# Identifying Counterfeit Medical Products with QR Code and Blockchain Technology for Securing Healthcare

Devanshu Sharma[1], Aryan Singhal[1], Pushpa Singh[1,*], Khushi Singh[1]

[1]Computer Science & Engineering, G.L. Bajaj Institute of Technology and Management, Greater Noida, India

*Author to whom correspondence should be addressed:
E-mail: pushpa.gla@gmail.com

(Received January 12, 2025; Revised September 14, 2025; Accepted November 18, 2025)

**Abstract**: Counterfeiting in the field of medicine has raised substantial concerns as a global issue, with its prevalence noticeably expanding in recent years. Counterfeit medicines pose a particularly severe threat to patient's life or safety and cause severe implications. It is difficult to trace a medical product as well as to identify its authenticity. This paper aims to combat the widespread issue of counterfeit goods in industries like Pharmaceuticals and Healthcare. Taking this as cognizant, we proposed a Blockchain and QR code-based product identification system to prevent the circulation of fake medical products where consumers do not have to rely on the distributors to know whether or not their products are real. The three main players involved in this Blockchain-based model are the manufacturer, supplier, and the consumer. The proposed system will have the power to track the history of the product all the way from the manufacturer to the supplier to the customer. Combining the potential of Blockchain technology along with a secure QR code mechanism will offer robust security, immutability of data and have transparency in all the transactions. Thus, this system will guarantee product traceability in the supply chain whereas the QR code will make it feasible for consumers to access product information instantly.

**Keywords:** Blockchain; Counterfeit; Healthcare; QR Code; Supply chain

## 1. Introduction

One of the major problems facing the online retail sector is the prevalence of fake/counterfeit goods in the market. These goods are imitations of the original branded goods, despite the fact that they seem to be real. Nearly 20% of the items sold on online marketplaces are fake/counterfeit. It is estimated that trade in counterfeit goods is now worth more than 5% of world trade[1)]. This impacts the company's reputation, revenue, and economics and also puts end user's finances, health, and safety at risk. Fake products can have a significant impact on various industries and areas, including FMCG (Fast-Moving Consumer Goods), Clothing and Fashion, Grooming and Beauty Products, Food and Beverages, Electronics, Entertainment and Media, Art and Collectibles, etc. but, apart from these, there are two areas where they pose significant hazards and harm to consumers, i.e. Pharmaceuticals and Agriculture.

Counterfeiting in the field of medicine has raised substantial concerns as a global issue, with its prevalence noticeably expanding in recent years[2)]. The range of counterfeit products and medicines increased during the COVID-19 pandemic [3-4)].

The World Health Organisation (WHO) claimed around one million deaths per annum due to fake and substandard medicine, which indicated $21 billion of global financial impact[5)]. Meanwhile, the growth of counterfeit Agro products has led to a downfall of the Indian Agro-industry. The distribution of medicines from manufacturers to patients is vulnerable to counterfeiting at several stages of the healthcare supply chain.

Emerging technologies have indeed played a vital role in improving the identification and prevention of counterfeit products using Radio-Frequency Identification (RFID), Quick Response (QR) Code, Internet of Things (IoT), AI, and Blockchain technologies. The proliferation of smartphones and the ease of generating QR codes make it feasible for consumers to access product information instantly. IoT and RFID are used to identify counterfeit product but relay on network bandwidth [6)]. AI can also identify unusual manufacturing or shipping patterns, enabling early detection and action against counterfeit goods. However, whenever a product's authenticity is in question, smart contracts can trigger actions to halt its distribution or initiate investigations [7)].

Here, the blockchain comes into its bigger picture for the identification and detection of fake/counterfeit product identification. Blockchain technology is secure,

Cite: D. Sharma et al., "Identifying Counterfeit Medical Products with QR Code and Blockchain Technology for Securing Healthcare". Evergreen, 12 (04) 1827-1840 (2025). https://doi.org/10.5109/7402619.

decentralized and distributed ledger system that records transactions across multiple node or block which cannot be changed. Users not need to depend on intermediary party to authorize the product's safety in the Blockchain technology. Smart contracts on the blockchain can automate various processes, such as payments and product verification [8]. Blockchain technology offers enhanced security, traceability, and transparency throughout the supply chain, ultimately benefiting consumers, manufacturers, and all parties involved in the fight against counterfeit goods [9]. Blockchain is a peer-to-peer network that establishes a record whose legality can be checked by the entire community. Hence, manufacturers can utilize this approach to supply genuine items to the customers. Blockchain assist to customer satisfaction, trust and loyalty. Especially in domains such as pharmaceuticals and drug supply chains.

Identifying genuine medical products and ensuring they are not counterfeit is of utmost importance to safeguard public health. Counterfeit medical products, which can include medicines, medical devices, or even personal protective equipment, pose serious risks to patients and healthcare systems. Taking this into cognizant, we proposed a blockchain and QR code-based method to prevent the circulation of fake medical products where consumers do not have to rely on the distributors to know whether or not their products are real and significantly reduce the expenses associated with product quality assurance. QR codes provide a practical technique for combating the practice of counterfeiting, particularly in context of current progresses in wireless and mobile technologies. To detect fake items, simply scan a QR code that is connected to a Blockchain. The proposed method can then be used to record medical product data and make a special identification for medical products in a database.

This paper aims to combat the widespread issue of counterfeit goods, with a focus on the critical problems they create in industries like Pharmaceuticals and Healthcare. Counterfeit medicines pose a particularly severe threat to patient's life or safety. By integrating Blockchain technology with QR codes, our aim is to guarantee the authenticity of pharmaceutical products, enhance consumer trust, and significantly reduce quality assurance costs. The ultimate goal is to make a substantial impact by safeguarding consumers and the pharmaceutical industry from the devastating effects of counterfeit medicines, protecting lives and well-being.

### 1.1. Research Questions (RQ)

This study is guided by the following research questions:

RQ1: How can blockchain technology be leveraged to ensure transparency and traceability in the medical product supply chain?

RQ2: How does QR code integration strengthen the identification and verification of genuine versus counterfeit medical products?

The remainder of the paper is systematised as follows. Section 2 discusses the related work. Section 3 describes the motivation and section 4 describes the methodology to develop the proposed model. Section 5 presented the implementation details while Section 6 shows the result and discussion. Section 6 highlighted the impact of the proposed work on the pharmaceutical Industry. Finally, the paper concludes with a future scope in section 8.

## 2. Related Work

Various research studies and initiatives have explored how AI, QR code, RFID and Blockchain technology can be applied to address the issue of fake/counterfeit product identification. Saeed et al.[10] suggested Near Field Communication(NFC) technology easily available in consumer's cell phone which acts as an RFID reader and hence detects counterfeit products. Khalil et al.[11] proposed an RFID-based anti-counterfeiting and anti-theft techniques to identify counterfeit items at the time of purchase. RFID based system could not able to work in poor quality of network. Another study was led by Picard et al.[12] to examine copy detection QR Codes which had been positioned in market for many years. However, by itself a QR Code can easily be copied by cloning. Hence, power of cryptography and web services was proposed by Shaik et al.[13] along with QR code to prevent counterfeit products by inserting copy sensitive layer to QR Codes. Yan et al. in 2020 proposed IoT system that utilized visual feature for the authenticity of the product along with QR code for tracking and tracing [14].

Modern techniques for fake/counterfeit product detection leverage advanced technology such as machine learning and blockchain technology to enhance the accuracy and efficiency. Machine learning-based image and text identification and classification could be a crucial tool in the fight against counterfeiting [15-17].

Roy et al.[18] suggested a better solution utilizing AI for non-technical customers who can scan the product or goods with the help of a mobile application to check the product is authentic or counterfeit. The proposed model was in two phases. The first phase was logo detection using spelling detection and color recognition and the second phase was training the ML model using the Naïve Bayes algorithm and then detecting fake or original logos with the help of the Feature Extraction method.

AI-based solution for fake/counterfeit product detection requires huge data sets for training and computation power. Some different anti-counterfeiting technologies (besides blockchain) along with their limitations and use cases can be seen in Table 1. To overcome this limitation, Blockchain technology has been introduced.

Recently, various research studies and initiatives have explored how blockchain technology can be functional to

address this issue in different sectors such as luxury[19-20]), healthcare [21-25], and E-commerce, [26-28]. Mani et al. [21]

**Table 1:** Anti-counterfeiting Technologies

| No. | Technology | Product Type | Drawback/Shortcomings |
|---|---|---|---|
| 1. | RFID | Any | 1. Can be counterfeited as well.<br>2. Unable to transmit through metal objects. |
| 2. | Artificial Intelligence | Daily use products | 1. Requires substantial investments in data collection, infrastructure, and expertise.<br>2.These systems can be expensive. |
| 3. | Machine Learning | Supply chain prediction | 1. Training & running ML models can require significant computational resources.<br>2. The don't generalize well to novel and unseen examples. |
| 4. | QR Code | Daily use products | 1. Easy to replicate<br>2. Choosing appropriate encrypting key |

made a study of detecting fake products. Adsul et al.[22] pointed that conventional supply chain activities didn't record the data about product among the various parties involved in the system, like manufacturers, producers, distributor and retailers.

Hence, these parties have no information regarding that medical product. Governing authority has no tractability, transparency of the system, taking follow-up of patients and supply chain activities are complex and costly affair. Therefore, the author proposed a blockchain based system or device in the field of the pharmaceutical supply chain to leverages with traceability, transparency, immutability and security to the medical supply chain. The proposed device may be utilized in the pharmaceutical industry to track the drugs from its manufacturing to distribution to patients. Wasnik et al. [23] conducted a research to enhance the identification of counterfeit products by monitoring the history record of the supply chain. A blockchain-based system decentralized everything, allowing various parties to access it simultaneously. Chen et al. [20] proposed a model using blockchain technology to minimize the issue of data falsification and tampering, while tracking the data of luxury products and ensuring the accuracy and authenticity of the related data, to achieve the goal of anti-counterfeiting of luxury products. Their work was limited to luxury products. Veronica et al. [27] proposed an Ethereum Blockchain which will be used to add a QR code to the products while manufacturing. The Author claims the system to be a robust technique to fight against the practice of counterfeiting products. The system produces a unique QR code of the product and the product details along with its QR code are stored as blocks in the blockchain. The Author's model is a generalized method and does not focus on the specific domain. Sharma et al.[24] proposed the efficacy of QR code and blockchain technology to identify fake medical products. However, the authors did not discuss in detail the implementation and results. Similarly, Islam et al. [25], also integrated QR codes and Blockchain in the supply chain from the manufacturing to the end user using public key infrastructure and digital signature to trace the medicine.

Singh et al. in 2021 suggested authenticating the product at every phase of the supply chain through the OTP system on the recipient's mobile device. However, network problems can stop to receive OTP[28]. Blockchain technology was also used by Anthony et al. to create a system that allows clients to verify a product without a corresponding merchant, but the supply chain involved too many different intermediaries[29].

Blockchain technologies have the potential to revolutionize supply [30-35] chains and recognize counterfeit goods[13-20]. Table 2 provides an overview of some important research and models, as well as the techniques used to detect counterfeit goods. Since Blockchain is a decentralized network and distributed digital technology[36-37]. The idea is to store medical product details along with its QR codes into a Blockchain instead of storing it in a centralized database. The hazards of data being tampered by third parties are eliminated when decentralized control is made possible.

Table 3 compares the existing work with various available technologies and application domains such as E-Commerce[26], recycling[38], etc., apart from the supply chain. Table 3 demonstrates the potential of integrating QR codes and blockchain technology for effective detection of product counterfeiting[23,26,38,39]. This motivates the author to explore the QR and blockchain for the supply of medical products.

## 3. Motivation

Anything that makes money can be counterfeited. Expensive medicines such as those used in the treatment of cancer or AIDS are particularly profitable for fake medicine-making companies. The most often

counterfeited medications are antibiotics, especially in low-income countries where many individuals cannot afford the cost of medications.

Some expensive medications [24] are stated below:

• Obinutuzumab – *(Rs 399305)* Used in chemotherapy to treat blood cancer.

• Pembrolizumab – *(Rs 197250)* Humanized antibody used in cancer immunotherapy that treats melanoma, lung cancer, skin cancer, etc.

• Nivolumab – *(Rs 39800)* Used in the treatment of cancers of the kidney, urinary tract, food pipe, stomach, etc.

Counterfeiting of life-saving medicines must be put to an end. This motivates the author to develop a type of model that can protect against the counterfeiting of medical products.

The proposed solution has the potential to overcome all the challenges in the existing systems as well as to provide a better architecture for the existing supply chain. Combining the potential of Blockchain technology along a secure QR code mechanism will offer robust security, data immutability, and transparency in all transactions.

Models like these ensure the authenticity of products and help maintain consistent quality and safety standards. This is especially crucial for sectors like medicines and healthcare, where low-quality counterfeit goods can have disastrous effects.

## 4. Proposed Methodology

The proposed methodology is centered on the integration of Blockchain technology and QR code, which ensures product authenticity without relying on middlemen for verification. QR are 2D matrix barcodes that you see on product packaging, to connect products to the Blockchain. Consumers can scan these QR codes with their smartphones to confirm that a product is genuine.

Algorithm-1 represents the overall working of the proposed methodology.

Each product gets its unique code securely stored in the Blockchain. The several steps involved in the process are mentioned below:

**Registration & Input Product Details (Manufacturer)** -The initial step involves establishing a secure website for manufacturer registration and login. Upon login, manufacturers can add product details such as batch numbers, manufacturing dates, and a product serial ID, etc. using *addProduct() function* ensuring accurate data entry for Blockchain verification.

**Table 2:** Existing works using different anti-counterfeiting technologies

| S.No. | Ref. | Contributions | Research Gap |
|---|---|---|---|
| 1. | Adsul et al. 2020 [22] | The author suggested a novel, well-established methodology for linking test case prioritization techniques with fuzzy logic and artificial intelligence. This system is based on three factors: necessity inclusion, endeavors, and complexity. | Training & running of ML models can require significant computational resources. Inaccurate or biased training data can cause inconsistencies in the result. |
| 2. | Singh et al., 2021 [28] | Authors suggested a collective method of the decentralized Blockchain technology and the Supply Chain to remove the need of traders by the customers. Authentication of the product has been done at each phase of recipient's phone via OTP. | The model requires the appointment of Quality control manager which is not very sustainable. End consumer and shopkeepers do not receive OTP, which is a loophole for counterfeiters. |
| 3. | Wasnik et al., 2022 [23] | The author suggested blockchain-based technology to enhance the detection of fake products by tracking its supply chain history. | The proposed work is limited to general products. The following work does not tackle medical products and related domains. |
| 4. | Chen et al., 2022[20] | Author suggested blockchain-based to solve the problems of data forgery and data tampering; The objective is to enhance the accuracy and authenticity of the relevant data of luxury product. | Too much involvement of various intermediatory people in supply chain, which makes the model more convoluted. |
| 5. | Anthony et al., 2023 [29] | The author proposed a system that allows consumers to verify the legitimacy of a product without the need for a corresponding merchant, utilizing blockchain technology. | Extensive implementation costs potentially limit its widespread use and effectiveness. There is an excessive amount of middlemen involved in the supply chain. |
| 6. | Sulaiman & Nur, 2024[27] | The Author suggests using Ethereum, smart contracts, and QR codes to authenticate the products. | High memory is needed to store the supply chain of every product. Limited to the general product. |

| | | | |
|---|---|---|---|
| 7. | Sharma et al., 2024[24] | The author advocates a blockchain and QR code-based method to identify fake medical products. | Only a prototype, need to add implementation details. |

**Table 3:** Comparison of Related Work Based on Technologies and Application Domains

| Publication Name | QR | AI | Blockchain | RFID | Workspace / Domain | Method / Approach |
|---|---|---|---|---|---|---|
| A blockchain-based recycling platform using image processing, QR codes, and IoT system [38]. | Yes | Yes | Ethereum smart contracts | No | Recycling | Deep Learning-based Image Recognition and IoT. Provides 98.2% accuracy in object recognition. |
| Detection of Counterfeit Products using Blockchain [23] | Yes | No | Ethereum Network | No | Supply Chain | Track the entire product's history from manufacturer to customer using blockchain and QR codes. |
| A Blockchain based Medicine Production and Distribution Framework to Prevent Medicine Counterfeit[25]. | Yes | No | Permissioned Blockchain | No | Medical Supply Chain | The blockchain-based framework was used. |
| Identification of Counterfeit Products Using Blockchain in E-Commerce[26]. | Yes | No | Public blockchain | No | E-commerce | QR and blockchain ledger for online goods authentication |
| A Blockchain-assisted Authentication Protocol for RFID-enabled Supply Chain Management System[35]. | No | No | Hyperledger | Yes | Supply Chain | Blockchain-assisted RFID-enabled Supply Chain Management System |
| AI-enabled Product Authentication and Traceability in Global Supply Chains[40]. | No | Yes | Consortium Blockchain | Yes | Global Supply Chain | AI, RFID, and blockchain traceability |
| Identifying Counterfeit Medical Products with QR Code and Blockchain Technology for Securing Healthcare (Proposed Work) | Yes | No | Permissioned Blockchain | No | Healthcare / Medical Products | QR code-based product verification integrated with blockchain ledger |

**Product Serialisation** - It involves assigning a unique identification code (UID) to each individual product unit. This UID is created by using SHA-256 and UID along with product details is stored in the block as shown in algorithm 1. This distinct serial number helps authenticate products throughout the supply chain, enabling precise monitoring and verification within the Blockchain system.

**Blockchain Record Creation**- It compiles product details securely into the Blockchain ledger, ensuring an immutable, transparent record for verification.

**QR Code Generation**- It involves creating QR codes for each medical product, allowing easy access to product information by scanning the code with a mobile device.

**Product Distribution**-Prior to product distribution, the QR code will be sent to the manufacturer and they will place it on each product. Subsequently, the product will be introduced to the market.

**Login & Edit Product Details (Supplier)**- Before selling the product to the customer, the supplier can scan the QR code on the products. The supplier will be authorised to edit details such as date of selling of product. The supplier will also will have to update that the product has been sold. This will keep track that out of total manufactured units how many products have been consumed.

**Smart Contracts**- It automate and enforce key supply chain agreements related to product distribution, verification, and data sharing. These contracts streamline processes, enhance transparency, and ensure compliance, all of which contribute to the overall efficiency and effectiveness of the model.

**Product Verification**- This is the subsequent step in our methodology, focusing on confirming the authenticity and details of each serialized medical product. This step typically involves scanning QR codes by the customers to

access Blockchain records and ensure product legitimacy and traceability.

After scanning the QR code, if the product's unique code matches the records, it's genuine otherwise it's considered as counterfeit. This simple and easy-to-do action will ensure that patients receive authentic products.

Overall, the methodology is shown in Figure 1. The main three players in the framework, i.e. manufacturer, supplier,

**Algorithm 1: Blockchain-Based Fake Medicine Detection using QR Code**

```
Input:
MProduct_Details(Manufacture_ID,
Product_Id, Product_Name ,
Product_Price, Brand)
Output: Verification Result
(Authentic / Fake)
Begin
Manufacturer registers medicine on
blockchain using function
addProduct().
Generate a unique Hash (UID) using
SHA-256.
MProduct_Details(Manufacture_ID,Pro
duct_Id, Product_Name ,
Product_Price, Brand)
SHA-256(MProduct_details,
Timestamp).
Store (UID, MProduct_details) in
the blockchain ledger.
Generate a QR code embedding UID
and transaction hash.
Supplier scans QR code and verifies
authenticity through
verifyMProduct(UID).
If record exists → mark MProduct as
Genuine.
Else → flag as Fake.
User scans QR code before purchase
for final verification.
End
```

consumer will have the following responsibilities and duties.

**Manufacturer** - Any more data that is needed is added to a block that will be inserted to the Ethereum blockchain using the Ethereum wallet of manufacturer. First, Manufacturer will login his Ethereum wallet account and generate a QR code for the particular product. If both are present, a link will be created between the entity's and the user's wallet addresses in our local database. If just the block is uploaded to the digital ledger, the manufacturer will enter data from his own wallet and account.

**Supplier** - The supplier scans the QR code on the product after logging into their account. The seller has access to the product data entered by the manufacturer. It adds further details about the product, such as the location of the store, to the Blockchain. The buyer can see these details. Algorithm-2 represents the working of the supplier side.

**Customer** – customers may confirm the legitimacy of a product by scanning the QR code that offers records of previous transactions on the blockchain. In case of any mismatch, the client will be aware that the goods are not authentic.

**QR Code** - In a blockchain-based system for detecting counterfeit goods, QR codes can be utilised as a product's unique identification. Here's how it will function:

Assign every product a distinct QR code: A distinct QR code is allocated to every product and is printed either on the product or its container.

**Post the QR code on the blockchain:** The QR code is sent to the blockchain along with other relevant data, such as date of manufacture, the location of each supply chain stage, and the names of the participants at each stage. Scan the product's QR code for authenticity: Customers can authenticate the product by scanning the QR code with a smartphone app. To confirm the validity of the product, the app would connect to the blockchain to obtain the data that was captured during the supply chain tracking stage.

**Anti-counterfeiting measures:** Other anti-counterfeiting techniques that the system can incorporate are tamper-evident packaging and unique, hard-to-copy QR codes.

**Enforcement:** When products are found to be fake, the blockchain can be used to locate the product's original manufacturer and assist in bringing legal action against people responsible for their creation and sale.

Using QR codes in a blockchain-based system for detecting counterfeit goods may make it quick and easy for customers to verify products. Furthermore, it enables the effective archiving and upkeep of product data on the blockchain, which can be employed to implement anti-counterfeiting measures and identify the source of counterfeit merchandise.

## 5. Implementation Strategy

The overall goal of this architecture (as illustrated in Figure 1) is to guarantee that manufacturers, sellers, and consumers can all access relevant product information that is stored on the blockchain. Through the use of smart contracts, the system will be able to guarantee that all participants in the supply chain abide by its laws and regulations and give customers great assurance regarding the legitimacy of the goods they buy.

**Algorithm 2: Execution steps at Manufacturer Side**

```
Supplier Login the System
Scan QR_Code → Extract UID
If UID Exists in Blockchain then
```

```
Fetch MProduct_Record
Update Inventory_Details
(Supplier_ID, Warehouse, Timestamp)
 Append new Transaction_Block
```

```
Else
 Display "Invalid MProduct Record"
End If
```

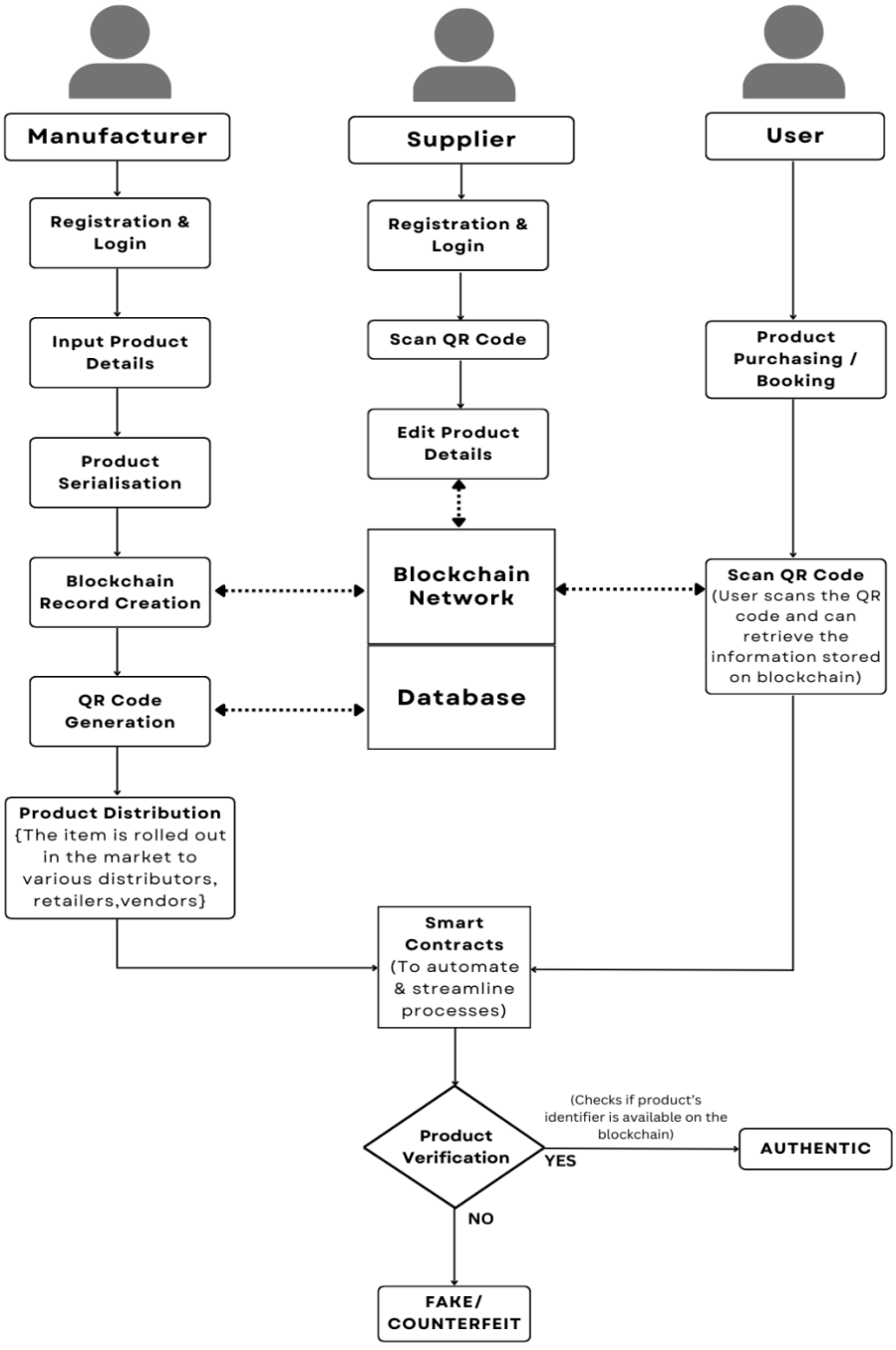



**Fig. 1:** Proposed Methodology

The proposed system enables interaction between suppliers and manufacturers so that each can contribute a block to the blockchain with transaction details without altering the other's block. Solidity is used in the writing of the contracts for the supplier and manufacturer block. Ganache has been used for local testing because the code is executing on a local network. In the truffle-config.js file, port 7545 and host "127.0.0.1" are configured. Truffle is then used to compile and deploy the contracts.

Port 7545 was selected as it is the default communication port of Ganache, enabling ease of integration with Ethereum-based development tools.

For deployment, migration files are created. We can deploy contracts on an Ethereum blockchain network with

the use of Migration files. React and HTML are used to develop the interface. Web3.js library is used to enable interaction with the Ethereum blockchain. It facilitates sending and receiving ether, verifies transactions, and reads and writes data from smart contracts. Usage of web3.js to connect the frontend to the backend and interact with contracts and JavaScript is used for backend-to-frontend connection. Installing Metamask on a browser makes it possible to access an Ethereum wallet via a browser and interact with the Ethereum blockchain.

Ganache accounts are loaded into Metamask, as seen in Figure 5, in order to add supplier and manufacturer blocks, they must validate the transactions using their Metamask wallet account, which is connected via Web3.js. After that, the end-user can verify the product's integrity and supply chain by scanning the QR code.

## 6. Result & Discussion

The proposed fake medicine identification model is developed as a full-stack decentralized app that can be used to identify counterfeit medicines with ease. Figure 2, shows the home page of the website where players like manufacturers, sellers, and consumer, can login using their Metamask accounts.

The home page of the app gives three options which first of which is used for manufacturer login, the second for seller login, and the third one is used to verify the product by the consumer. The user has to login according to the position allotted to the player. The manufacturer must have a Metamask account, which he/she must be connected to the website.

Figure 3 shows Metamask portal prompt message asking the user to connect his account with the website. Here, the address of the manufacturer is 0xe3DF96aB6Dd7336457D1126632a3184c766F1C34.

After connecting the wallet, the manufacturer will be able to see his ETH coins, and a green dot beside his account name, indicating that the Metamask wallet has been successfully connected with the website as shown in Figure 4 Whenever a manufacturer adds some data on the blockchain its Metamask account is used to make a transaction on the blockchain. For completing this transaction some amount of gas is deducted from the Metamask account. On clicking on the manufacturer button, a login page appears as shown in Figure 4. Here, the manufacturer will have to enter his correct credentials, i.e. his username, password and his manufacturer ID.

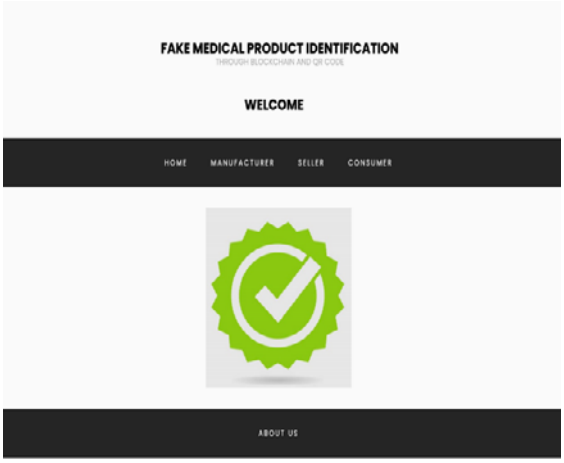
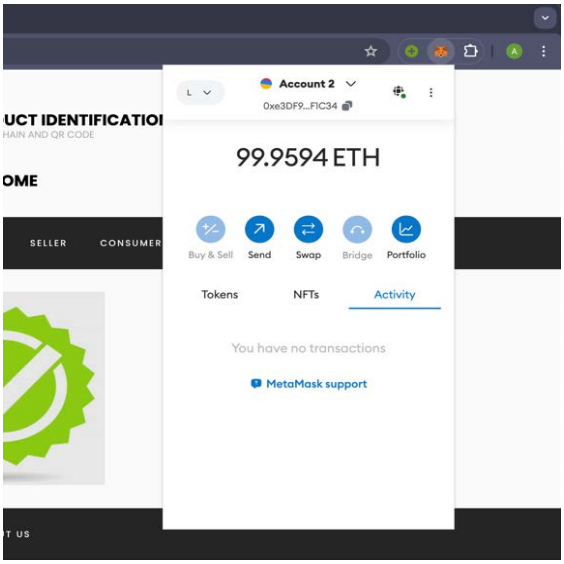



**Fig. 2:** Home Page

After successful login, the manufacturer section page appears. This page has all the relevant options for a manufacturer, i.e., add a product, add seller, check inventory, sell product to seller, etc. Figure 5 show the Add Product section. Manufacturer is adding product details on the platform like product ID, product name, product brand, price. When the manufacturer clicks on add the product, a Metamask message appears to confirm the transaction for which some amount of gas is used. On successful transaction, a QR code is generated real time and a unique product serial number is also generated. Subsequently, these details are added on the blockchain.

A manufacturer can view their inventory by clicking on check the inventory as shown in Figure 6.

The manufacturer can add the sellers to whom he sells his medicines. The manufacturer has to enter complete details about the seller such as his name, address, phone number, seller ID, etc. The Query Sellers page allows the manufacturer to see the details of all the sellers to whom he sells his medicines. By this the manufacturer can have a record of all the various sellers associated with him. Figure 7 shows the Query Sellers page.




Cite: D. Sharma et al., "Identifying Counterfeit Medical Products with QR Code and Blockchain Technology for Securing Healthcare". Evergreen, 12 (04) 1827-1840 (2025). https://doi.org/10.5109/7402619.

**Fig. 3:** Manufacturer Connecting his Metamask Wallet

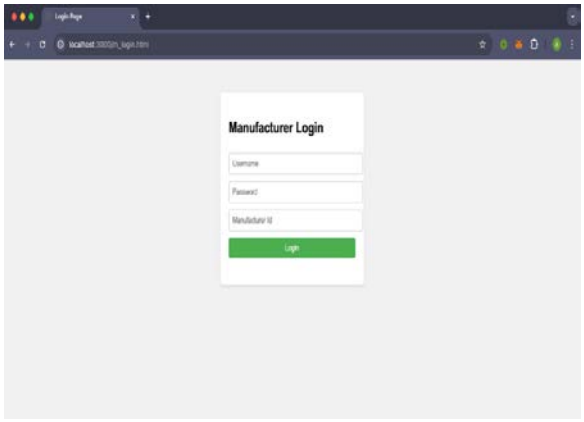



**Fig. 4:** Manufacturer Login

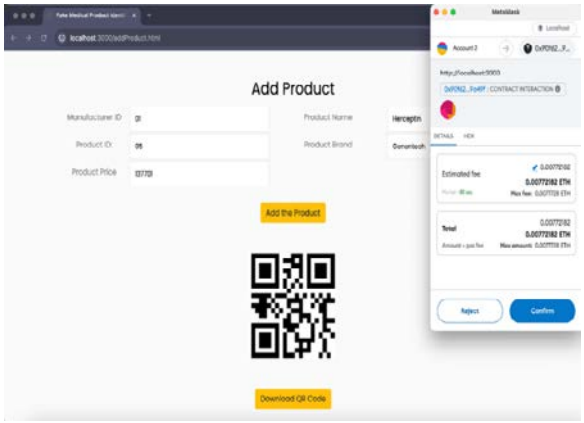



**Fig. 5:** Add Product

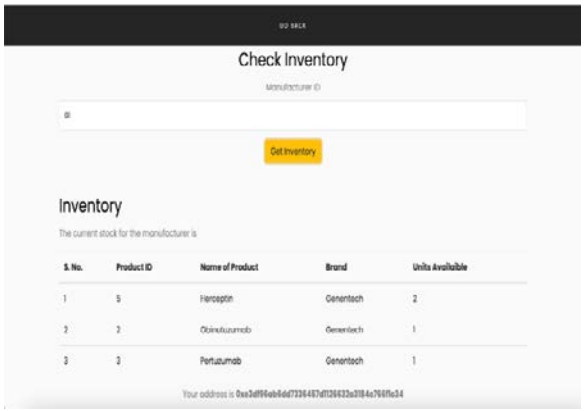



**Fig. 6:** Check Inventory

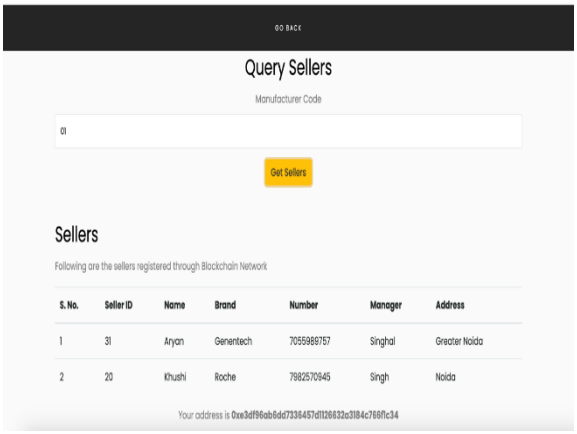



**Fig. 7:** Query Sellers

When the medical product is sold to the seller, the manufacturer clicks on Sell Product to Seller, then simply scans the QR code on the medicine. The website automatically detects the QR code and retrieves the corresponding product serial number. The manufacturer enters the seller code to whom he is selling his medicines and finally clicks on the Sell to Seller button. Figure 8 shows the Sell Product to Seller page.

All the work from the manufacturer's end is completed. The details of the manufactured medicines are successfully stored on the blockchain. Moreover, the medicines are also sold to respective sellers.

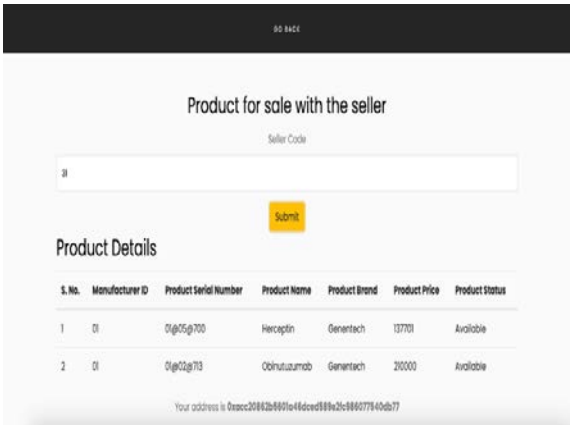



**Fig. 8:** Sell Product to Seller

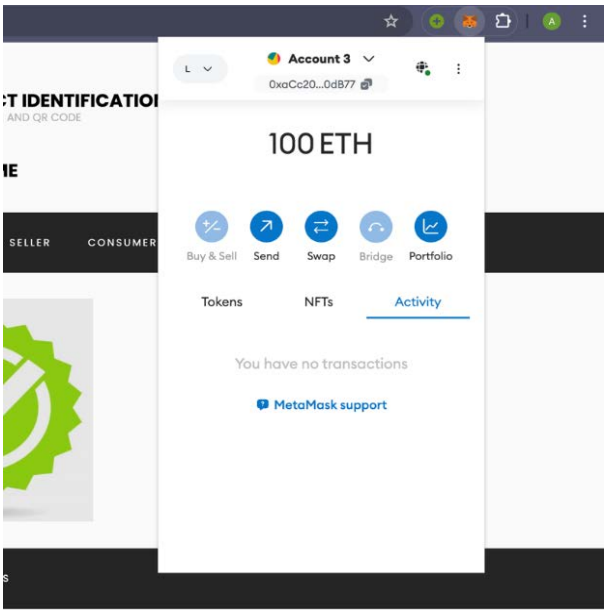



**Fig. 9:** Seller Successfully Connected to the Dapp

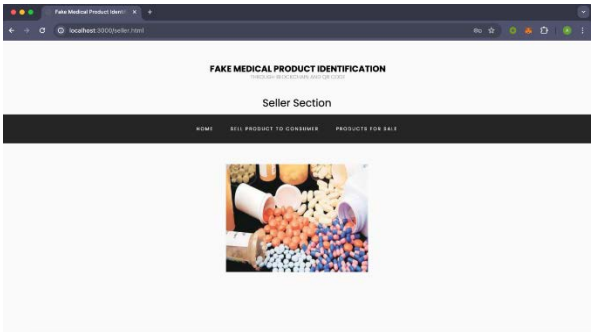



**Fig. 10:** Seller Section

Now, the seller comes into play. The seller will have to connect his Metamask account with the Dapp to perform transactions. Figure 9 shows the account of the seller, which is 0xaCc20862b5601A46DCED589e2fc986077540dB77, and its ETH coins.

On the homepage the seller will click on the Seller section and fill its correct credentials to login. After successful login, the Seller Section page is opened, which has only two options, either sell medicine to consumer or check the available stock. Figure 10 shows the Seller Section page.

The check the availability of medicines, the seller can click on Products for Sale. Figure 11 shows the Products for Sales page, which displays the details of the medicines which the seller can sell or has sold in the past. The seller can see details such as its serial number, name, brand, manufacturer ID, and the status of the medicines, whether they are sold or not.

The Sell Product to Consumer page allows the seller to sell medicines to end consumers. The seller will have to scan the QR code on the medicines, enter the consumer code and finally click on the Sell to Consumer button as shown in Figure 12.

The medicine has been successfully sold to the consumers and now the final step remains, i.e., product verification by the end consumers. In order to check the authenticity of a medicine the consumers will click on Product Verification page. The consumer will have to scan the QR code placed on the medicine, then enter his/her consumer ID and click on get product status as shown in Figure 13. If the medicine is authentic, a “Genuine Product” message is displayed.

If the product is fake/counterfeit or the product details are

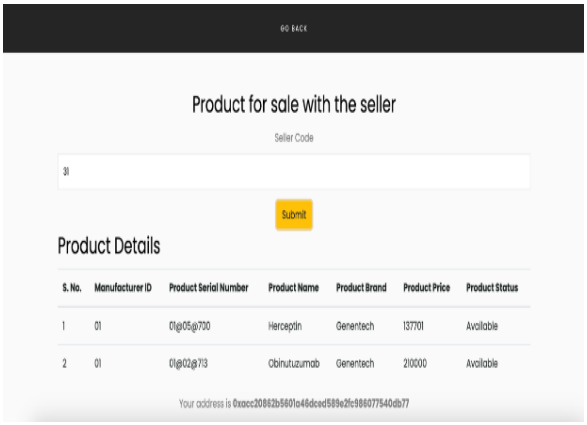



**Fig. 11:** Products for Sales

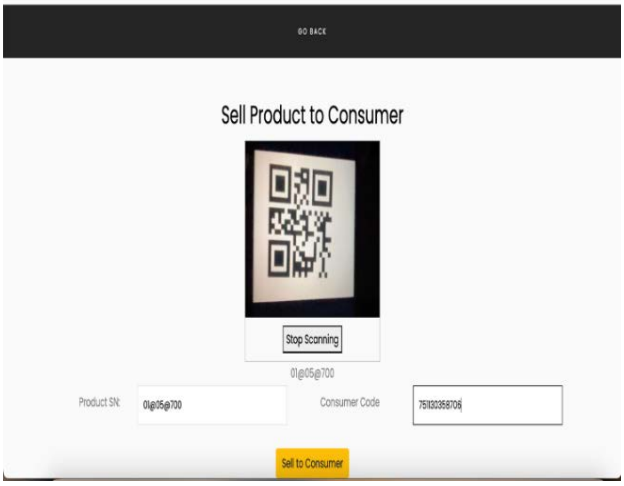



**Fig. 12:** Sell Product to Consumer

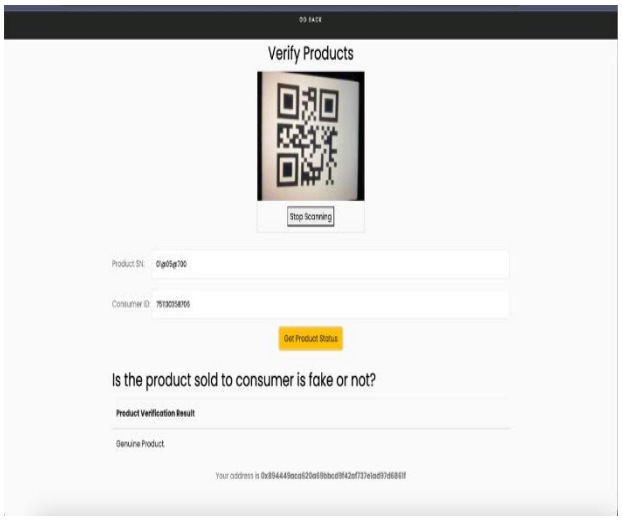



**Fig. 13:** Verify Products

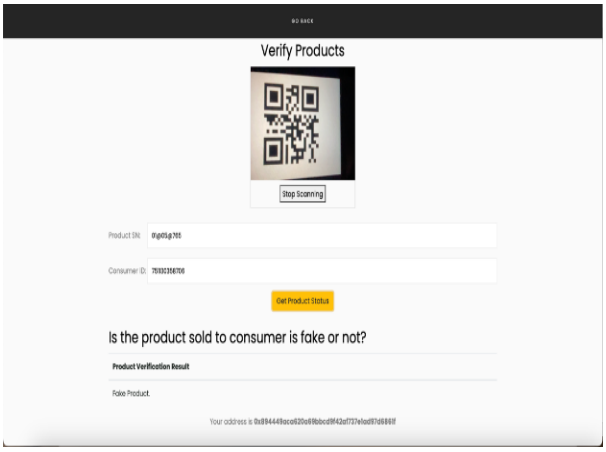



**Fig. 14:** Fake Product Message

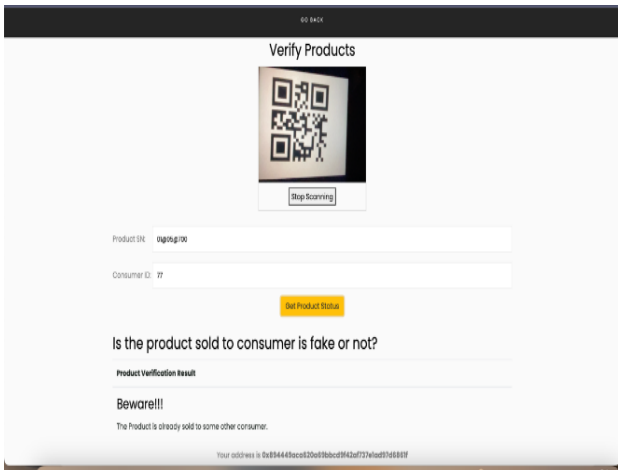



**Fig. 15:** Multiple Selling of Same Medicine to Different Consumers

not stored on the blockchain, then the "Fake Product" message is displayed as shown in Figure 14.

If a seller tries to copy the QR code and sell the same medicine to some other consumer as well, then upon product verification by the consumer, the consumer will be warned by a different message, so that the consumer

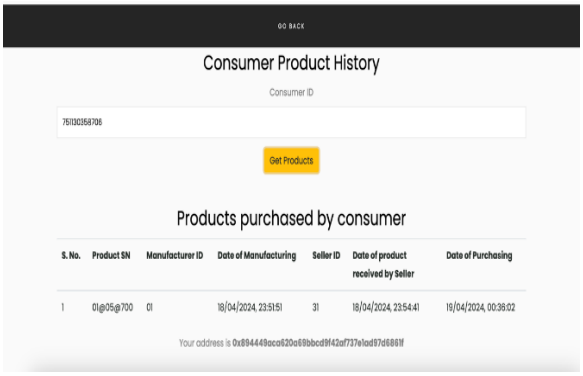



**Fig. 16:** Consumer Purchase History

gets alerted and does not purchase the medicine. Figure 15 shows one such case.

The consumer can also see the complete details of the medicines and his purchase history by clicking on the Consumer Purchase History page. Figure 16 shows the details of the medicines throughout the supply chain and the purchase history.

Therefore, from the proposed application, we were able to successfully trace a medicine throughout the supply chain, reducing the chances of counterfeiting. Blockchain and QR codes helped us store the details of medicines securely on a decentralised ledger, making it very secure and at the same time convenient for end consumers to fetch medicine information.

## 6.1. Response of RQ1:

From Figure 4 to Figure 16, it has been observed that Blockchain offers a decentralized, secure, and tamper-proof infrastructure where every medical product's journey can be recorded, verified, and audited. This enhances transparency, trust, and counterfeit detection in the healthcare ecosystem. Stakeholders can verify authenticity through a distributed ledger accessible to all participants.

## 6.2. Response to RQ2:

QR code integration maximizes the identification and verification process by embedding unique, tamper-resistant digital identities for each medical product. When linked to a blockchain ledger, these QR codes provide instant access to product details such as manufacturer, batch number, expiration date, and distribution history. QR code offers a machine-readable tag that links physical products to digital records and enables product identification and user-level verification through scanning. If we are using QR codes alone, then it would be vulnerable to duplication unless connected to blockchain.

## 7. Impact on Pharmaceutical Industry

The impact of a fake medical product identification system on the pharmaceutical industry and society could be significant and multifaceted:

*Improved Trust and Safety*: A major advantage would be a rise in public confidence in the pharmaceutical sector. Finding and stopping the spread of counterfeit medications will improve drug safety and effectiveness, improving patient confidence and health outcomes.

*Protection of Public Health*: Treatment failure, the emergence of drug resistance, and unpleasant reactions are only a few of the major health hazards associated with counterfeit medications. Finding and eliminating fake medications from the market would safeguard public health and shield individuals from possible harm.

*Economic impact*: Pharmaceutical businesses may initially incur higher costs as a result of greater investments in regulatory compliance and authentication technologies that result from the installation of a fake medicine identification system. However, getting rid of counterfeit medications can preserve the market share of real pharmaceuticals, which might boost sales for real drug producers.

*Public Awareness and Education*: By detecting fake medications, medical professionals and the general public may become more aware of the risks associated with using illicit medications. Education programmes could encourage people to buy pharmaceuticals from reputable suppliers and assist people in recognising phoney medications.

## 8. Conclusion & Future Scope

The proposed system actually assists manufacturers, consumers, and the retail market in preventing product counterfeiting; however, the system was unable to prevent the sale of fake products after a QR code from a genuine product was transferred to a fake product. This led to the sale of the fake product being mistaken for the genuine one, regardless of whether it was real or fake. A significant amount of memory is also needed to store the supply chain for each product, which will increase the cost of this system. Future work will involve putting this model into practice and attempting to overcome the restriction by integrating secure QR codes (graphic, content, or password based) or by embedding material in the product so that, upon a user attempting to scan it, a chip or other device will transmit a signal to the relevant manufacturer or earlier supply chain participant.

## Data Availability Statement

Not Applicable

## Research Involving Human and/or Animals

Local vendors have participated during the investigation of the need of the platform and during the assessment of the platform thus developed considering the usability perspective.

## Informed Consent

Authors have taken care of welfare of humans who participated in the research work carried out here.

## References


1) United Nations Office on Drugs and Crime, “A transnational organized crime threat assessment. In the globalization for crime,” chapter 8, (2010). https://www.unodc.org/documents/data-and-analysis/tocta/8.Counterfeit_products.pdf. doi: 10.36695/2219-5521.2.2020.67.
2) I. Islam, & M. N. Islam, “Digital intervention to reduce counterfeit and falsified medicines: A systematic review and future research agenda,” Journal of King Saud University-Computer and Information Sciences, 34(9), 6699-6718, (2020). doi: https://doi.org/10.1016/j.jksuci.2022.02.022
3) K. S. Ziavrou, S. Noguera, & V. A. Boumba, “Trends in counterfeit drugs and pharmaceuticals before and during COVID-19 pandemic,” Forensic Science International, 338, 111382, (2022). doi: https://doi.org/10.1016/j.forsciint.2022.111382.
4) S. Ćuzović, S. S. Mladenović, & D. Ćuzović, “Trade in Counterfeit Products in Conditions of Crisis Caused by the COVID-19 Pandemic,” In Counterfeiting and Fraud in Supply Chains , 2022,121-145, (2022). doi: https://doi.org/10.1108/978-1-80117-574-620221006.
5) World Health Organization, “Substandard and falsified medical products,” (3 December, 2024). Available: https://www.who.int/news-room/fact-sheets/detail/substandard-and-falsified-medical-products.
6) G. Khalil, R. Doss, and M. Chowdhury, “A comparison survey study on RFID-based anti-counterfeiting systems,” *J. Sensor Actuator Netw.*, 8 (3) 37 (2019). doi:10.3390/jsan8030037.
7) Alqarni, M. A., Alkatheiri, M. S., Chauhdary, S. H., & Saleem, S., Use of Blockchain-Based Smart Contracts in Logistics and Supply Chains. Electronics. 2023;12(6): 1340. doi: https://doi.org/10.3390/electronics12061340.
8) H. Taherdoost, “Smart contracts in blockchain technology: A critical review,” information,14(2), 17, (2023). doi:https://doi.org/10.3390/info14020117.

9) W. Lu, Y. Jiang, Z. Chen, and X. Ji, "Blockchain adoption in a supply chain system to combat counterfeiting," *Comput. Ind. Eng.*, 171, 108408 (2022). doi: https://doi.org/10.1016/j.cie.2022.108408.
10) M. Q. Saeed, Z. Bilal, and C. D. Walter, "An NFC based consumer-level counterfeit detection framework," in *2013 11th Annu. Conf. Privacy, Security Trust*, 135–142 (2013). doi:10.1109/PST.2013.6596047.
11) G. Khalil, R. Doss, & M. Chowdhury, "A novel RFID-based anti-counterfeiting scheme for retail environments," IEEE Access, 8, 47952-47962, (2020). doi:10.1109/ACCESS.2020.2979264.
12) J Picard, L. Paul, & B. Michael, "Counterfeit detection with QR codes," In Proceedings of the 21st ACM Symposium on Document Engineering (DocEng '21), Association for Computing Machinery, New York, NY, USA,2021; 16, 1-4. doi:10.1145/3469096.3474924
13) C. Shaik, "Preventing Counterfeit Products Using Cryptography, QR Code and Webservice," Computer Science & Engineering: An International Journal (CSEIJ). 11(1), (2021). doi:https://doi.org/10.5121/cseij.2021.11101.
14) Y. Yan, Z. Zou, H. Xie, Y. Gao, & L. Zheng, "An IoT-based anti-counterfeiting system using visual features on QR code," IEEE Internet of Things Journal, 8(8), 6789-6799, (2020). doi: 10.1109/JIOT.2020.3035697.
15) E. Daoud, D. Vu, H. Nguyen, and M. Gaedke, "Improving fake product detection using AI-based technology," *Proc. 18th Int. Conf. on E-Society (ES)*, 2020, 119–125. doi:10.33965/es2020_202005L015.
16) M. M. H. Sohan, M. M. Khan, I. Nanda, and R. Dey, "Fake product review detection using machine learning," *Proc. IEEE World AI IoT Congress (AIIoT)*, 527–532 (2022). doi:10.1109/AIIoT54504.2022.9817271.
17) D. Godse, C. Nigade, N. Mulla, and S. Jadhav, "Fake product identification using machine learning," *Int. Res. J. Adv. Eng. Manag. (IRJAEM)*, 2 (07) 2437–2442 (2024). doi:https://doi.org/10.47392/IRJAEM.2024.0351.
18) R. Roy and S. Patil, "Fake product monitoring system using artificial intelligence," in *Proc. 4th Int. Conf. on Advances in Sci. & Technol. (ICAST2021)*, 2021. doi: http://dx.doi.org/10.2139/ssrn.3867602
19) M. Klöckner, C. G. Schmidt, A. Fink, L. Flückiger, and S. M. Wagner, "Exploring the physical–digital interface in blockchain applications: Insights from the luxury watch industry," *Transp. Res. Part E: Logist. Transp. Rev.*, 179, 103300 (2023). doi: https://doi.org/10.1016/j.tre.2023.103300.
20) C.-L. Chen, L.-H. Guo, M. Zhou, W.-J. Tsaur, H. Sun, W. Zhan, Y.-Y. Deng, and C.-T. Li, "Blockchain-based anti-counterfeiting management system for traceable luxury products," *Sustainability*, 14 (19) 12814 (2022). doi: https://doi.org/10.3390/su141912814.
21) V. Mani, M. Prakash, and W. C. Lai, "Cloud-based blockchain technology to identify counterfeits," *J. Cloud Comp.*, 11, 67 (2022). doi: https://doi.org/10.1186/s13677-022-00341-2
22) K. B. Adsul and S. P. Kosbatwar, "A novel approach for traceability & detection of counterfeit medicines through blockchain," *Int. J. Curr. Eng. Technol.*, 2020. doi: http://inpressco.com/category/ijcet.
23) K. Wasnik, I. Sondawle, R. Wani, and N. Pulgam, "Detection of counterfeit products using blockchain," in *ITM Web Conf.*, 03015 (2022). doi:10.1051/itmconf/20224403015. https://doi.org/10.1051/itmconf/20224403015
24) D. Sharma, A. Singhal, K. Singh, and P. Singh, "Fake/counterfeit medical product identification using blockchain & QR code," in *2024 2nd Int. Conf. on Disruptive Technol. (ICDT)*, 1021–1026 (2024). 10.1109/ICDT61202.2024.10489506
25) I. Islam and M. N. Islam, "A blockchain-based medicine production and distribution framework to prevent medicine counterfeit," *J. King Saud Univ. – Comput. Inf. Sci.*, 36 (1) 101851 (2024). https://doi.org/10.1016/j.jksuci.2023.101851
26) H. C. Pavithra, J. Rajeshwari, R. Sunitha, S. Dhanajaya, A. P. Kumar, and J. Chandrika, "Identification of counterfeit products using blockchain in e-commerce," in *Int. Conf. on Innovative Comput. and Commun.*, 465–482 (2024). doi: https://doi.org/10.1007/978-981-97-3591-4_36.
27) R. B. Sulaiman and A. H. Nur, "Blockchain technology to detect fake products," in *Digital Transformation for Improved Industry and Supply Chain Performance*, IGI Global, 1–32 (2024). doi: 10.4018/979-8-3693-5375-2.ch001.
28) S. Singh, G. Choudhary, S. K. Shandilya, V. Sihag, and A. Choudhary, "Counterfeited product identification in a supply chain using blockchain technology," *Res. Briefs Inf. Commun. Technol. Evol.*, 7, 20–34 (2021). https://doi.org/10.22667/ReBiCTE.2021.07.15.003.
29) M. C. L. Anthony, R. R. P., I. S. E., and D. S., "Developing an anti-counterfeit system using blockchain technology," *Procedia Comput. Sci.*, 216 (2023). https://doi.org/10.1016/j.procs.2022.12.114.
30) M. K. Singh, N. Singh, R. Singh, and P. Singh, "Blockchain technology based healthcare supply chain management," in *Transformation in Healthcare with Emerging Technologies*, Chapman and Hall/CRC, 137–157 (2022). https://doi.org/10.1201/9781003201960.


Cite: D. Sharma et al., "Identifying Counterfeit Medical Products with QR Code and Blockchain Technology for Securing Healthcare". Evergreen, 12 (04) 1827-1840 (2025). https://doi.org/10.5109/7402619.

31) D. Mishra, P. Singh, and N. Singh, "Role of blockchain in achieving solutions in ambiguous supply chain operations," in *Blockchain in a Volatile-Uncertain-Complex-Ambiguous World*, Elsevier, 57–73 (2023). doi: https://doi.org/10.1016/B978-0-323-89963-5.00012-5.
32) M. Kouhizadeh, S. Saberi, and J. Sarkis, "Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers," *Int. J. Prod. Econ.*, 231, 107831 (2021). doi: https://doi.org/10.1016/j.ijpe.2020.107831.
33) P. D. Franke and F. Fischer, "Will blockchain technology revolutionize supply chain management?," *Sri Lanka J. Mark.*, 9 (1) 23–40 (2023). doi: 10.4038/sljmuok.v9i1.118.
34) G. Tripathi, M. A. Ahad, and G. Casalino, "A comprehensive review of blockchain technology: Underlying principles and historical background with future challenges," *Decis. Anal. J.*, 100344 (2023). doi: https://doi.org/10.1016/j.dajour.2023.100344.
35) T. Tariq, M. S. Obaidat, W. C. Kuo, K. Mahmood, M. F. Ayub, and M. J. Alenazi, "A blockchain-assisted authentication protocol for RFID-enabled supply chain management system," *IEEE Trans. Netw. Sci. Eng.*, 12 (4) 3108–3117 (2025). doi: https://doi.org/10.1109/tnse.2025.3556736.
36) S. P. Krishna and P. Singh, "Security challenges in building blockchain bridges and countermeasures," *Evergreen*, 10 (3) 1558–1569 (2023). doi: https://doi.org/10.5109/7151703.
37) "Most expensive cancer drugs in India: What to know?," 2022. Available: https://www.mrmed.in/health-library/cancer-care/expensive-cancer-drugs-india.
38) E. Borandag, "A blockchain-based recycling platform using image processing, QR codes, and IoT system," *Sustainability*, 15 (7) 6116 (2023).
39) A. Aziz, S. Suman, S. S. Sohail, and D. Ø. Madsen, "Leveraging blockchain for combatting drug counterfeiting in the pharmaceutical sector," *Cogent Bus. Manag.*, 2551811 (2025). doi:10.1080/23311975.2025.2551811.
40) D. Zhang and C. Cheng, "AI-enabled product authentication and traceability in global supply chains," *J. Adv. Comput. Syst.*, 3 (6) 12–26 (2023). doi: https://doi.org/10.69987/JACS.2023.30602