International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

Secure Online Pharmacy Billing with Prescription Upload and Encrypted Invoice Management

Bathulla Kavya, K. Sucharitha*

Vaagdevi Engineering College, Warangal, 506005, Telangana, India.

*Correspondence: K. Sucharitha

ABSTRACT

The rapid growth of online healthcare services has accelerated the digital transformation of pharmacy billing and prescription management systems. Modern online pharmacies process large volumes of sensitive medical prescriptions, patient records, and financial invoices, making secure data management and controlled access essential. Ensuring the confidentiality, integrity, and availability of healthcare information is critical for maintaining patient trust and meeting regulatory requirements. However, many conventional pharmacy billing systems still rely on manual procedures or partially digital platforms where prescriptions and invoices are stored without adequate security. These systems often lack role-based access control, encrypted file storage, centralised data management, and secure authentication, making them vulnerable to unauthorised access, data tampering, billing delays, and human errors. To overcome these limitations, the proposed secure web-based pharmacy billing system integrates modern web technologies with cryptographic security techniques. The system is developed using the Flask framework to manage request routing, session handling, and role-based authorisation. Tiny Database (TinyDB) is used to store user information, product records, prescriptions, invoices, orders, and encrypted file metadata in JSON format. Sensitive documents, including prescriptions and invoices, are secured using Alleged Rivest Cipher (ARC2) encryption in Cipher Block Chaining (CBC) mode, while user passwords are protected using Secure Hash Algorithm (SHA-256) hashing. The proposed system enhances data security, minimizes manual effort, improves operational reliability, and provides secure, efficient, and role-based pharmacy billing and document management.

Keywords: Online Pharmacy, Flask Framework, TinyDB, ARC2 Encryption , SHA-256 Authentication.

1. INTRODUCTION

The rapid growth of online pharmacies has transformed the way patients purchase medicines and healthcare products. The internet enables consumers to access pharmaceutical products conveniently and often at lower prices than traditional retail pharmacies. However, this growth has also led to the emergence of unauthorised and fraudulent online pharmacy websites that distribute counterfeit, substandard, or unapproved medicines. In many cases, prescription drugs are sold without proper medical authorisation, increasing the risk of unsafe self-medication and inappropriate drug usage. Such practices pose serious public health concerns because poor-quality medicines may be ineffective or harmful, while unsupervised medication can lead to adverse drug reactions, increased illness, and even mortality [1]. The increasing popularity of online pharmacies is mainly driven by their convenience, wider accessibility, and competitive pricing compared to physical pharmacies [2].

The availability of counterfeit and low-quality medicines varies across countries depending

Received: 30-05-2026 | Accepted: 01-07-2026 | Published: 08-07-2026

International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

on the effectiveness of pharmaceutical regulations and quality assurance systems. Nations with well-established regulatory frameworks generally experience lower rates of counterfeit medicines, whereas countries with weaker regulatory controls are more vulnerable to their circulation. Reports indicate that counterfeit medicines remain a significant concern in several developing countries, with India recording one of the highest rates of counterfeit drug production, followed by Nigeria and Pakistan. Although stricter regulations have reduced their prevalence in developed countries, counterfeit medicines can still enter markets through illegal distribution channels and black-market networks [3].

Despite the advantages of online pharmacies, concerns remain regarding the authenticity of medicines, the safety of consumers, and the risks associated with unsupervised medication use. Improper use of prescription drugs obtained online without professional guidance may result in severe health complications and medication-related risks. Therefore, developing secure and reliable online pharmacy systems with proper authentication, controlled access, and protected prescription management is essential to ensure safe medicine distribution, improve healthcare services, and enhance consumer trust in digital pharmacy platforms [4,5].

2. LITERATURE SURVEY

Chiau Soon Long et al. [6] reviewed online pharmacy systems by examining three major aspects: the types and characteristics of online pharmacies, the quality of medicines purchased through these platforms, and the characteristics of consumers using online pharmacy services. The study highlighted concerns regarding medicine quality, regulatory compliance, and patient safety in digital pharmaceutical platforms. Vincent Schlatt et al. [7] proposed a blockchain-based electronic prescription exchange system that integrates two blockchain networks with a digital wallet application. The framework enables secure, privacy-preserving, and verifiable communication among doctors, patients, and pharmacies while preventing double spending through token-based verification. Hsuan-Yu Chen et al. [8] developed an integrated medical information system by combining electronic patient records, electronic prescriptions, smart cards, and fingerprint authentication. The proposed framework incorporates proxy signatures and group signatures to strengthen data security, protect patient privacy, and improve interoperability among healthcare information systems.

Allam et al. [9] investigated the impact of Artificial Intelligence (AI) on pharmaceutical applications, including drug discovery, drug repurposing, clinical trials, and productivity enhancement. The study reported that AI significantly reduces manual effort, improves accuracy, and accelerates pharmaceutical research and development. Mhamdi et al. [10] introduced SEMRAchain, a blockchain-based Electronic Medical Record (EMR) management framework that combines Role-Based Access Control (RBAC), Attribute-Based Access Control (ABAC), and smart contracts. The proposed approach provides decentralized, fine-grained access control while ensuring data integrity, transparency, and immutability. Poh Ling Ooi et al. [11] conducted a retrospective cross-sectional study to evaluate pharmacist interventions on electronic prescriptions in a public hospital. The study analyzed prescription interventions, medication categories, hospital wards, and prescriber acceptance, demonstrating the importance of pharmacist involvement in improving prescription accuracy. Reyhane Norouzi Aval et al. [12] reviewed different electronic prescription security protocols and classified them into seven major components. The study emphasised that although several

International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

mechanisms ensure privacy, confidentiality, and security, the lack of internationally accepted security standards remains a significant challenge to the widespread adoption of electronic prescription systems.

Yanjiang Yang et al. [13] proposed a secure electronic prescription system that enhances patient privacy through the use of smart cards. The smart cards securely store updated medical records and insurance information, allowing authorized healthcare professionals to access essential patient data during diagnosis and prescription while protecting sensitive information. Anette Vik Josendal et al. [14] evaluated the implementation of electronic prescribing for multidose drug dispensing (MDD) using interviews with nurses and pharmacists. The findings indicated that the proposed system improved integration between healthcare systems across different care levels, leading to better coordination and enhanced patient safety. Imen Ahmed et al. [15] compared the energy efficiency of two blockchain consensus mechanisms, namely Proof of Work (PoW) and Quorum-based Byzantine Fault Tolerance (QBFT). Their experimental evaluation across multiple blockchain networks demonstrated that QBFT provides better energy efficiency while maintaining reliable performance for practical healthcare blockchain applications.

3. PROPOSED SYSTEM

This research developed using the Flask web framework. Flask is used to handle routing, session management, and role-based access control for different users such as pharmacy companies, distributors, and customers shown in Fig.1. The system integrates ARC2 (RC2) symmetric key encryption in CBC mode to secure sensitive files including prescriptions and invoice documents during storage and download operations. User authentication is implemented using SHA-256 password hashing to ensure secure credential storage. TinyDB, a lightweight NoSQL JSON-based database, is used to store user details, product information,orders, invoices, prescriptions, and encrypted file metadata. File upload, encryption, decryption, and access validation processes are tightly integrated with Flask controllers to ensure controlled data access.

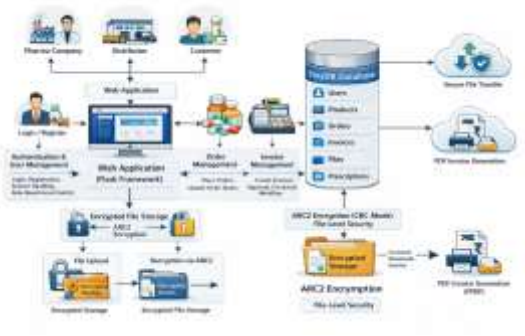


Fig.1: Proposed system architecture of secure online pharmacy billing

User Authentication and Role-Based Access: Pharma Company, Distributor, and Customer access the system through the Flask web application using login and registration. User credentials are securely validated, sessions are created, and role-based access control ensures each user only sees permitted dashboards and actions.

Core Web Application Processing: The Flask web application acts as the central controller, handling all requests related to products, orders, invoices, files, and prescriptions. Based on user roles, it routes requests to appropriate internal modules and enforces business logic.

Product, Order, and Invoice Management: Pharma companies manage product inventory, distributors place and track orders, and invoices are generated with approval and correction workflows. All transactional data is processed by the application and prepared for storage or output.

Data Storage Using TinyDB: All structured data including users, products, orders,

International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

invoices, files, and prescriptions is stored in a local TinyDB (JSON-based) database. The database maintains records and metadata, while all access is controlled through the Flask application.

File Encryption and Secure Local Storage: Uploaded files and prescriptions are encrypted using ARC2 encryption in CBC mode before being saved to local encrypted storage. During authorized downloads, files are decrypted on-the-fly, ensuring file-level confidentiality without exposing raw data.

PDF Invoice Generation and Secure Delivery: When customers download invoices, the system generates PDF documents using the FPDF library. These invoices are securely delivered through the application after permission checks, completing the billing workflow.

4. RESULTS AND DISCUSSION

Fig. 2 illustrates the Adding New Product Screen, which represents the data entry interface used for expanding inventory records. It depicts structured input mechanisms for capturing product-related information required for inventory management and billing operations. The screen demonstrates how new pharmaceutical products are registered into the system database with essential attributes that support tracking and pricing workflows. It reflects the integration between product creation and downstream processes such as orders, reports, and inventory calculations.

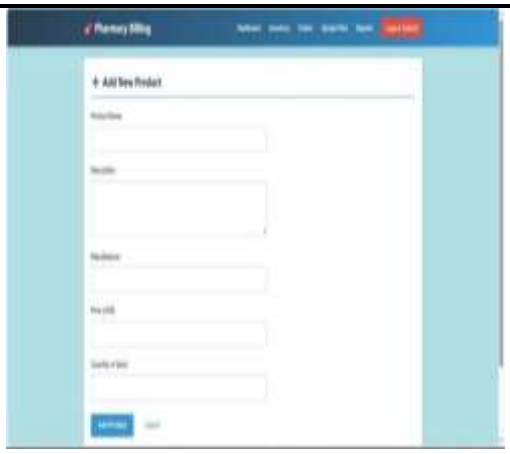


Fig.2: Adding new product screen

Fig. 3 depicts the Product Inventory Screen, representing the inventory monitoring component of the application. It illustrates how stored product data is organized into a structured format for easy viewing and analysis. The screen highlights system capabilities related to inventory valuation, quantity tracking, and product information management. It demonstrates how pharma companies maintain visibility over available stock and associated financial metrics.

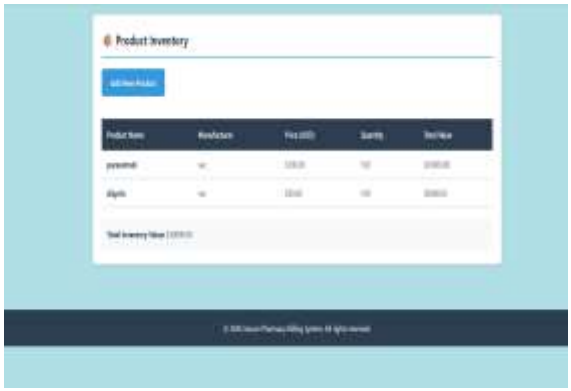


Fig. 3: Product inventory screen

Fig. 4 illustrates the Available Products Screen, which represents the distributor-side product browsing interface within the system. It depicts the centralized listing area where pharmaceutical products shared by companies are displayed for distributor access. The screen reflects the system's product synchronization mechanism that ensures updated inventory

International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

visibility across roles. It demonstrates how distributors rely on this interface to review product availability before initiating order placement workflows.

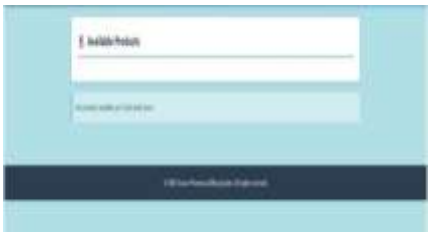


Fig. 4: Available products screen

Fig. 5 depicts the Customer Prescriptions Screen, representing the prescription management interface accessible to distributors. It illustrates the structured area where customer-submitted prescriptions are received and processed for order fulfillment. The screen reflects the secure transmission workflow that routes encrypted prescriptions from customers to authorized distributors. It demonstrates how prescription records are organized to support validation, order generation, and billing activities.



Fig. 5: Customer prescriptions screen

Fig. 6 illustrates the Creating New Invoice Screen, which represents the invoice generation module within the distributor dashboard. It depicts the structured data entry process required to associate customer orders with billing records. The screen reflects integration between order management and financial processing components of the system. It demonstrates how invoice details are systematically captured to ensure accurate transaction documentation and traceability.

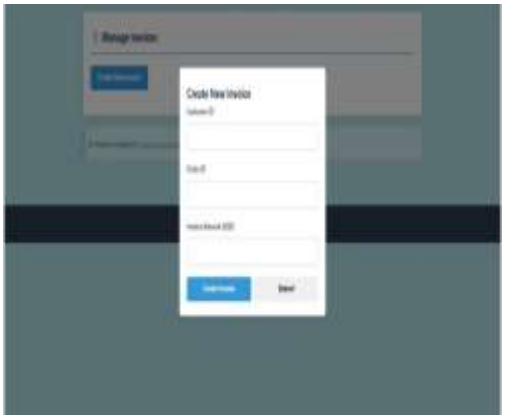


Fig. 6: Creating new invoice screen

Fig. 7 illustrates the Billing & Payment Screen, representing the financial management component accessible to customers. It depicts summarized financial metrics such as total invoiced amounts, payments made, and outstanding balances. The screen reflects the integration of billing records with payment tracking mechanisms to provide real-time financial status. It demonstrates how customers can review transaction summaries and manage pending payments through a centralized interface.



Fig. 7: Billing & payment screen

5. CONCLUSION

The Secure Pharmacy Billing and Prescription Management System successfully

Received: 30-05-2026 | Accepted: 01-07-2026 | Published: 08-07-2026

International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

demonstrates a role-based, secure, and structured approach to handling pharmaceutical transactions. The system integrates Flask-based web services with ARC2 encryption to ensure confidentiality of prescriptions, invoices, and shared documents. Performance is improved by using TinyDB as a lightweight database, enabling faster read and write operations for small to medium-scale data without the overhead of a full database server. Role-based access control minimizes unnecessary data exposure and reduces processing overhead during authorization checks. Modular separation of authentication, encryption, and data management enhances maintainability and execution efficiency. Finally, the system achieves secure data handling, efficient workflow management, and reliable performance suitable for academic and prototype-level deployment.

REFERENCES

[1]. Fittler, A.; Bosze, G.; Botz, L. Evaluating aspects of online medication safety in long-term follow-up of 136 Internet pharmacies: Illegal rogue online pharmacies flourish and are long-lived. J. Med. Internet Res. 2013, 15, e199.

[2]. Alwon, B.M.; Solomon, G.; Hussain, F.; Wright, D.J. A detailed analysis of online pharmacy characteristics to inform safe usage by patients. Int. J. Clin. Pharm. 2015, 37, 148–158

[3]. Lee, K.S.; Yee, S.M.; Zaidi, S.T.R.; Patel, R.P.; Yang, Q.; Al-Worafi, Y.M.; Ming, L.C. Combating sale of counterfeit and falsified medicines online: A losing battle. Front. Pharmacol. 2017, 8, 268.

[4]. Attaran, A.; Bate, R.; Kendall, M. Why and how to make an international crime of medicine counterfeiting. J. Int. Crim. Justice 2011, 9, 325–354.

[5]. Al-Worafi, Y.M.; Alseragi, W.M.; Ming, L.C.; Alakhali, K.K.M. Drug Safety in China. Available online: https://www.sciencedirect.com/science/article/pii/B9780128198377000285

[6]. Kumaran, H.; Long, C.S.; Bakrin, F.S.; Tan, C.S.; Goh, K.W.; Al-Worafi, Y.M.; Lee, K.S.; Lua, P.L.; Ming, L.C. Online pharmacies: Desirable characteristics and regulations. Drugs Ther. Perspect. 2020, 36, 243–245.

[7]. Sharma, D.; Patel, R.; Zaidi, S.; Camerino, G.; Moraes, L. Interplay of the quality of ciprofloxacin and antibiotic resistance in developing countries. Front. Pharmacol. 2017, 8, 546.

[8]. Fittler, A.; Vida, R.G.; Kaplar, M.; Botz, L. Consumers Turning to the Internet Pharmacy Market: Cross-Sectional Study on the Frequency and Attitudes of Hungarian Patients Purchasing Medications Online. J. Med. Internet Res. 2018, 20, e11115.

[9]. Orizio, G.; Merla, A.; Schulz, P.J.; Gelatti, U. Quality of online pharmacies and websites selling prescription drugs: A systematic review. J. Med. Internet Res. 2011, 13, e74.

[10]. Baig, M.R.; Al-Worafi, Y.M.; Alseragi, W.M.; Ming, L.C. A Siddique, Chapter 25-Drug safety in India. In Drug Safety in Developing Countries; Al-Worafi, Y., Ed.; Academic Press: Cambridge, MA, USA, 2020; pp. 327–334. Available online: https://www.sciencedirect.com/science/article/pii/B9780128198377000025X

International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

[11]. Elkalmi, R.M.; Al-Worafi, Y.M.; Alseragi, W.M.; Ming, L.C. A Siddique, Chapter 21-Drug safety in Malaysia. In Drug Safety in Developing Countries; Al-Worafi, Y., Ed.; Academic Press: Cambridge, MA, USA, 2020; pp. 245–253. Available online: https://www.sciencedirect.com/science/article/pii/B9780128198377000212

[12]. Chen, H.-Y.; Wu, Z.-Y.; Chen, T.-L.; Huang, Y.-M.; Liu, C.-H. Security Privacy and Policy for Cryptographic Based Electronic Medical Information System. Sensors 2021, 21, 713. https://doi.org/10.3390/s21030713

[13]. Long, C.S.; Kumaran, H.; Goh, K.W.; Bakrin, F.S.; Ming, L.C.; Rehman, I.U.; Dhaliwal, J.S.; Hadi, M.A.; Sim, Y.W.; Tan, C.S. Online Pharmacies Selling Prescription Drugs: Systematic Review. Pharmacy 2022, 10, 42. https://doi.org/10.3390/pharmacy10020042

[14]. Ahmed, I.; Turki, M.; Baklouti, M.; Dammak, B.; Alshahrani, A. Towards an Optimized Blockchain-Based Secure Medical Prescription-Management System. Future Internet 2024, 16, 243. https://doi.org/10.3390/fi16070243

[15]. Josendal, A.V.; Bergmo, T.S. From Paper to E-Prescribing of Multidose Drug Dispensing: A Qualitative Study of Workflow in a Community Care Setting. Pharmacy 2021, 9, 41. https://doi.org/10.3390/pharmacy9010041

[16]. Kumar, Anuj. "Optimization of Process Parameters in Metal Additive Manufacturing for Defect Reduction Using Machine Learning." International Journal of Engineering Research and Science & Technology, Vol. 14, No. 1, 2018, pp. 41-60