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IMPACT OF BLOCKCHAIN ON HEALTHCARES AND PHARMACEUTICALS AMID COVID-19 PANDEMIC SITUATION

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Abstract: The COVID-19 coronavirus has had a wide range of effects on countries, communities, and individuals, ranging from school closures to health-care insurance concerns, not to mention deaths. As governments struggle to address these issues, a slew of blockchain-based solutions has sprung up to address the global health epidemic. Blockchain is a distributed, immutable record that allows for faster transactions. The practice of recording transactions and tracking assets in a corporate network is known as transaction recording and asset tracking. Intellectual property, patents, and copyrights are examples of intangible assets that are not physical, such as a house, cash, or land. In an ideal scenario, blockchain would provide an immutable ledger containing real-time, shared, and completely transparent data that could only be viewed by members of a permissioned network. Pharmaceutical supply chains are intricate. Using blockchain to ensure pharmaceutical traceability and compliance with the Drug Supply Chain. Existing healthcare blockchains are being built with patient data management in mind. Management, insurance, provider directories, and worker credentialing are all things that need to be considered. In this article, we will look at how blockchain has influenced healthcare and pharmaceuticals during the pandemic, as well as blockchain applications in these two industries.

Index Terms **– Blockchain, immutable, tangible, intangible, pharmaceuticals, credentialing.**

I. INTRODUCTION

The term "blockchain" refers to a shared immutable record of a sequence of transactions, each of which is made up of one block, and which is held together by cryptographic keys ("hashes"). These keys or signatures are maintained in shared ledgers and connected by a network of nodes or processes. Each node maintains a copy of the entire chain, which is constantly synchronized and updated. Its tamper-resistant character, the decentralized nature of digital ledgers, and the impossibility of modifying a published transaction later within the user community that shares the ledger are just a few of the benefits. Digital ledger technology is another name for this technology (DLT). Digital ledger technology is another name for this technology (DLT). Network infrastructure security at all levels, identity verification and authentication of all participants, and uniform patterns of authorization to access electronic health information are all major challenges with blockchain applications in healthcare. In healthcare, blockchains can be used to manage electronic medical record (EMR) data, protect healthcare data, manage personal health record data, handle point-of-care genomics, and manage electronic health records data. Electronic health records currently only allow for the automatic updating and sharing of medical information on a single patient inside a single organization or network of organizations. Blockchain has the potential to build a single system for storing and retrieving health records in a secure and timely manner by authorized users. Blockchain has the potential to significantly enhance supply chains. While blockchain cannot account for all possible scenarios, it can significantly reduce the risk of chain errors. The Covid-19 vaccine roll-out is one supply chain that is getting a lot of attention right now. As a result, the primary goal of this research is to provide an overview of blockchain technology and its applications in healthcare and pharmaceuticals-based applications. Furthermore, in light of the pandemic crisis, this study analyses the possible need for and obstacles of developing blockchain-based healthcare and pharmaceutical systems. In recent years, a range of market sectors have found methods to incorporate blockchain technology's capabilities into their operations, demonstrating its versatility. While the financial services industry has received the majority of the attention thus far, various projects in other service-related fields, like as healthcare, demonstrate that this is beginning to change. This project focuses on a variety of Blockchain technology start-ups in the healthcare field. It tries to show various influences, ambitions, and potentials associated with this disruptive technology by using examples from public healthcare administration, user-oriented medical research, and medication counterfeiting in the pharmaceutical business. Patients, hospitals, clinics, and other medical stakeholders can share data and promote

interoperability by using blockchains to manage and distribute electronic health and medical records [1]. Among the many applications sectors where blockchain is expected to have a significant influence is healthcare. In today's healthcare systems, it is producing a wide range of options and possibilities. It's all about looking into the potential applications of blockchain technology in present healthcare systems, as well as highlighting the most crucial needs for such systems, such as trustless and transparent healthcare. Interoperability allows software apps and technology platforms to communicate safely and seamlessly, share data, and utilize that data across health organizations and app vendors, resulting in a more efficient and effective healthcare system. Unfortunately, today's healthcare is plagued with walled and fragmented data, delayed communications, and a dire lack of resources. Due to a lack of interoperability, healthcare today suffers from silos and fragmented data, delayed communications, and frantic workflow tools. In a secure and pseudo anonymous manner, blockchain provides access to longitudinal, full, and tamper-aware medical records that are kept in fragmented systems [2]. A system architecture that will leverage blockchain technology in the healthcare system to transmit essential information on medical analyses across hospitals, medical clinics, and research institutes based on patient-defined access policies. To protect confidential data, the solution employs two types of chains: a private one, the sidechain, which stores information about patients' real IDs, and a public one, the mainchain, which stores information about patients' health data marked with a temporary ID. The design was created using the Hyperledger Fabric framework for testing. Access control methods for healthcare systems are difficult to design because they must strike the correct balance of permissions and limits. In this paper, we present a unique strategy for storing patient medical data and creating an audit logging system that can secure health data from unintended disclosure based on Blockchain technology. To protect confidential data, the solution employs two types of chains: a private one, the sidechain, which stores information about patients' real IDs, and a public one, the mainchain, which stores information about patients' health data marked with a temporary ID. The design was created using the Hyperledger Fabric framework for testing. Access control methods for healthcare systems are difficult to design because they must strike the correct balance of permissions and limits. In this paper, we present a unique strategy for storing patient medical data and creating an audit logging system that can secure health data from unintended disclosure based on Blockchain technology. In this paper, we present a unique technique for storing patient medical data and creating an audit logging system that protects health data from illegal alteration and access based on Blockchain technology. A tree structure exists, with one or more subchains for storing additional vital data and a primary chain tied to the patient's identity [3]. MedBloc is a blockchain-based secure EHR solution that allows patients and healthcare providers to access and share health records in a way that is both convenient and private. MedBloc uses an encryption technique to safeguard medical data and implements a smart contract-based access control mechanism to regulate access. The patient's medication information and medical history are stored in electronic health records. The attackers are drawn to the health data because they contain valuable information. The loss of an electronic health record can result in the administration of incorrect medication or surgery. Healthcare systems have less security procedures in place to protect patient information [4]. Individuals value personal health records (PHRs) because they allow them to integrate and manage their medical data. A patient health record (PHR) is an electronic program that allows patients to manage their health information. Giving patients authority over their medical data is a good way to realign the doctor-patient relationship. Today's PHR management solutions fall short of providing patients with dependable, traceable, trustworthy, and secure control over their medical data, putting their authenticity and accuracy at risk. The majority of current PHR management approaches and systems are centralized, which not only makes medical data sharing difficult but also increases the risk of a single point of failure. Smart contracts based on the Ethereum blockchain have been designed to provide patients authority over their data in a decentralized, immutable, transparent, traceable, trustworthy, and safe manner. The blockchain technology will aid in the creation of a centralized repository for clinical data collecting. In comparison to the previous healthcare system, this architecture for securing EHR will increase the security and privacy of EHR [7].

II. BLOCKCHAIN IN HEALTHCARES AMID COVID-19 PANDEMIC

Due to a lack of medical supplies and hospital capacity, government officials have been compelled to impose a partial or complete lockdown in order to prevent the spread of the sickness. The emergence of COVID-19 has created antagonistic repercussions that demand concerted response and collaboration among health professionals, authorities, research institutes, and the government. The high-level design of three blockchain-based tools to help governments and medical professionals deal with COVID-19-related health emergencies. Pandemics can be combated via blockchain technology, which allows for early detection of epidemics while still protecting individual privacy and data security using smart contracts. A framework has been proposed to assist governments, the aviation industry, health authorities, and residents in making critical decisions on infection detection, prediction, and prevention [8]. The recent spread of Covid19, as well as the resulting confusion about immunizations and immunity, has heightened the need for a safe, reliable system for reporting vaccination data, with blockchain applications for the COVID-19 pandemic largely from a public health emergency standpoint. Several digital and paper-based alternatives have been tried, but none have proven to be successful. Hashing techniques and asymmetric cryptography ensure the integrity of transactions on the blockchain network. To verify the authenticity and integrity of data, blockchain employs asymmetric cryptography. Hashing (a cryptographic method) is used in blockchain technology to link each block to its predecessor, making the data on the blockchain immutable [9] [12]. Although blockchain technology has been dubbed "a solution in search of a problem," as the healthcare industry responds to the pandemic's demands, several promising use cases have emerged that could benefit from the developing technology. Blockchain has emerged as today's greatest technology-based choice for achieving the key goal of offering real-time access to crucial information that is presented in a consistent way from reliable sources, thanks to its enormous role and capacity to encourage trust, transparency, and privacy. False positives, duplicate records, and privacy concerns make it difficult to obtain actionable insight with confidence from the healthcare industry's current data-sharing infrastructure. Furthermore, a lack of trust is a barrier to greater transparency, as most of the healthcare business is still hesitant to disclose data widely. Furthermore, a lack of trust is a barrier to greater openness, as most of the healthcare business is still hesitant to share data widely due to privacy concerns and competitive constraints. By design, blockchain enables competing businesses to collaborate in a completely auditable way to share data about their patients while keeping their competitive independence and privacy concerns. These essential traits have enabled blockchain emerge as a viable

solution for a variety of essential healthcare services, including as contact tracing, provider credentialing, and patient data sharing, that have gained in prominence during the COVID-19 pandemic. A blockchain-based programme will initially be able to track patient movements and offer real-time data regarding infected zones, all while gathering data rapidly and creating a real-time audit trail. It allows for data sharing and ensures that patient records are transparent and traceable. Then, using blockchain, it is possible to make the donation process more transparent, which improves social trust. Finally, it must be able to safeguard medical supply chains, protect user identity, limit the sharing of personal information, and give users permission to selectively disclose information.

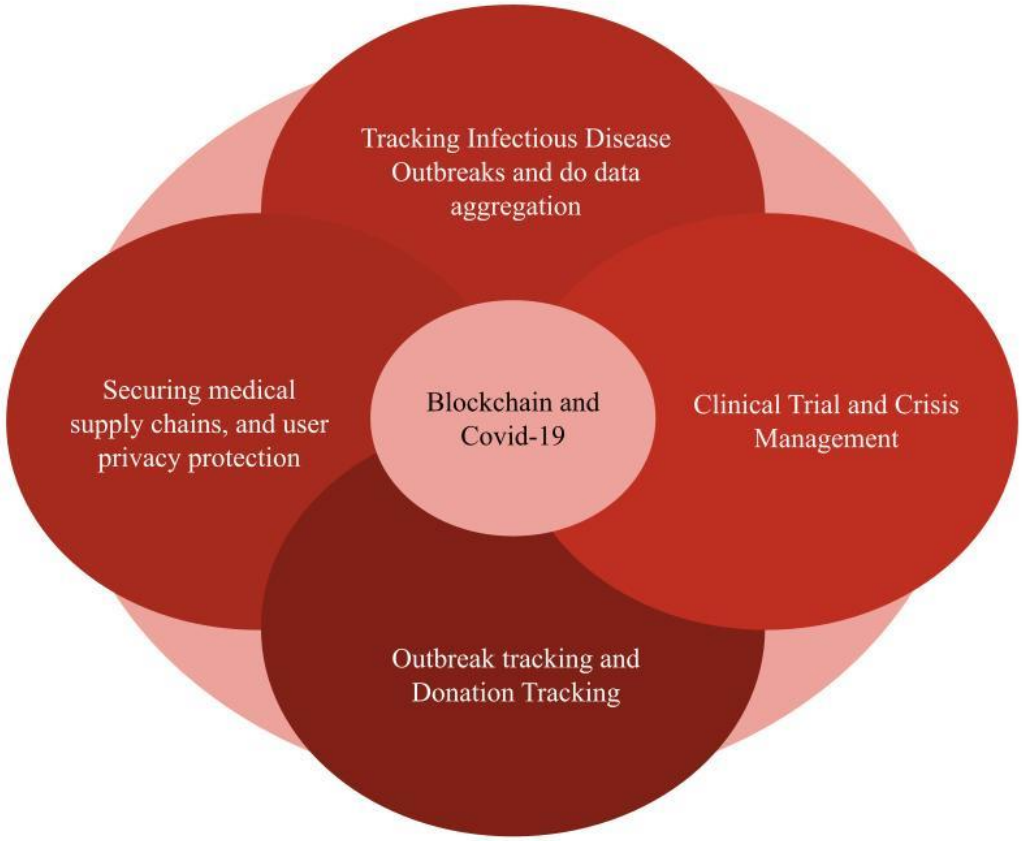


Figure 1: Blockchain applications in fighting COVID-19

III. EXISTING SYSTEM

Patient medical data is not secure under the current system. They get these files from the storage system whenever they are required. There is no protection for these data because they can be accessed by any hacker. A solution that is tailored to increase the security of patient medical data should be available. Disadvantages are increases the chances of being hacked and its time demanding to manage a large amount of data.

IV. PROPOSED SYSTEM

The suggested framework aims to give patients a secure means to manage their medical data and approve access to their medical records while maintaining their personal autonomy. The use of blockchain to record audit trails of the information flow in the health information exchange. A blockchain records the data exchange relationships between patients and healthcare providers. As a result, visible and immutable audit trails of information flow are created. Cryptographic hashes are used to sign the encrypted medical information, ensuring the integrity of the transmitted data. The hashing algorithm's result is subsequently stored on the blockchain. EHR medical data is encrypted for security. Originally, a blockchain-based protocol was presented as a method for facilitating the exchange of digital assets bundled as transactions on an immutable, tamper-proof ledger. Advantages are security is attained, it allows for privacy, it is simple to access and retrieve and it is cost economical.

V. SYSTEM ARCHITECTURE

The design phase's goal is to devise a strategy for resolving the problem identified in the requirements document. The first step in going from the problem domain to the solution domain is to complete this phase. To put it another way, we start with what we need and work our way to how we can meet those needs through design. The design of a system is likely the most important component influencing software quality; it has a significant impact on subsequent phases, particularly testing and maintenance.

High-level design outlines the modules that should be created in order to create the system, as well as their specifications. All key data structures, file formats, output formats, and so on are also designed at the end of the system design. are repaired as well. The emphasis is on locating the modules. In other words, the focus is on the modules that are required. The internal logic of each module is documented in the comprehensive design. The emphasis is on developing the logic for each module. In other words, the issue is how modules can be implemented in software. A design methodology is a process for generating a design using a set of tools and standards in a systematic manner. The majority of approaches concentrate on high-level design. This project's goal is to create a web application. It uses blockchain technology and the AES encryption technique to secure patient medical data. Medical data will be owned, operated, and used by people who aren't affiliated with hospitals. The transition from institution-driven to patient-centered interoperability can be aided by blockchain technology. Patients can designate access rules for their medical data using blockchain technology, such as allowing specific researchers to access parts of their data for a set period of time. Patients can link to other hospitals and have their medical data collected automatically using blockchain technology. Furthermore, these capabilities, which can be implemented via blockchain technology, may be beneficial in safeguarding data subjects rights as stated by the EU General Data Protection Regulation. Because of the bulk and sensitivity of medical data, it is widely assumed that just the tag information will be saved in data blocks, rather than the data itself. The taxonomy can help with decision-making during the design phase by allowing a systematic comparison of the capabilities of various design solutions. The taxonomy also illustrates the impact of various design alternatives on quality criteria. After that, we'll look at the "Proposed System Block Diagram."

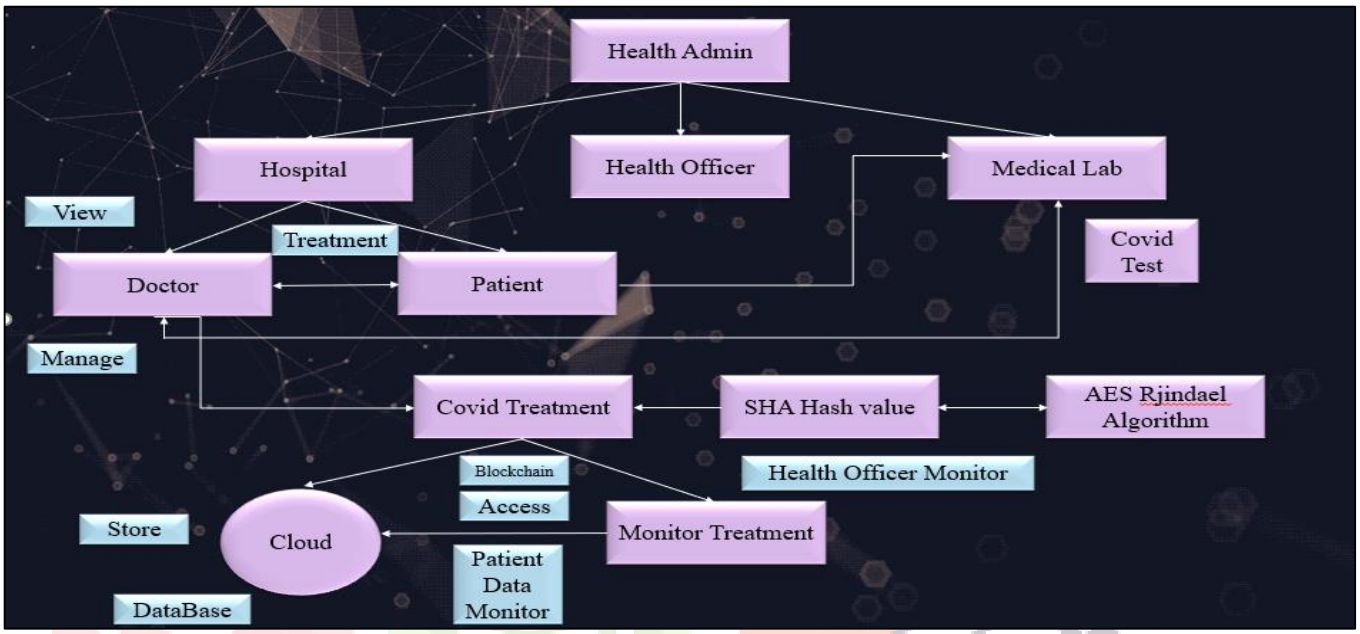


Figure 2: Block Diagram of Proposed System of Healthcare sector

VI. ALGORITHM USED

AES RIJNDAEL ALGORITHM - The National Bureau of Standards in the United States created the DES (Data Encryption Standard) encryption standard, which allowed for infinite data encryption. Rijndael encryption has largely supplanted this encryption standard. The name Rijndael is derived from the names of the Belgian cryptologists Joan Daemen and Vincent Rijmen, who invented this encryption technology. Rijndael uses a 128, 192, or 256-bit key for encryption, which ensures greater security against brute-force assaults. Furthermore, in software, this encryption approach is three times faster than DES. This approach can be used for both secure key exchange and data transport with a length of 128 or 256 bits. Although all the candidates considered for the AES were secure under various forms of assault, Rijndael was chosen on account of its low memory requirements and overall efficiency. Crypto-analysts generally agree that Rijndael will prove secure for all its real-world applications – and the process may be strengthened through the addition of more rounds of transformation. A limited number of attacks on the algorithm have succeeded, but these have been staged within laboratory conditions, and largely represent theoretical situations unlikely to occur in a business context. In addition to its inherent security and stability to crypto-analysis, Rijndael is also noteworthy for its ability to run efficiently on a number of computing platforms, including large arrays, desktop systems, mobile devices, and smart cards.

SHA-256 ALGORITHM - The Secure Hash Algorithm is available in two types: SHA1 and SHA256. These algorithms produce 160 bit and 256-bit hashes, respectively, which are represented by 40 and 64 char Hexadecimal numbers. SHA256 reduces input blobs to 512-bit messages. These messages will be precise multiples of the block size, with the exception of the last message, which will include an extra 64-bit padding. The input blob is sliced into 512-bit messages as illustrated in the image above. The first message and 256 bits from the input blob are fed into 'C,' a compression function, which creates a 256-bit output that is input for the second message, which also goes through 'C,' creating 256 bits, and so on until all messages are processed, we will receive a 256-bit HASH of the input. As long as the letter 'C' is collision free SHA-256 is collision free. In SHA-256, messages up to 2^{64} bit (2.3 exabytes, or 2.3 billion gigabytes) are transformed into digests of size 256 bits (32 bytes). For perspective, this means that an object 7 times the size of Facebook's data warehouse in 2014 passed to SHA-256 would produce a chunk of data the size of a 32-letter string of ASCII characters, and that string would the object's very special fingerprint.

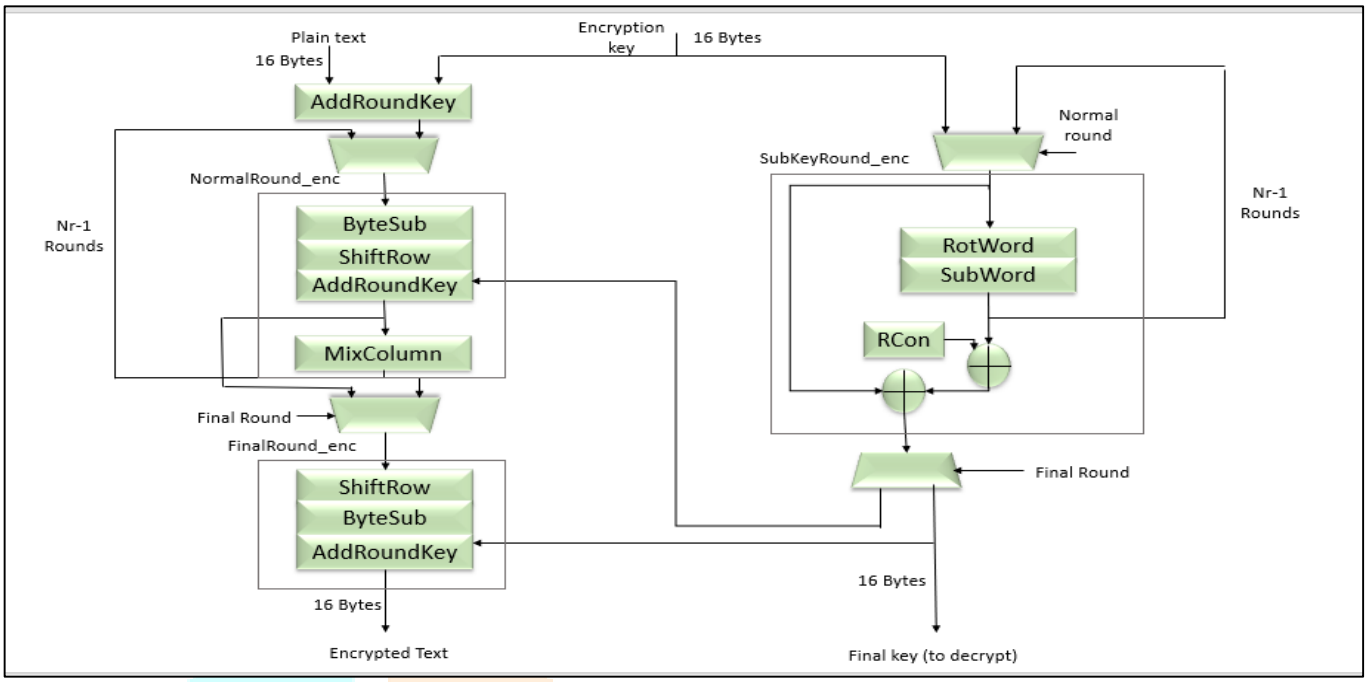


Figure 3: AES Rijndael Algorithm

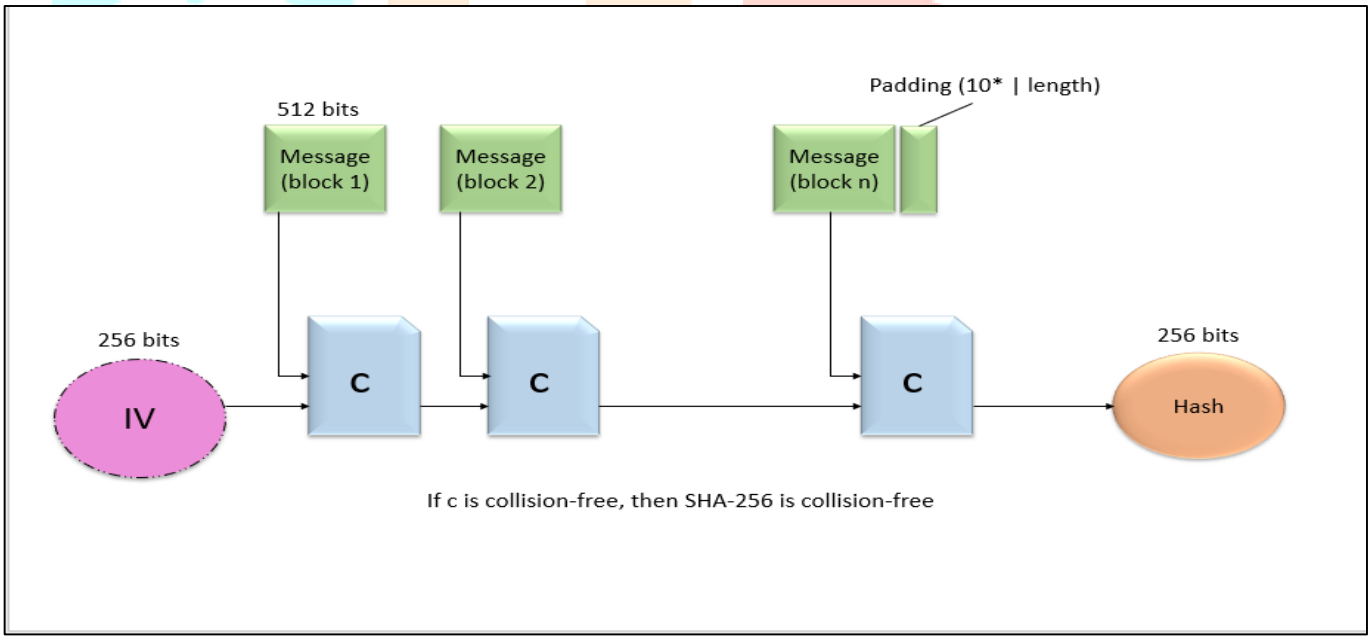


Figure 4: SHA-256 Algorithm

VII. BLOCKCHAIN IN PHARMACEUTICAL SUPPLY CHAIN AMID COVID-19 PANDEMIC

Blockchain is a distributed and decentralized ledger that is critical for data and transaction security. The use of blockchain in healthcare systems safeguards patient information from hackers. The blockchain has been protected from assaults via a tiered authentication-based approach [5]. The transfer of items at each stage in the pharmaceutical supply chain can be recorded and time-stamped using a blockchain-based application. Every transaction of commodities will be logged and time-stamped by scanning the bar code as the drug passes through the supply chain. The ledger will be utilized to ensure the product's security and safety [6]. Blockchain has the potential to significantly enhance supply chains. While blockchain cannot account for all possible scenarios, it can significantly reduce the risk of chain errors. Many players and stages are engaged in pharmaceutical supply chains, ranging from API providers to medication manufacturers, packaging and distribution businesses, and regulators, all the way to hospitals, pharmacies, and finally, the patient. Because there are so many middlemen, it is more difficult to check and assure authenticity, which means counterfeit drugs are more likely to infiltrate the distribution chain. With so many intermediates, counterfeit drugs are more likely to infiltrate the distribution chain, making it more difficult to detect and verify authenticity. Due to the nature of blockchain, it will be able to provide proof of product provenance as well as increased security. The Covid-19 vaccine roll-out is

one supply chain that is getting a lot of attention right now. Because there are numerous different vaccinations with various storage requirements, the COVID-19 vaccinations have additional issues (over and above those associated with the supply of any medication or vaccine). Some require constant storage at precise temperatures to be effective, and this temperature must be maintained throughout the manufacturing process, distribution, travel, and in hospitals and immunization facilities. The vaccinations are not currently interchangeable, therefore a patient's successive dose must be the same as their first, which necessitates close monitoring and coordination between suppliers and medical personnel. To ensure that the COVID-19 vaccine rollout is safe, reliable, and traceable, and that errors are reduced, a well-functioning supply chain is required. End-to-end tracking and monitoring of vaccinations and other pharmaceuticals could be possible using blockchain. End-to-end tracking and monitoring of vaccinations and pharmaceuticals along the supply chain could be possible with blockchain. Assigning a digital identity to a physical object, such as pharmaceuticals or vaccinations, is one of the challenges. This could be accomplished by using identifiers on the product, such as barcodes. These must be tamper-proof in addition to having an identification, so that counterfeit medicine cannot be inserted into the marked packing. This might be accomplished by scanning barcodes at each point of contact and making the data available to the manufacturer or regulator (or whoever requires access to that data). The data might also be made available to parties with limited infrastructure, such as pharmacies or hospitals, who may check the legitimacy of a drug using a barcode scanner. If an issue (such as a counterfeit drug or even a faulty or expired drug) is discovered using blockchain, the user may check back at all prior data entries, touch points, locations, and timestamps to locate the product's origin, the precise manufacturer, and even the precise batch it originated from. As a result, blockchain would make it easier to trace and verify products in the supply chain, as well as discover and correct problems. As a result, counterfeit, faulty, or expired products would be detected and removed from distribution more quickly and efficiently. Although counterfeiters may still copy barcodes, the blockchain would signal any suspicious activity instantly and immutably, and any efforts to modify the data on the chain would be immediately accessible to all authorized users and may be refused. This not only ensures authenticity over a traditional manual database, which is more easily tampered with and where individuals may be able to edit or delete important information, but it also allows for ways to verify that an entity handling the product complied with regulatory requirements [10] [11].

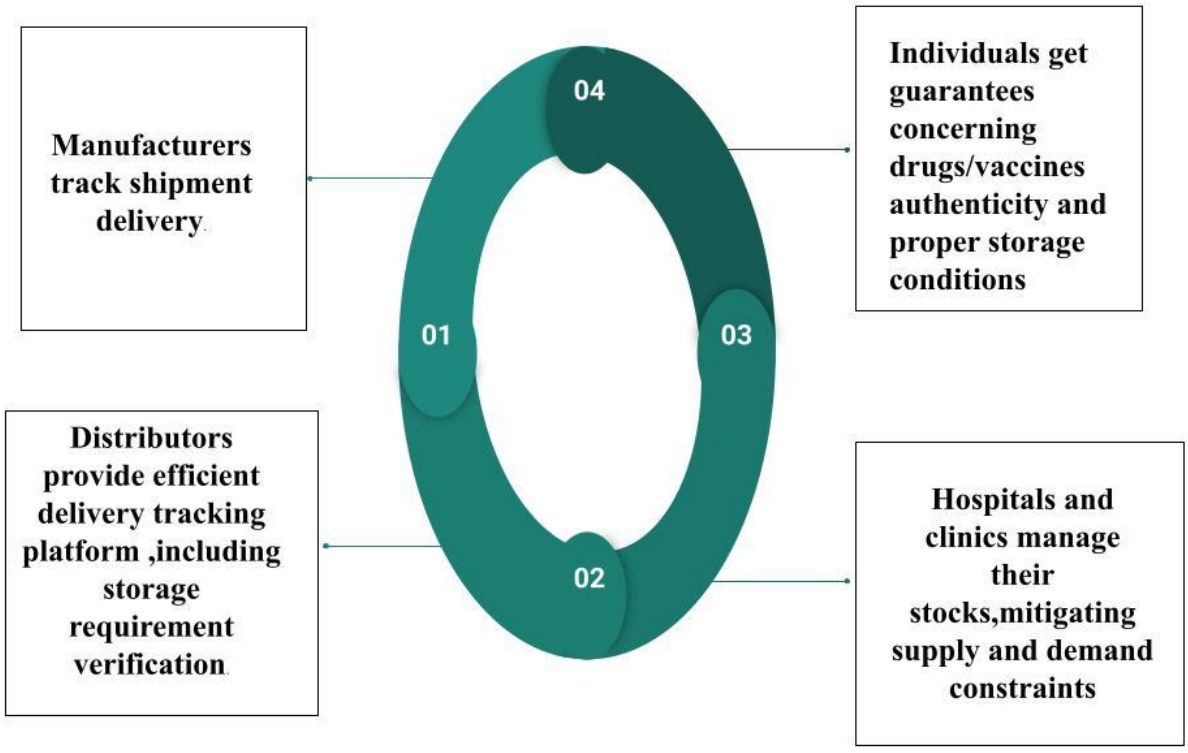
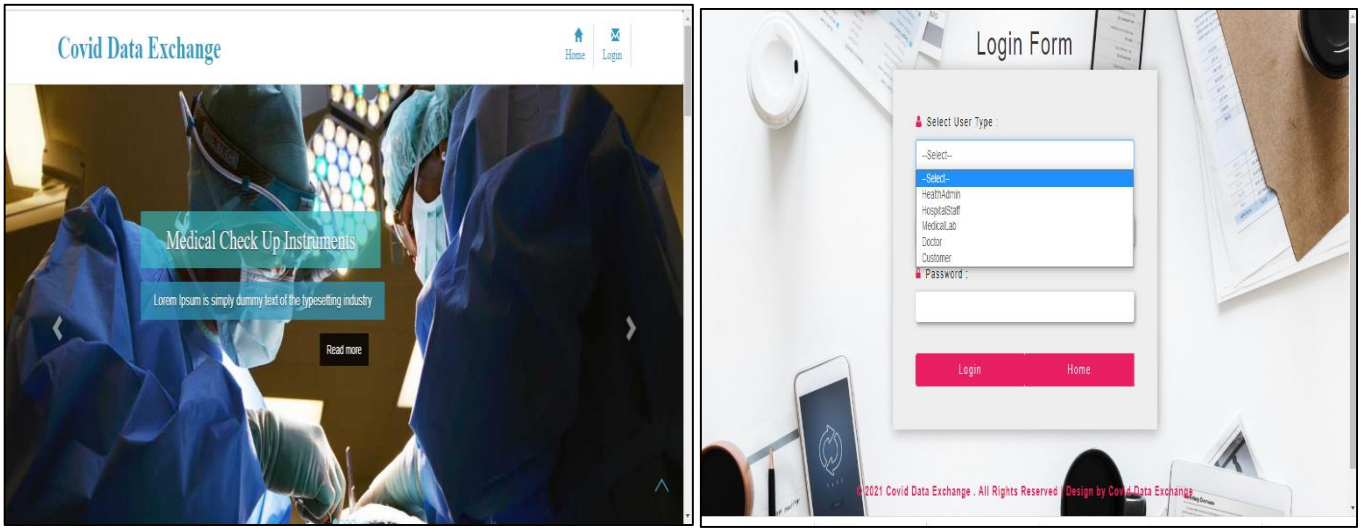


Figure 5: Blockchain pharmaceutical supply chain functions

VIII. RESULT ANALYSIS AND DISCUSSION

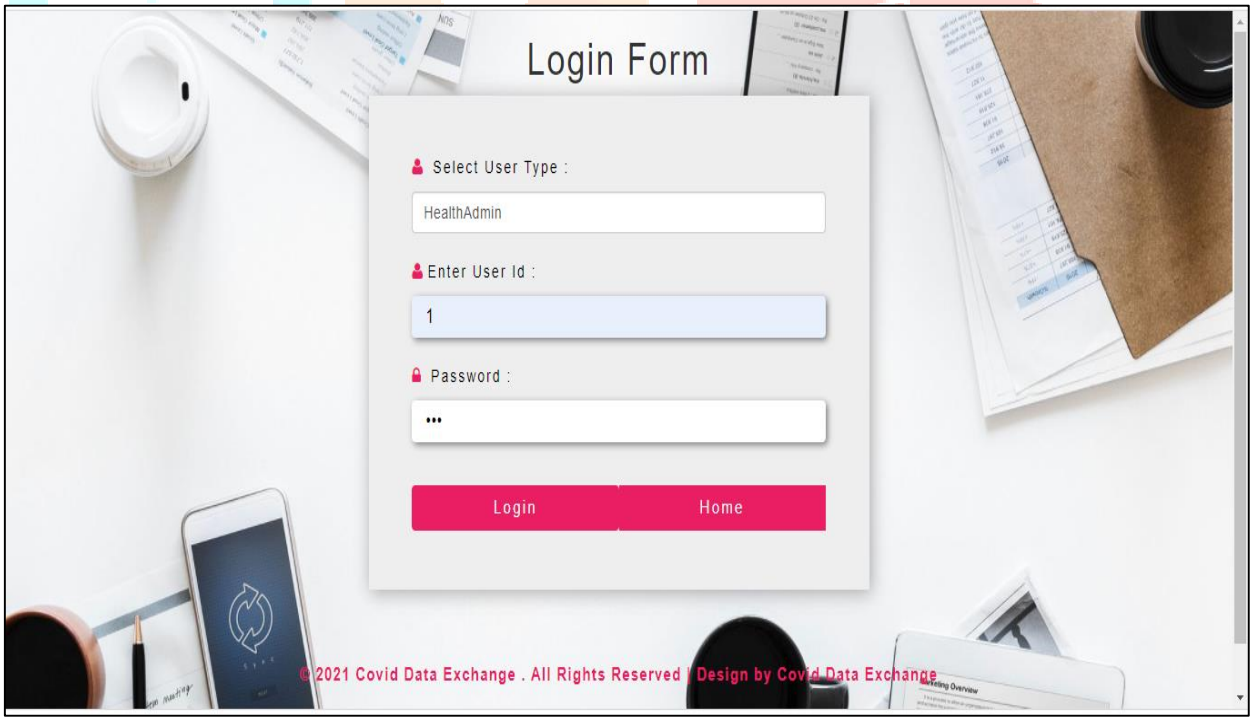
We demonstrate how covid data is exchanged in this application. We have a Health Admin who is in charge of all of the other subordinates, such as Health Officers, Hospitals, Medical Laboratories, Doctors, and Patients. All performers who have been added to the application will receive an email with an ID and password. All modules will login to their accounts using that credential.

Blockchain protocols and cryptography methods are used to secure the data. The application is user-friendly and is used in the healthcare industry; but, with minor changes, it might be used in the pharmaceutical industry as well.



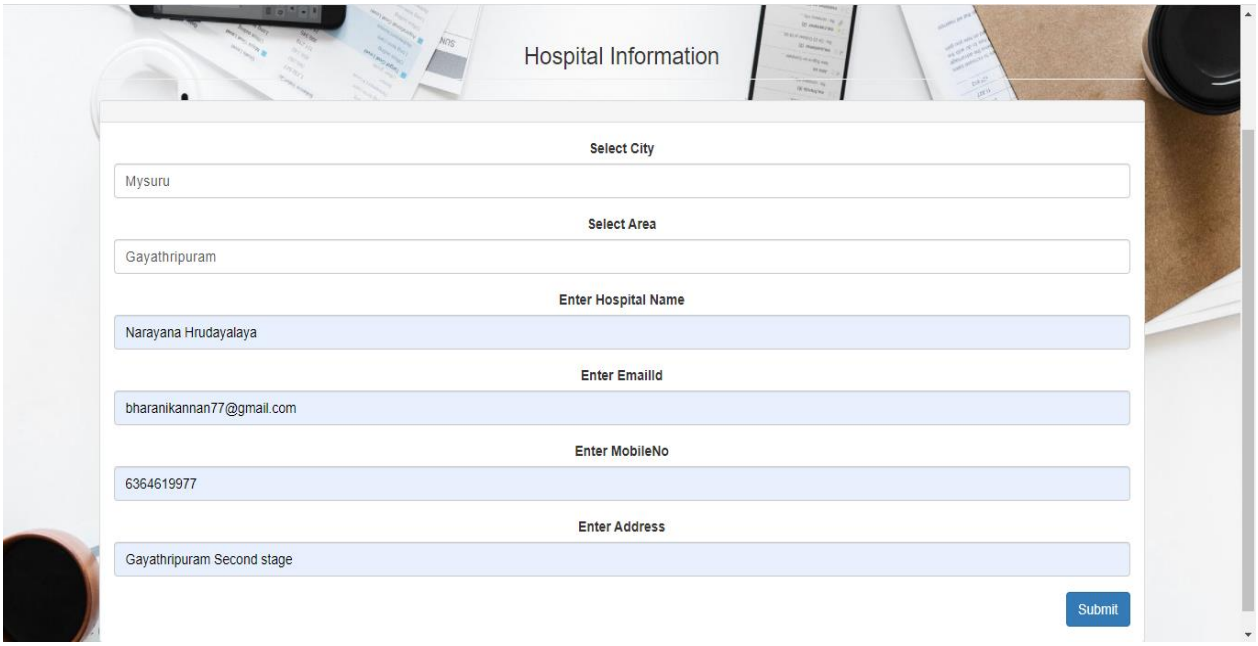
Snapshot 1: Home page and Login page

The above snapshot depicts home page and login page of the application where login page accepts authenticated user id and password credentials.



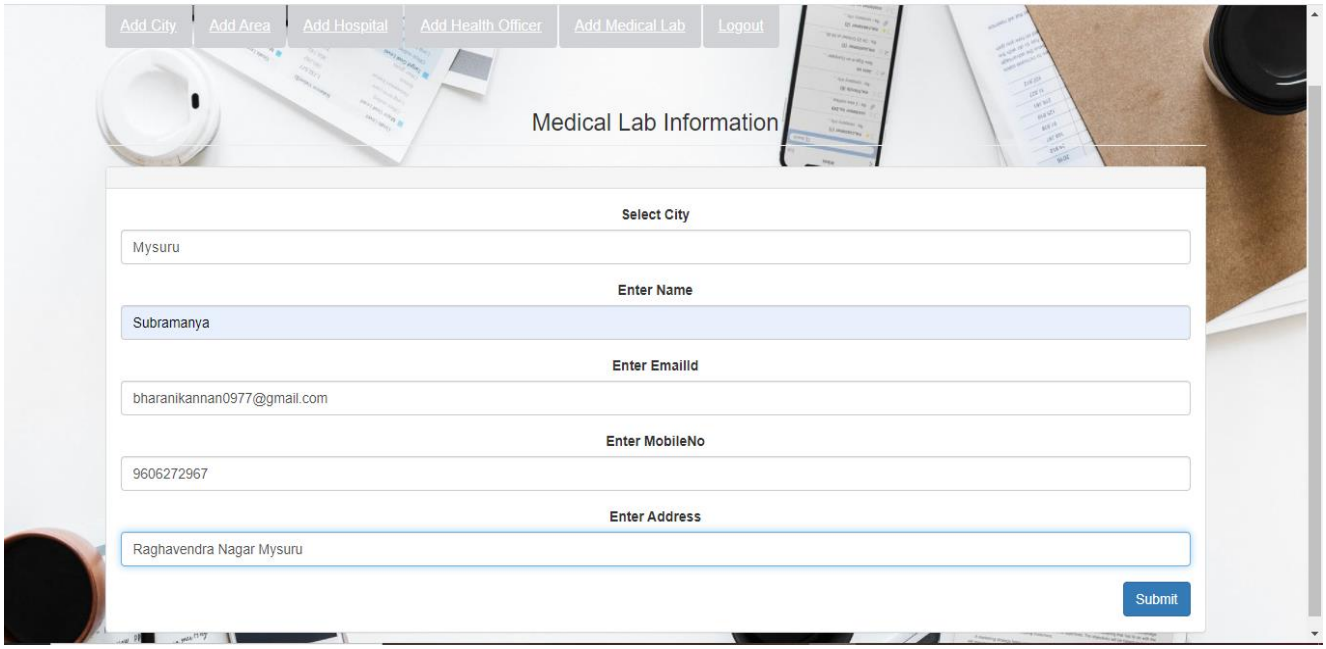
Snapshot 2: HealthAdmin using his credentials to login

The above snapshot depicts the login page where health admin is entering his credentials user id and password to login. The respective user id and password for health admin to login will be sent to his respective email id.



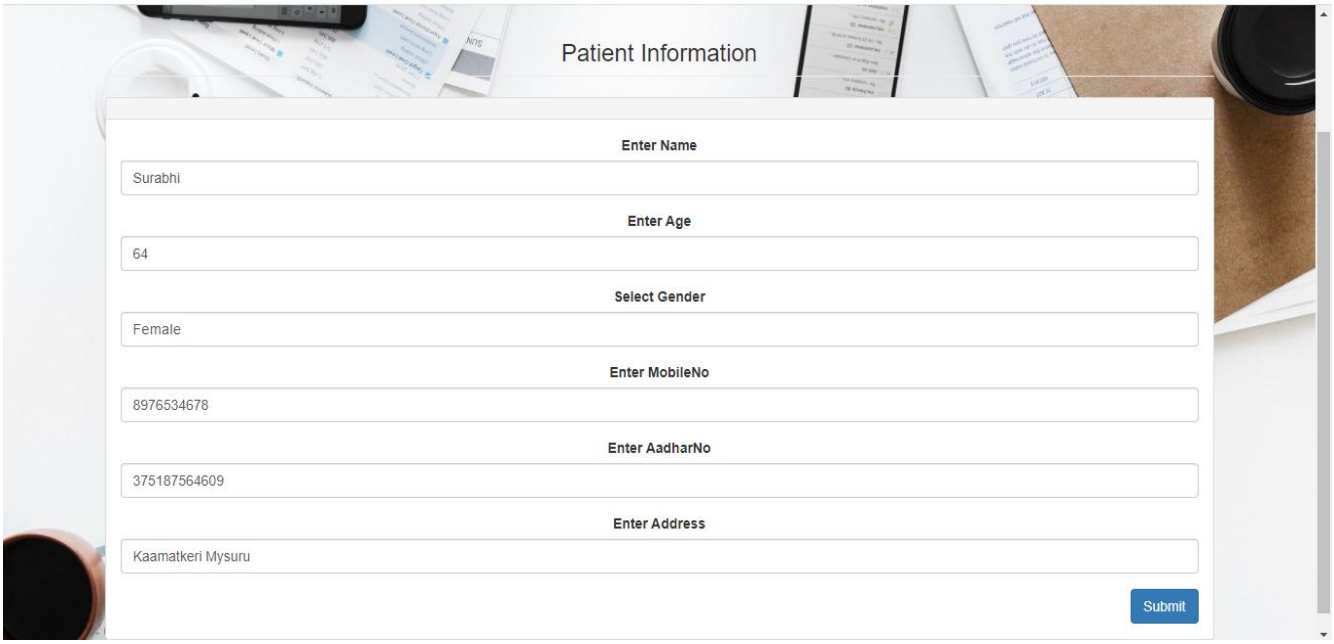
Snapshot 3: HealthAdmin page where he can add city, area, hospital, health officer and medical lab

The above snapshot depicts the page health admin can view after login. Health admin can add integrated information like city, area, hospitals, health officers and medical labs.



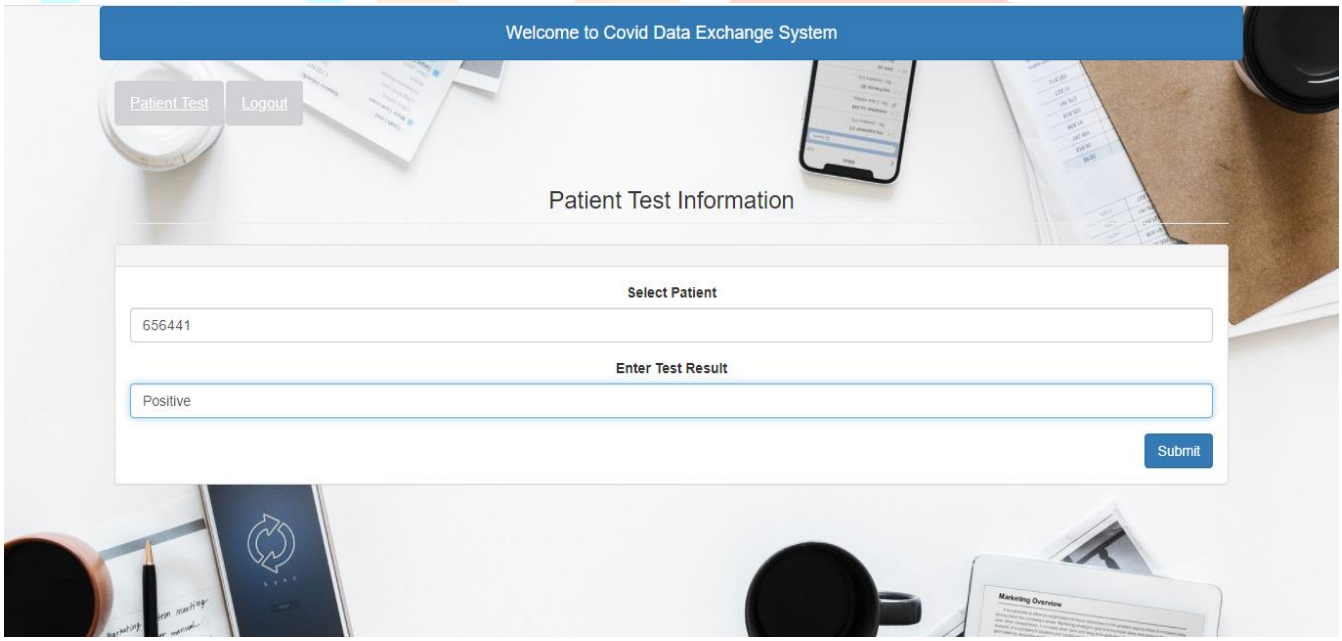
Snapshot 4: HealthAdmin adding Medical Lab information

The above snapshot depicts adding of medical lab information by health admin with labels such as city, name, email id, mobile number and address.



Snapshot 5: HealthOfficer adding patient information

The above snapshot depicts adding of patient information by health officer with labels such as name, age, gender, aadhar number and address.



Snapshot 6: MedicalLab adding patient test information

The above snapshot depicts adding of patient test information by medical lab by selecting patient and entering his test result.

IX. CONCLUSION

In this paper we discussed Blockchains, their applications in fighting covid-19, their functions in pharmaceutical supply chains and how they could be implemented in healthcare and pharmaceuticals amid covid-19 pandemic situation. The pandemic may have accelerated the industry's ability to better trace and manage supply chains. A better handle on supply chains, possibly with blockchain, could help cut costs, provide more flexible sourcing, increase safety, and boost compliance. Consumers hungry for health information also may want to know more about sourcing.

X. ACKNOWLEDGMENT

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