

Blockchain for Blood Based Therapeutic

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Abstract — Blood is essential component in human body and fulfills many functions, including transporting oxygen and nutrients to the lungs and tissues. Once extracted from the human body, it becomes a perishable product that can be used in surgeries, organ transplants, and in the treatment of cancer and blood diseases. Management of the blood supply chain is considered essential to minimize shortages and wastage of blood and to manage the flow of blood products from donor to patient. Blockchain technology has the potential to address these challenges by providing a secure, transparent, and tamper-proof way to track and manage the supply chain of blood products. This article aims the usage of blockchain as a platform for a trusted ecosystem for blood supply chain, to enable the tracking & transparency, safety & efficacy, and secure data storage & sharing.

Keywords: Blood Supply Chain, Blockchain, Healthcare, Life Sciences, Ecosystem

I. INTRODUCTION

Blood is essential component in human body and fulfills many functions, including transporting oxygen and nutrients to the lungs and tissues. Once extracted from the human body, it becomes a perishable product that can be used in surgeries, organ transplants, and in the treatment of cancer and blood diseases. Some of the main components of blood are Red blood cells (RBCs), Plasma and Platelets (PLTs). Blood deficiency and wastage can lead to death and complications in patients. Management of the blood supply chain is considered essential to minimize shortages and wastage of blood and to manage the flow of blood products from donor to patient carrying out the six main processes including collection, analysis, ingredient processing, storage, distribution and transfusion.

Some current challenges facing the blood product supply chain include:

- Ensuring the safety and quality of blood products
- Managing and tracking the distribution of blood products
- Maintaining accurate and up-to-date information about blood donors and recipients
- Managing the complex logistics of transporting blood products
- Ensuring compliance with regulatory requirements

Blockchain technology has the potential to address these challenges by providing a secure, transparent, and tamper-proof way to track and manage the supply chain of blood products. For example, blockchain can be used to:

- Create an immutable record of all transactions related to blood products, such as donations, testing, storage, and distribution
- Enable real-time tracking of blood products from donor to recipient
- Facilitate secure sharing of information between different organizations involved in the blood supply chain

- Improve transparency and accountability by providing a decentralized platform for storing and accessing information
- Ensure compliance with regulatory requirements by allowing for easy auditing of transactions

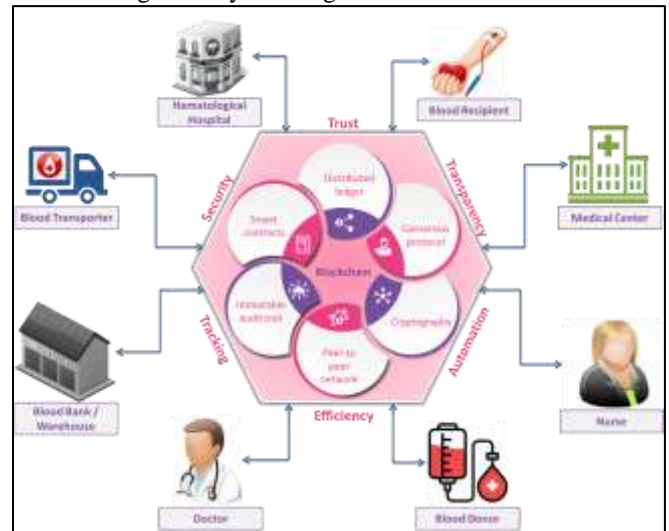


Fig. 1: Blockchain for Blood Supply Chain and Ecosystem

A. Tracking and Transparency

A blockchain-based system can be used to track the entire supply chain of blood products, from donation to testing and distribution, by creating a decentralized, tamper-proof, and transparent record of all transactions related to the handling and movement of these products. This can be achieved through the following steps:

- Blood donors and recipients are identified and registered on the blockchain network, providing a secure and immutable record of their identities.
- Blood products are tested and verified for quality and safety by authorized testing labs, and the results are recorded on the blockchain.
- Blood products are then stored in a secure location and the information about the storage location and conditions is recorded on the blockchain.
- When a blood product is distributed, the information about the recipient and the distribution location is recorded on the blockchain.
- All transactions related to the handling and movement of blood products are recorded on the blockchain, providing a tamper-proof and transparent record of the entire supply chain.
- With the use of smart contract, it can automate the decision-making process, like allocating blood products to patients in need, and perform compliance checks.
- With the help of IoT devices, real-time tracking of blood products can be achieved, making it possible to track the movement of blood products from donation to distribution, in real-time.

By implementing a blockchain-based system to track the entire supply chain of blood products, organizations can ensure the safety, quality, and availability of blood products, while providing transparency and security for all stakeholders.

B. Safety and Efficacy

Blockchain technology can be used to ensure the safety and efficacy of blood products by providing an immutable record of all testing and handling procedures. This can be done through the following steps:

- Blood products are tested for safety and efficacy by authorized testing labs, and the results are recorded on the blockchain. This information is stored in a tamper-proof and secure manner, ensuring that it cannot be altered or tampered with.
- The information about the testing and handling procedures is recorded on the blockchain, which includes details such as the type of test performed, the testing lab, and the date of the test.
- As the blood products move through the supply chain, the information about their handling and storage is also recorded on the blockchain. This can include details such as the temperature and humidity conditions during storage, and the date and location of the product.
- With the use of smart contract, the testing and handling procedures can be automated and performed as per the predefined rules.
- With the help of IoT devices, real-time monitoring of blood products can be achieved, making it possible to track the movement of blood products from donation to distribution, in real-time.

By providing an immutable record of all testing and handling procedures, blockchain technology can ensure that blood products are safe and effective for use. This can help to improve the overall quality and safety of blood products, and increase the trust and confidence of all stakeholders in the blood supply chain.

C. Secure Data Storage and Sharing

A blockchain-based system can be used to securely store and share patient data and medical records related to the use of blood-based therapeutics in the following ways:

- Patient data and medical records are encrypted and stored on the blockchain, providing a secure and tamper-proof record of the patient's health history.
- Patients are given control over their own data, including the ability to grant or revoke access to their medical records to authorized healthcare providers.
- Authorized healthcare providers can access the patient's data and medical records with permission, allowing them to view and update the patient's information as needed.
- Smart contracts can be used to automate the sharing of patient data and medical records with authorized parties, ensuring that the data is only shared with the intended recipients and that patient privacy is protected at all times.
- The blockchain platform can also be used to track the usage and administration of blood-based therapeutics,

including information such as the type of treatment, dosage, and outcome.

- With the help of blockchain, the data can be shared across different healthcare providers, ensuring continuity of care and avoiding duplication of tests or treatments.

By using a blockchain-based system to securely store and share patient data and medical records, healthcare providers can improve the quality and efficiency of patient care while also protecting patient privacy. Additionally, a blockchain-based system can enable researchers to access large amounts of data to perform more accurate and reliable research on blood-based therapeutics.

D. Potential Use Cases:

- Tracking blood donations and transfusions: Blockchain technology can be used to create an immutable record of all blood donations and transfusions, including information such as the donor's identity, the date and location of the donation, and the recipient's identity. This can be used to ensure the safety and quality of blood products, as well as to ensure compliance with regulatory requirements.
- Managing the distribution of plasma products: Blockchain technology can be used to track the movement of plasma products from the point of donation to the point of use, providing transparency and security for all stakeholders in the supply chain. This can include information such as the storage location and conditions, the expiration date, and the recipient's identity.
- Monitoring the storage and expiration of blood products: Blockchain technology can be used to track the storage conditions and expiration dates of blood products, ensuring that they are stored in the appropriate conditions and that they are used before their expiration date.
- Monitoring compliance with regulatory requirements: Blockchain technology can be used to ensure compliance with regulatory requirements related to the handling and distribution of blood products. This can include information such as the testing and screening of donors, the storage and transportation of blood products, and the administration of blood products to recipients.
- Improving the accuracy of inventory management: Blockchain can be used to track the inventory levels of blood products, enabling organizations to more accurately manage their inventory and avoid stockouts or overstocking.
- Facilitating the sharing of data and information between different organizations: Blockchain can be used to securely share information between organizations involved in the blood supply chain, such as blood banks, hospitals, and testing laboratories, allowing them to more efficiently coordinate their efforts and improve the overall safety and quality of blood products.

II. CONCLUSION

The key benefits of using blockchain technology for blood-based therapeutics include:

- Improved security and privacy: Blockchain technology provides a secure and tamper-proof way to store and share patient data and medical records, protecting patient

privacy and ensuring the security of sensitive information.

- Improved transparency and traceability: Blockchain technology provides a transparent and traceable record of all transactions related to blood-based therapeutics, including information about testing, handling, and distribution. This can help to ensure the safety and quality of blood products and improve compliance with regulatory requirements.
- Improved efficiency and coordination: Blockchain technology can be used to facilitate the sharing of information between different organizations involved in the blood supply chain, improving coordination and communication and reducing the risk of errors or delays.
- Improved patient care and research: Blockchain technology can be used to improve the quality and efficiency of patient care by giving healthcare providers access to accurate and up-to-date information about patient health history. Additionally, blockchain technology can enable researchers to access large amounts of data to perform more accurate and reliable research on blood-based therapeutics.

Future research and development in this area should focus on finding ways to effectively integrate blockchain technology into existing systems and processes in the blood supply chain, as well as on identifying and addressing any potential challenges or limitations of using blockchain technology in this context. Additionally, research could focus on the implementation of blockchain in blood banks and plasma centers to improve the overall efficiency and safety of the blood supply chain.

