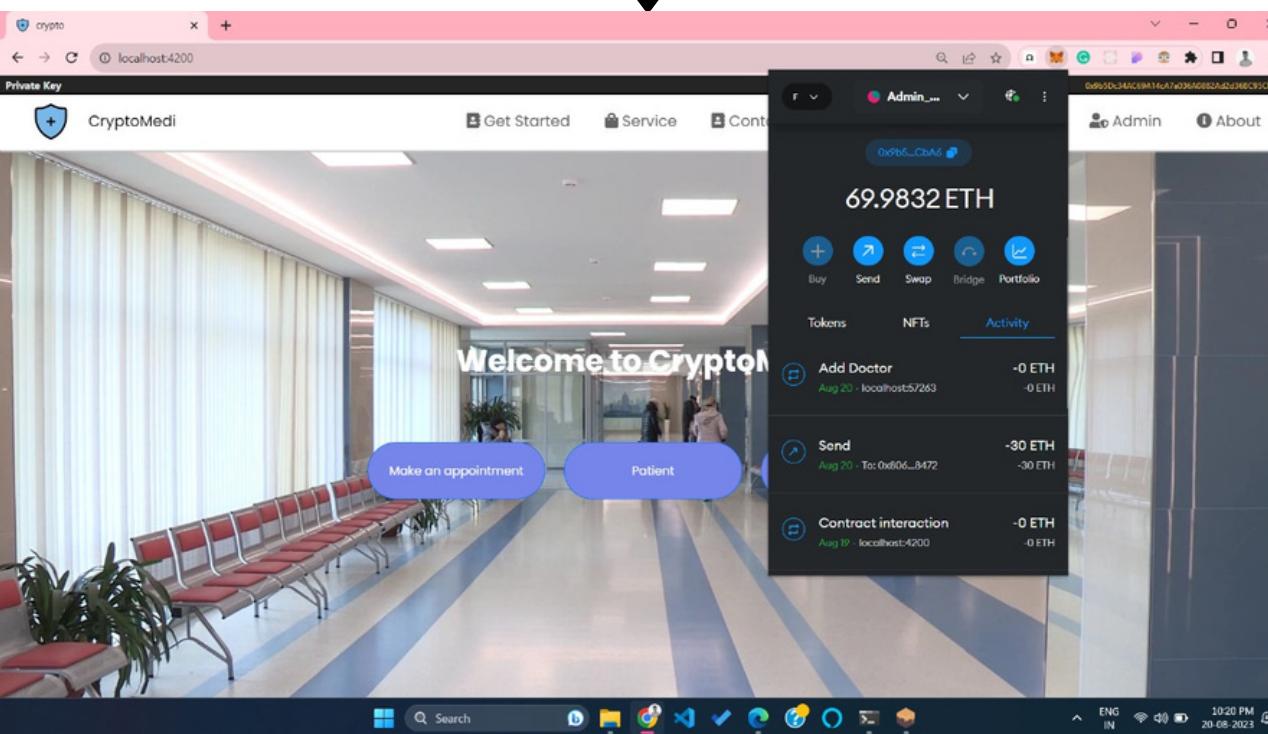
Access Control of Admin.



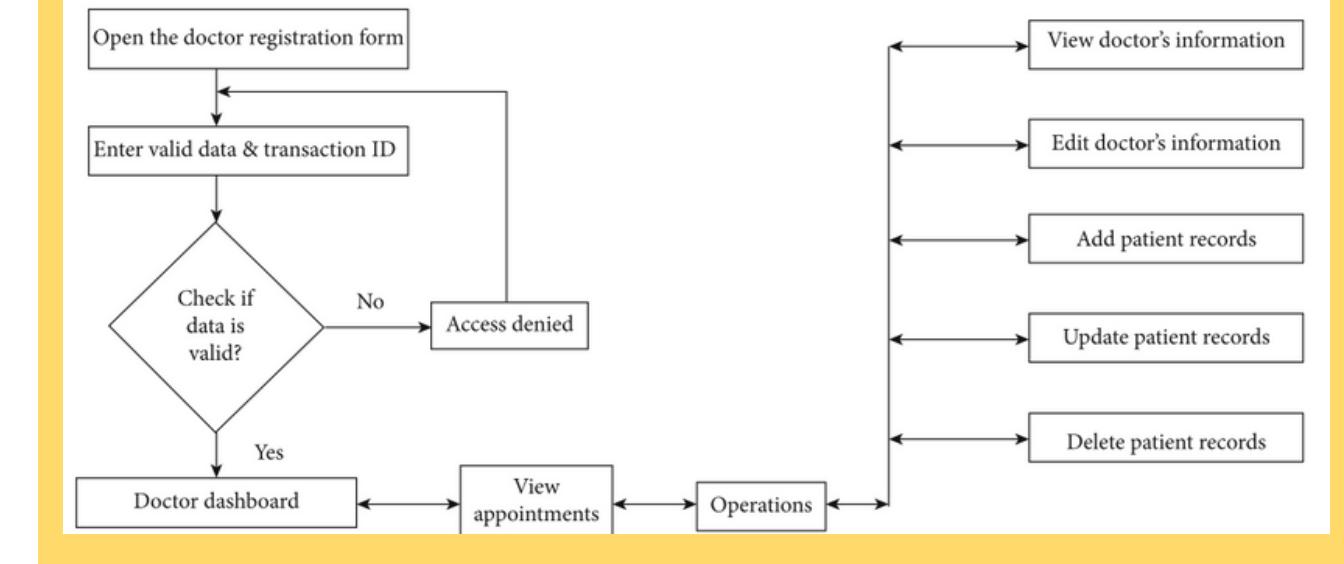
- Admin. will add the doctor to the network.



- Admin. can access the Patient appointment

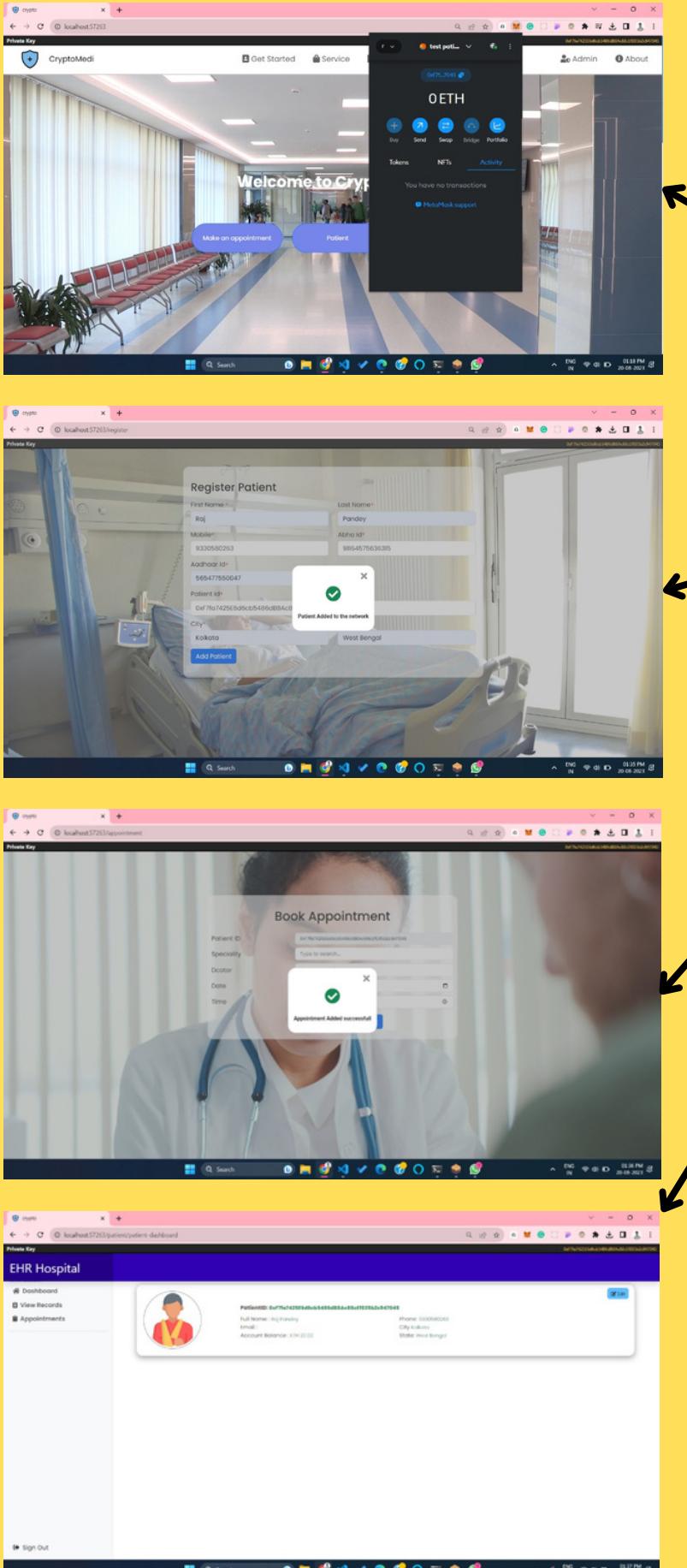


# Journey of Admin.

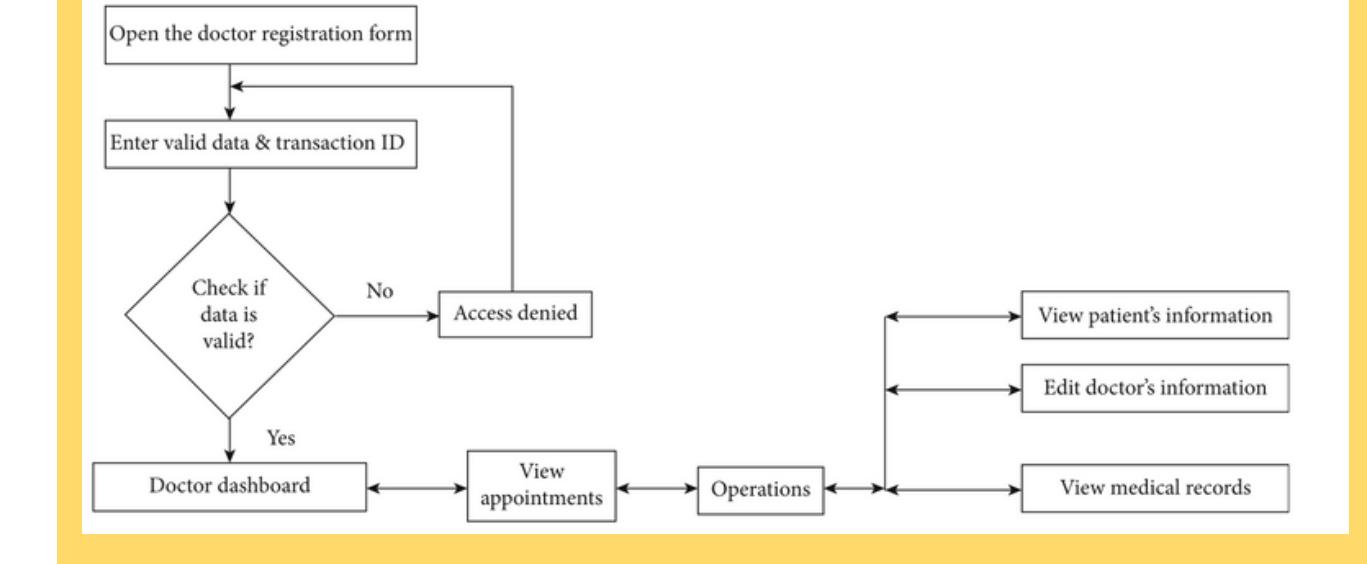
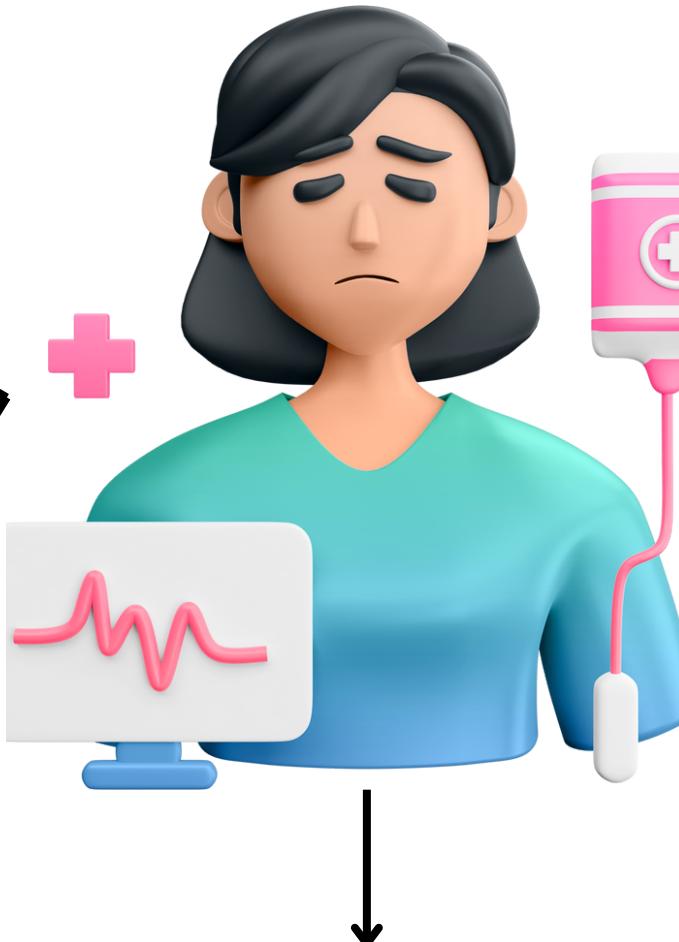


- **Private Key Access:** In the Ganache Ethereum (ETH wallet), each transaction ID has a corresponding private key for admin access.
- **Authentication:** Verified users with confirmed Ethereum wallet access can enter the admin dashboard.
- **System Management:** The admin dashboard enables administrators to perform various system management tasks.
- **User Management:** Admins can add and delete users from the system.
- **Confirmation Control:** Admins can provide confirmation for updates and changes within the system.
- **Appointment Tracking:** Administrators can monitor and manage appointments between doctors and patients.
- **Interaction with Doctors:** Admins can facilitate communication and coordination between doctors and patients.
- **Centralized Control:** The admin dashboard serves as a centralized platform for overseeing and managing system activities.

## Registration and Appointment Booking

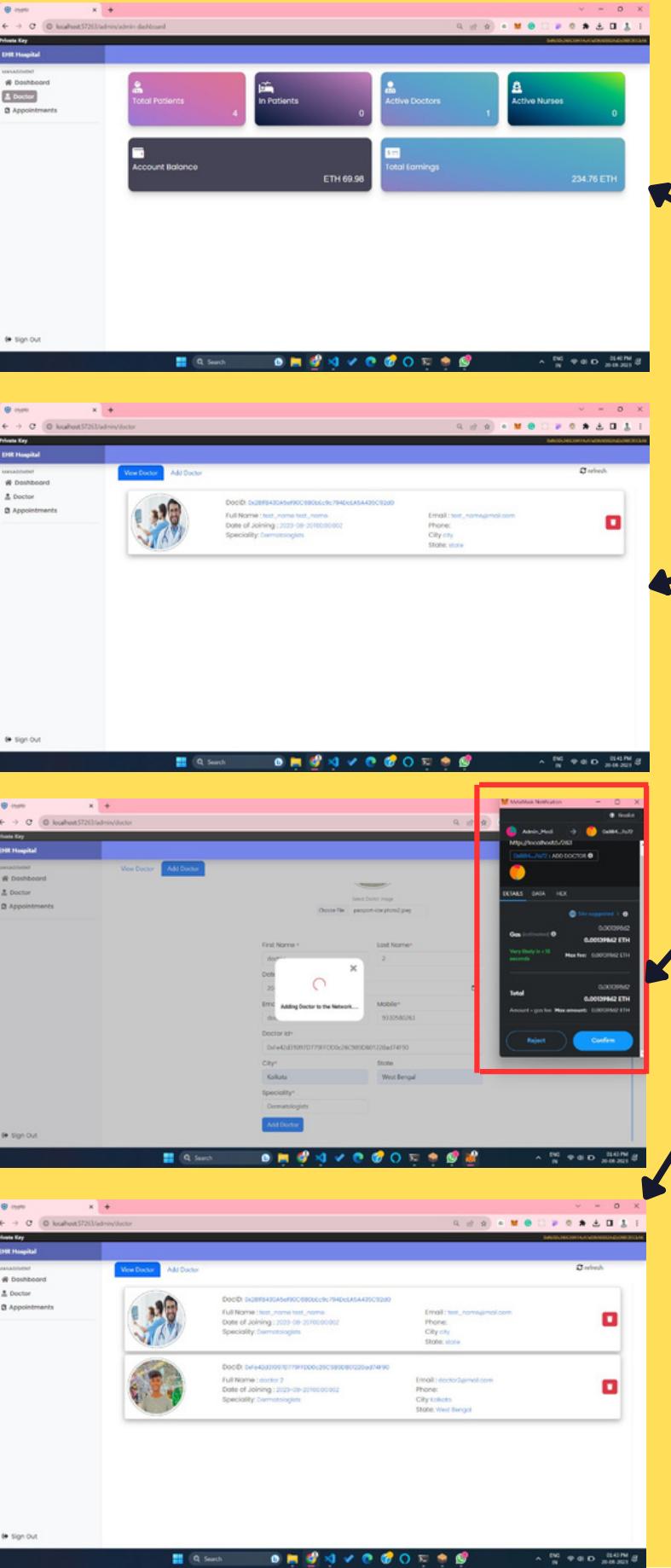


# Journey of Patients

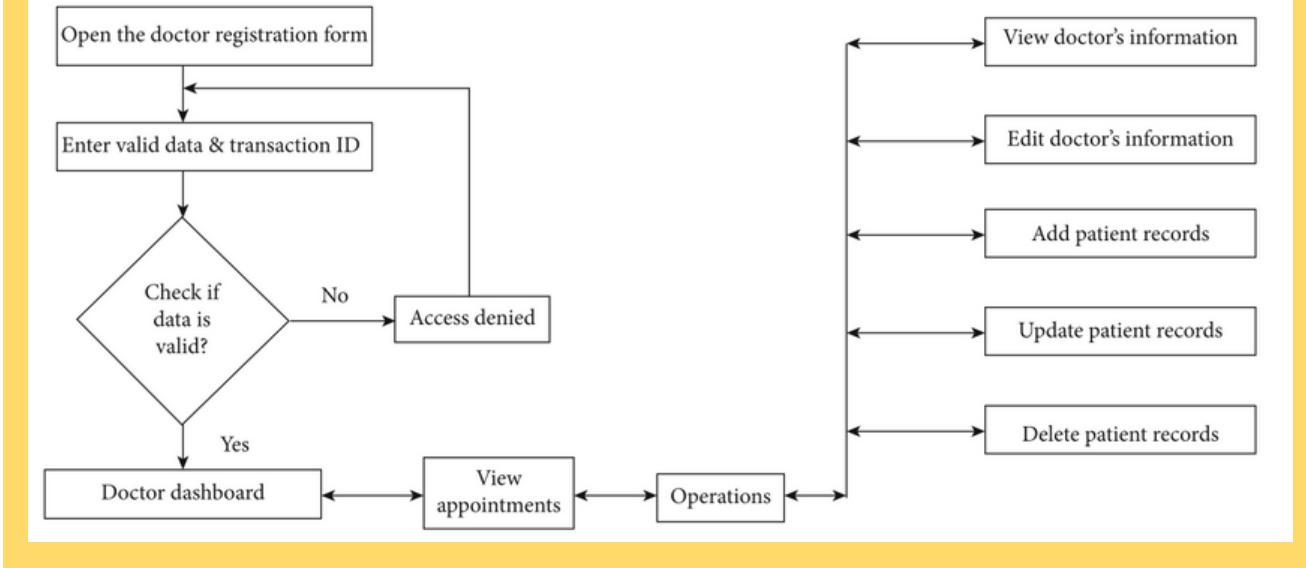
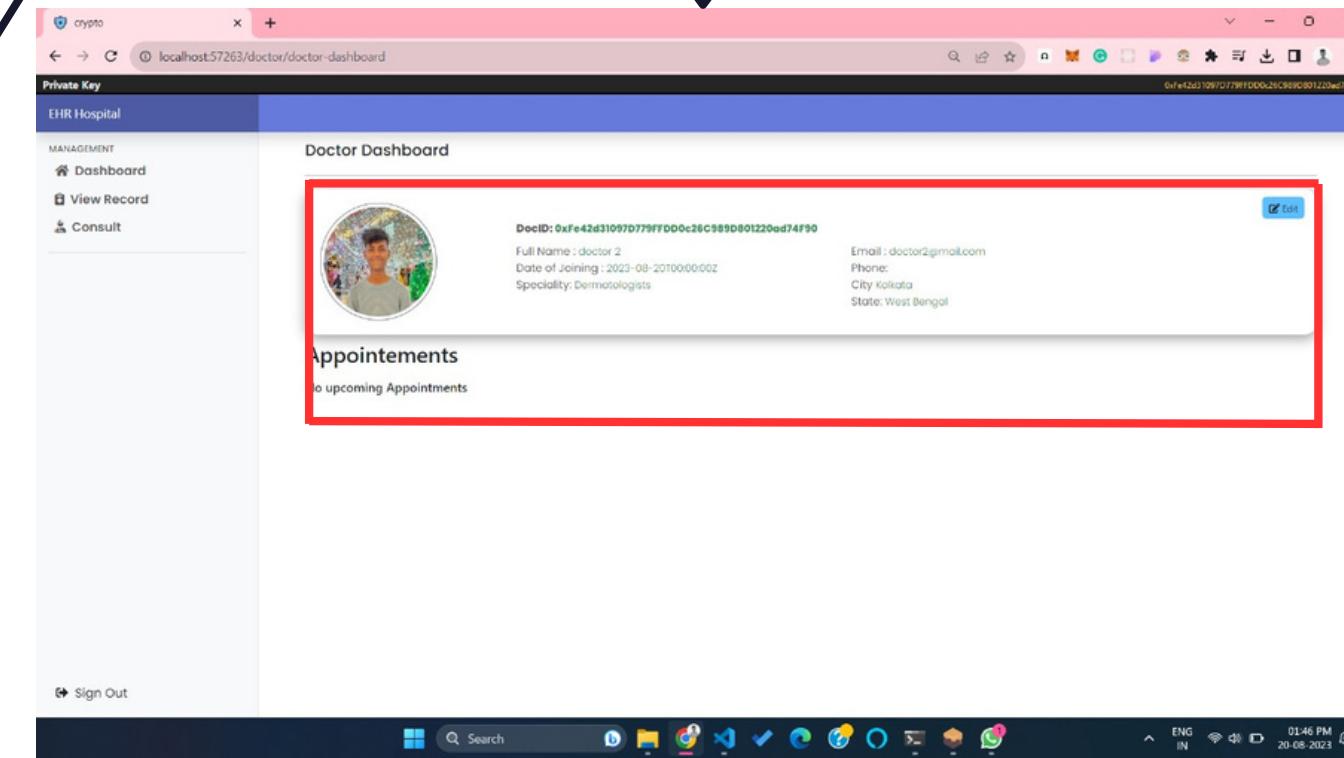


- Patient Dashboard Creation:** The Fig. outlines the patient dashboard creation process, involving registration with accurate details and a transaction ID.
- Access Conditions:** Access to the dashboard requires a registered ID and valid information; incorrect details prompt password input.
- Dashboard Functions:** Apart from appointment booking, patients perform three procedures on the dashboard.
- Viewing Personal Information:** Successful registration grants patients access to view their personal information.
- Access to Medical Records:** Patients can access medical records provided by their doctor upon successful registration.
- Personal Information Update:** Patients can modify personal details like name, age, contact, address, and photo if necessary.

Doctor will be added by Admin.



# Journey of Doctor



- Doctor's Dashboard Mechanism:** Figure illustrates the doctor's dashboard mechanism, allowing registration completion with relevant information and transaction ID.
- Limited Access:** The dashboard is exclusive to doctors, blocking unauthorized access.
- Doctor's Dashboard Functions:** Alongside admin's appointment viewing, doctors perform five procedures on the dashboard.
- Personal Information Update:** Doctors can update personal details like name, age, contact, address, photo, and qualifications.
- Medical Records Evaluation:** Doctors review patients' past medical records and personal information for future treatment decisions.
- Adding Extra Data:** If needed, doctors can add essential additional data to patients' dashboards.
- Record Modification:** Doctors can edit patient records, similar to admin capabilities.
- Record Deletion:** Doctors have the authority to delete any records, including older ones, for accuracy and clarity.
- Recent Data Priority:** Emphasis on the most recent data ensures accuracy and relevance.

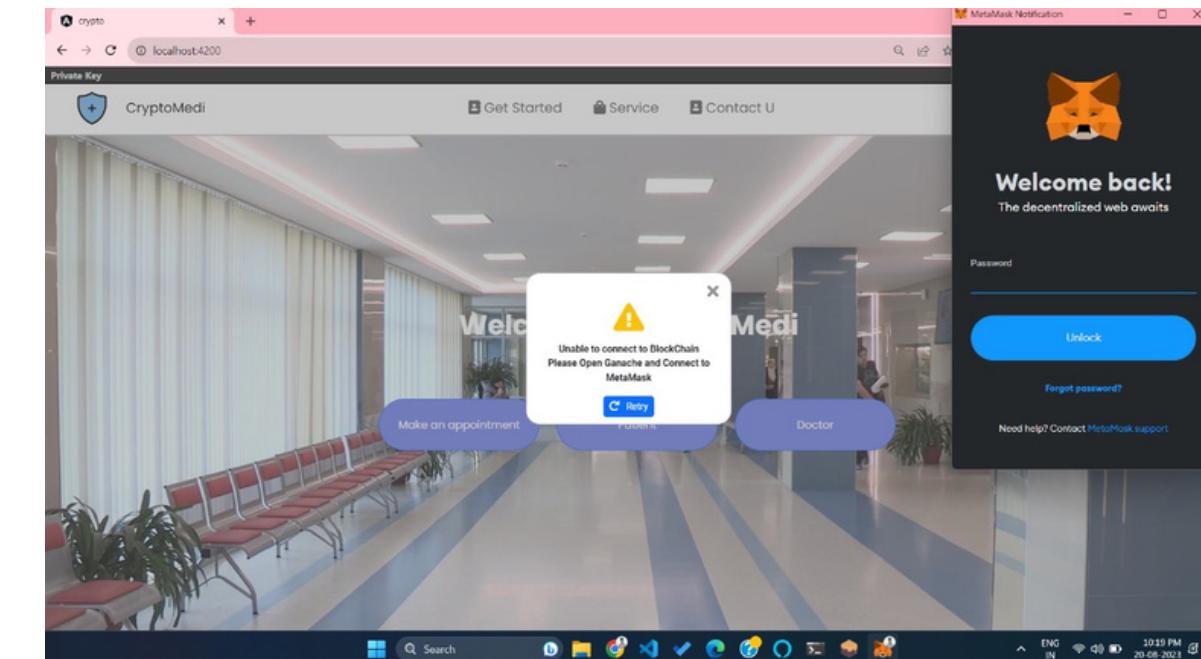


# Process to Get Access to the Proposed System (BackEnd Part)

- In case of blockchain technology scalability is an issue. Our proposed system used the off-chain storage mechanism as the patient's data stored on the blockchain contains the basic information of patient along with the **IPFS hash**, i.e., the **off-chain scaling** solution used in our proposed system framework.
- As, the data size being stored on the blockchain. IPFS uses **cryptographic hash**.

## Deploying Transaction Using Ethereum Blockchain.

- **Ethereum Blockchain Deployment:** Figure shows Ganache used to deploy transactions on the personal Ethereum blockchain for testing and development.
- **Testing Environment:** Ganache mimics Ethereum main net, allowing testing of transactions executed by virtual accounts.
- **Transaction Display:** Application displays transaction details including hashes, contract addresses, and currency values.
- **Setup:** Download and install Ganache Ethereum from Truffle Suite, a leading environment for decentralized apps and smart contracts.
- **Workspace Creation:** Establish "ehr\_project" workspace, add Truffle from truffle-config.js in project directory.
- **Account Generation:** Secure addresses, indices, balances, and private keys are created by Ganache for system access.



## Connection to the Server Using Smart Contract.

- **Smart Contract Connection:** This Fig. shows how MetaMask smart contracts connect to the system, enforcing metadata rules for record titles, access, and data integrity.
- **Policy Enforcement:** Cryptographically signed instructions ensure only valid transactions alter data, maintained through state-transition functionalities.
- **Adaptable Rules:** Smart contracts enforce diverse conditions, permits, and data access rules for electronic medical records.
- **Stakeholder Roles:** Engaging multiple stakeholders improves doctor-patient communication.
- **Data Authorization and Tracking:** Contracts authorize data access and trace activities via unique IDs, boosting transparency.
- **Decentralized Oversight:** Direct supervision and approval by smart contracts reduce administration costs and central control.
- **Efficient Storage:** Local database storage enhances medical record data efficiency.

MNEMONIC	HD PATH
kitten palm spend disagree fringe action ketchup auto whip during prize refuse	m/44'/60'/0'@account_index
ADDRESS	0xb5Dc34AC69A14cA7a036A0882Ad2d36BC95CbA6 BALANCE 69.98 ETH TX COUNT 12 INDEX 0 ⚙
ADDRESS	0x281f8430A5ef90C680bEc9c794DcEA5A435C92d0 BALANCE 99.96 ETH TX COUNT 13 INDEX 1 ⚙
ADDRESS	0x2A9F5C198f7D8e39F999E4Fa437e08f18aD44B8d BALANCE 99.99 ETH TX COUNT 4 INDEX 2 ⚙
ADDRESS	0x37DE7Af17f27a3d3570e5aFf2ac6bb99Bf4607AA BALANCE 100.00 ETH TX COUNT 1 INDEX 3 ⚙
ADDRESS	0xE2ECF6a1514bd339105381C9eB3bcE28Cfc9154 BALANCE 99.99 ETH TX COUNT 2 INDEX 4 ⚙
ADDRESS	0xc4eeB31f74E8A8f549c8F345Cb4D9f9Fc69EBdFb BALANCE 99.99 ETH TX COUNT 4 INDEX 5 ⚙
ADDRESS	0x928980C24f2068c95e3dacB02aaF074597B0bb6c BALANCE 100.00 ETH TX COUNT 0 INDEX 6 ⚙

# Truffle Migration and Deployment to Compile and Execute the Contracts.

- **Truffle Migration and Deployment:** This Fig. showcases Truffle migrating and deploying smart contracts on a blockchain, followed by execution on the Ethereum network.
- **Smart Contract Upload:** Truffle migrations enable smart contract upload to the Ethereum blockchain, facilitating integration and initial data setup.
- **Deployer Statement:** To deploy multiple contracts from the same migration file, users can add a deployer statement inside the function.
- **Multiple Contract Deployment:** The migration process results in deploying two different smart contracts simultaneously.
- **Smart Contract Execution:** The deployed smart contracts are executed, enabling the system's functionalities.

## Key Attributes of Our Approach

### • The multiparty authentication

- **Centralized Governance:** Our system operates under a single governing institution or authority.
- **Data Transfer Challenges:** Transferring sensitive individual information is complex to prevent unauthorized data misuse.
- **Permission Requirement:** Even during emergencies, any authority must seek permission from legal bodies before accessing the data.

### • Content addressable storage

- **IPFS Framework:** Our system is constructed using IPFS features, a peer-to-peer version-controlled file system.
- **Content-Addressable Storage:** IPFS employs a content-addressable block storage format for secure distribution.
- **File Storage and Addressing:** Files are stored on IPFS, and their content (hash) addresses are sent as transactions to the blockchain.
- **Transaction Integration:** The system integrates IPFS by saving file content on it and referencing the content's hash in blockchain transactions.

### • Smart contracts

- **MetaMask Usage:** Our paper employs MetaMask for the smart contract wallet.
- **Ethereum Interaction:** MetaMask enables users to sign smart contracts and interact with Ethereum blockchains.
- **No Complete Node Deployment:** Users are not required to deploy a complete Ethereum node to use MetaMask.
- **Efficient Ethereum Interaction:** MetaMask eliminates the need to download the extensive Ethereum blockchain file for network interaction.

### • Identity management

- **Decentralized Control:** Identity information, such as Aadhar and ABHA IDs, can be stored in a decentralized manner, reducing the reliance on centralized authorities.
- **Fraud Prevention:** Blockchain's transparency and security can help prevent identity fraud and unauthorized access.
- **Ownership and Portability:** Users own their identity information and can easily share it across different services and platforms.
- **Reduced Identity Theft:** Blockchain's encryption and consensus mechanisms can enhance the security of sensitive identity data like Aadhar and ABHA IDs.

```
C:\Users\MY PC\Desktop\EHR-2.0-20230813T053148Z-001\EHR-2.0\Client>truffle migrate
Compiling your contracts...
=====
✓ Fetching solc version list from solc-bin. Attempt #1
✓ Downloading compiler. Attempt #1
> Compiling ./contracts/Contract.sol
> Compiling ./contracts/Migrations.sol
> Compiling ./contracts/Roles.sol
> Artifacts written to C:\Users\MY PC\Desktop\EHR-2.0-20230813T053148Z-001\EHR-2.0\Client\build\contracts
> Compiled successfully using:
  - solc: 0.8.11+commit.d7f03943.Emscripten clang

Starting migrations...
=====
> Network name: 'ganache'
> Network id: 5777
> Block gas limit: 6721975 (0x6691b7)
```

# Bussiness Prospects



- U.S. dominated the North America blockchain technology in healthcare market in 2020 and is poised to reach over USD 1.91 billion by 2027.



- Blockchain Technology in Healthcare Market size valued at USD 281 million in 2020 and is estimated to witness over 52.1% CAGR from 2021 to 2027.

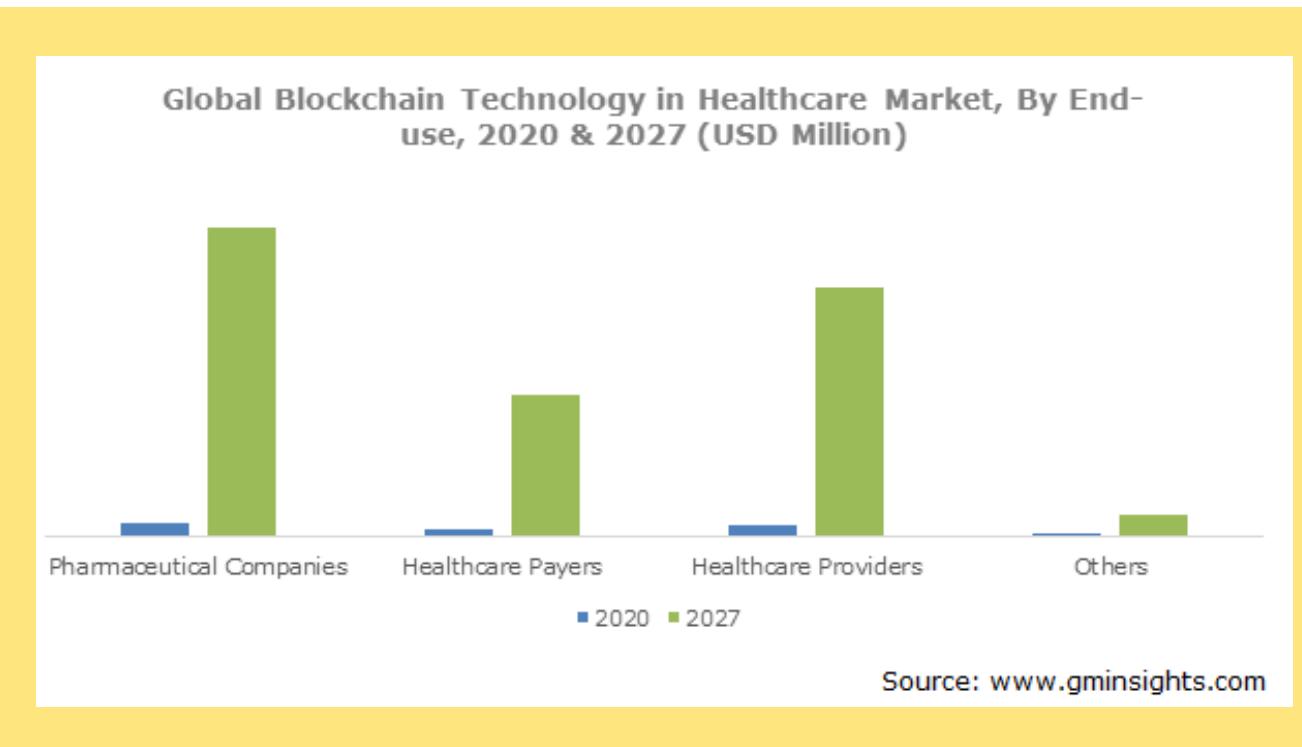
Report Coverage	Details
Base Year:	2020
Market Size in 2020:	281.0 Million (USD)
Forecast Period:	2021 to 2027
Forecast Period 2021 to 2027 CAGR:	52.1%
2027 Value Projection:	6,173.7 Million (USD)
Historical Data for:	2016 to 2020
No. of Pages:	120
Tables, Charts & Figures:	197
Segments covered:	Type, Application, End-use, and Region
Growth Drivers:	<ul style="list-style-type: none"><li>Increasing risk of counterfeit drugs</li><li>Growing incidence of medical data breaches</li><li>Increasing application of Internet of Things (IoT) in healthcare</li><li>Cost-savings in several healthcare applications</li><li>Rising need to store and secure medical data</li></ul>
Pitfalls & Challenges:	<ul style="list-style-type: none"><li>Lack of technical infrastructure in developing countries</li><li>Lack of skilled professionals</li><li>Absence of necessary regulatory norms</li><li>Lack of awareness and trust</li></ul>



- The clinical trials segment held 18% of the blockchain technology in healthcare market share in 2020 impelled by the wide range applications of blockchain technology for improving clinical trials quality.



- The public segment in the blockchain technology in healthcare market exceeded USD 202 million in 2020 led by the rising preference for a public blockchain system that provides several advantages comprising greater transparency, offer decentralized structure, and records everything among others.

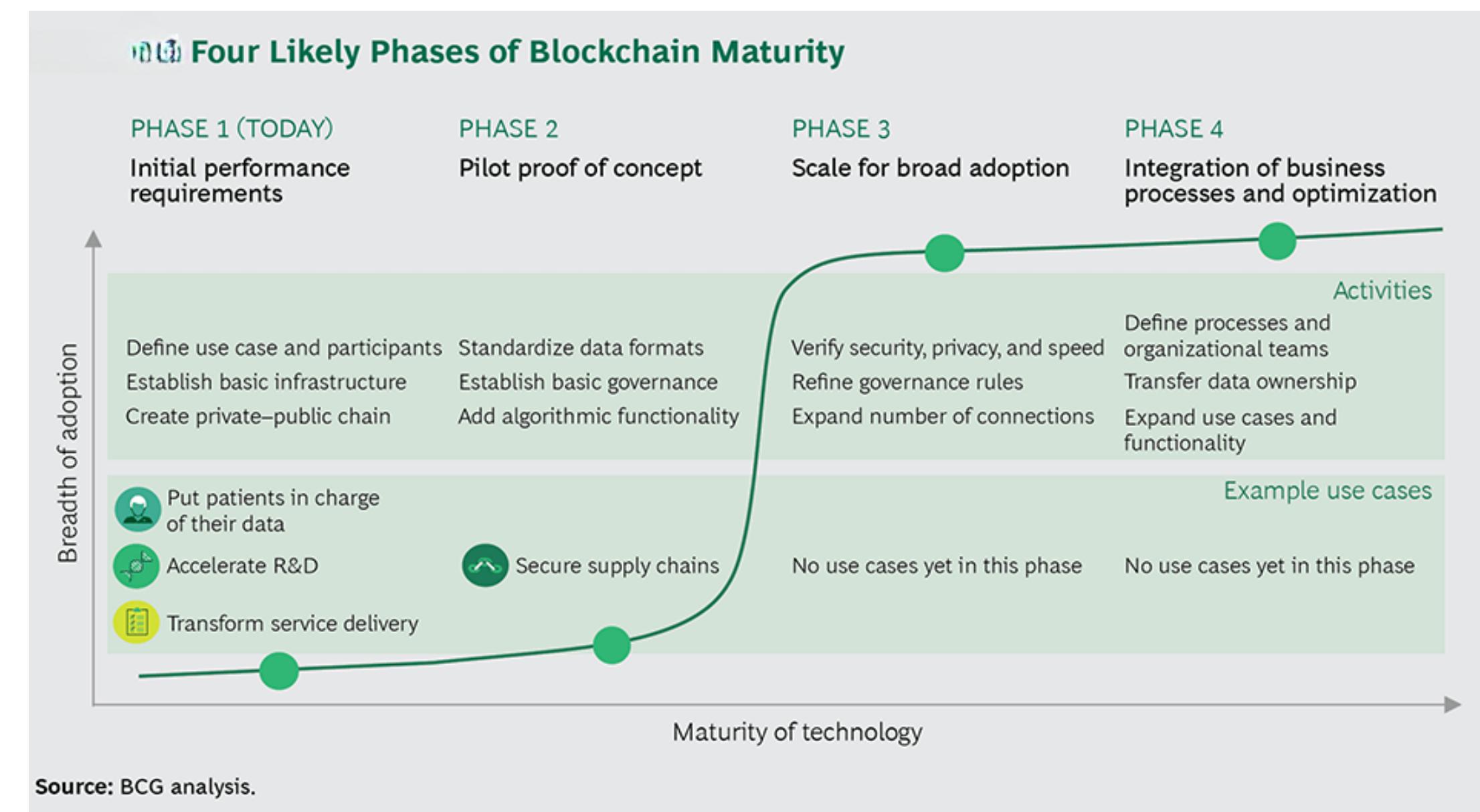
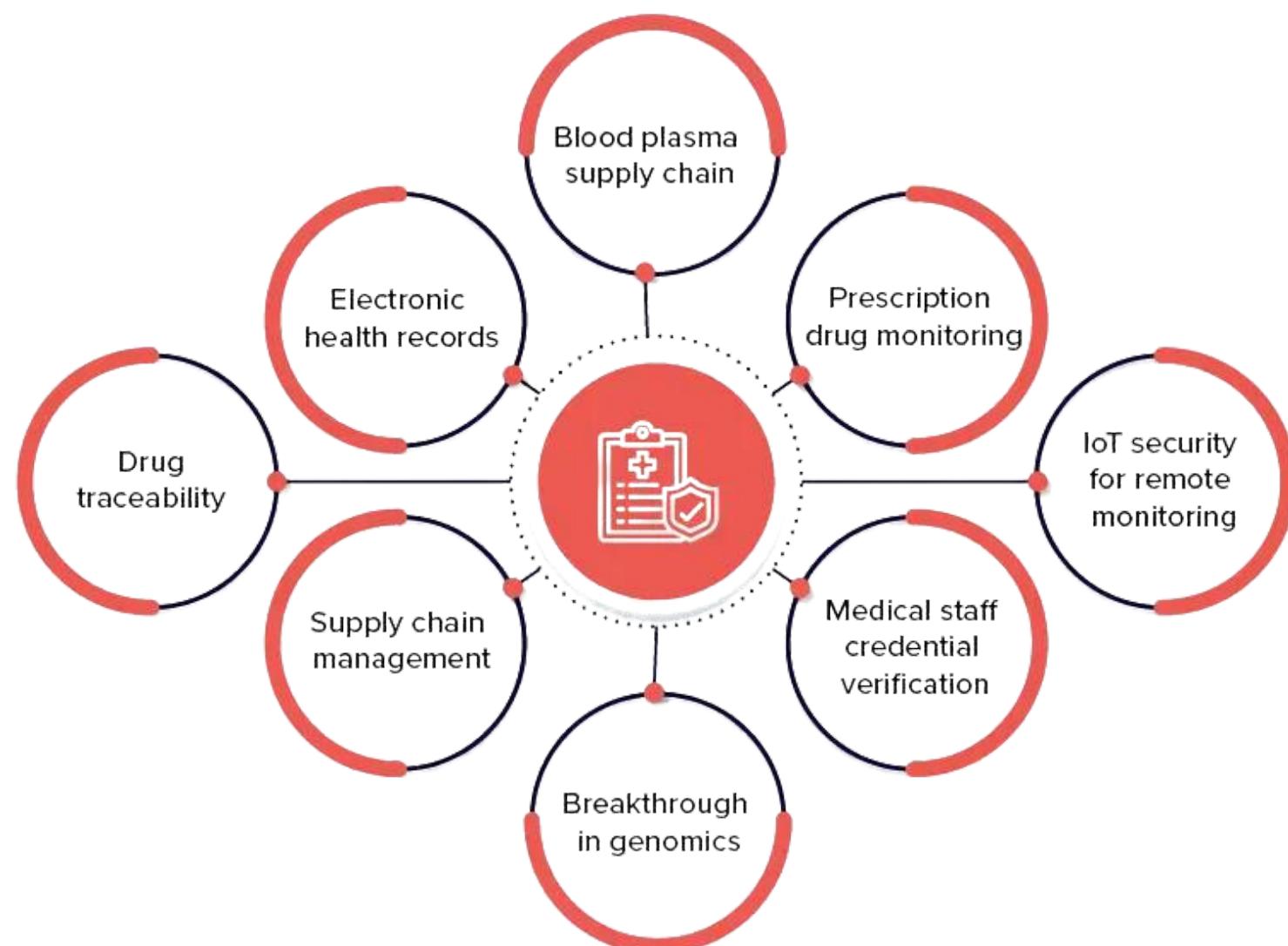


- Market, By Type, 2016 - 2027 (USD Million)**
  - Public
  - Private
- Market, By End-use, 2016 - 2027 (USD Million)**
  - Pharmaceutical Companies
  - Healthcare Payers
  - Healthcare Providers
  - Others

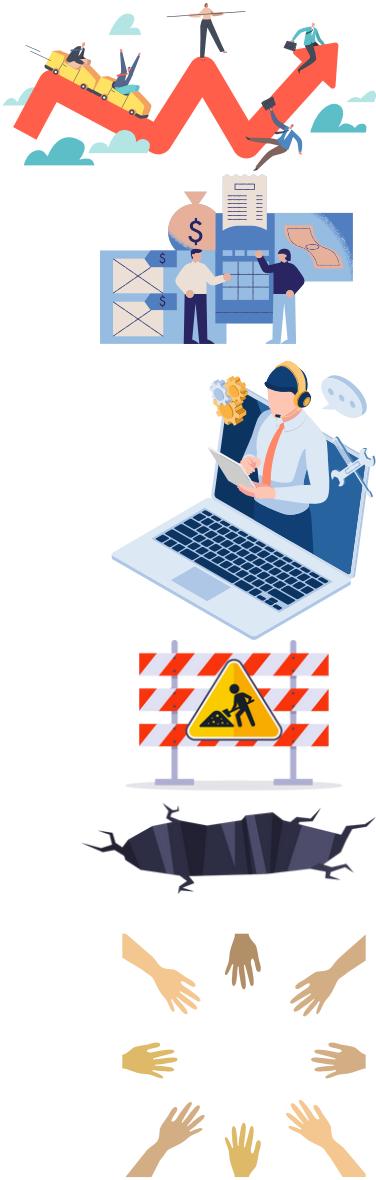
- Market, By Application, 2016 - 2027 (USD Million)**
  - Clinical Trials
  - Supply Chain Management
  - Data Exchange and Interoperability
  - Claims Adjudication and Billing Management
  - Others

# Future Prospects

- We plan to implement the **payment module** in the existing framework.
- For this we need to have certain considerations as we need to decide how much a **patient would pay** for consultation by the doctor on this decentralized system functioning on the blockchain.
- We would also need to **define certain policies and rules** that comply with the principles of the healthcare sector.



# Limitation



- **Regulatory Uncertainty:** Lack of clear regulations hampers blockchain adoption in India's healthcare, causing uncertainty for stakeholders.
- **Cost Implications:** Implementing blockchain solutions can be costly, deterring budget-sensitive healthcare institutions.
- **Technical Literacy:** Limited technical expertise among healthcare professionals poses challenges in implementing and managing blockchain solutions.
- **Infrastructure Gap:** Inadequate digital infrastructure in certain regions impedes the widespread adoption of blockchain technology.
- **Cultural Acceptance:** Overcoming cultural barriers and gaining acceptance for innovative solutions like blockchain in traditional healthcare settings can be challenging.

# References

- A. A. Siyal, A. Z. Junejo, M. Zawish, K. Ahmed, A. Khalil, and G. Soursou, "Applications of blockchain technology in medicine and healthcare: Challenges and future perspectives," *Cryptography*, vol. 3, no. 1, p. 3, Jan. 2019.
- AYESHA SHAHNAZ 1, USMAN QAMAR1, AND AYESHA KHALID 2, (Member, IEEE), "Using Blockchain for Electronic Health Records" Received September 10, 2019, accepted September 20, 2019, date of publication October 9, 2019, date of current version October 23, 2019.
- Farjana Khanam Nishi,1 Mahizebin Shams-E-Mofiz,1 Mohammad Moniruzzaman Khan ,1 Abdulmajeed Alsufyani ,2 Sami Bourouis ,3 Punit Gupta ,4 and Dinesh Kumar Saini 4 " Electronic Healthcare Data Record Security Using Blockchain and Smart Contract" Received 27 September 2021; Revised 19 April 2022; Accepted 15 May 2022; Published 29 May 2022

*Flipkart*



**GRID**

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*Thank You*