



A SYSTEMATIC REVIEW ON INFORMATION QUALITY ASSESSMENT OF INDIAN E-PHARMACY WEBSITES: RISKS, CHALLENGES, AND REGULATORY PERSPECTIVES

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ABSTRACT

The rapid advancement of digital technology has transformed the healthcare sector, leading to the emergence and widespread adoption of e-pharmacy platforms that facilitate the online purchase and delivery of medicines. In India, the growth of e-pharmacies has been driven by increasing internet penetration, enhanced healthcare awareness, and the demand for convenient and cost-effective healthcare services. This study evaluates the quality of information provided by Indian e-pharmacy platforms based on key parameters, including accuracy, completeness, reliability, transparency, and data security. The findings reveal significant deficiencies in the availability and quality of drug-related information, particularly regarding dosage instructions, adverse effects, contraindications, and drug interactions. Such inadequacies may contribute to self-medication, medication errors, adverse drug reactions, and other potential health risks. The study also identifies concerns related to transparency, including limited disclosure of licensing information and restricted access to qualified pharmacists, which may affect user trust and regulatory compliance. Furthermore, weaknesses in prescription verification processes were observed, potentially enabling the misuse of prescription-only medicines. Data privacy and security measures were found to be inconsistent across platforms, increasing the risk of unauthorized access to sensitive patient information. Although e-pharmacy services offer substantial benefits in terms of accessibility, affordability, and convenience, the findings highlight the need for strengthened regulatory oversight, standardized information quality requirements, robust prescription validation mechanisms, and enhanced data protection practices to ensure the safe, effective, and responsible use of e-pharmacy services in India.

KEYWORDS: E-pharmacy, Information Quality, Drug Safety, Online Pharmacy, Data Privacy, India, Self-medication.

1. INTRODUCTION

The incorporation of digital technologies into healthcare systems has fundamentally altered the way medical services are provided. One of the most important advancements in this field is the rise of e-pharmacy platforms, which allow customers to buy medications online and have them delivered to their homes. E-pharmacy, or online pharmacy, is a new approach to pharmaceutical delivery that blends healthcare services with digital convenience.

Over the last decade, India's adoption of e-pharmacy services has increased dramatically. This expansion is mostly driven by rising internet penetration, broad smartphone use, and increased awareness of healthcare accessible. The COVID-19 pandemic increased the demand for online medical services, especially e-pharmacies, since consumers preferred contactless methods to purchase crucial medicines.^[1] As a result, various online pharmacy platforms have joined the Indian market, providing a diverse selection of prescription and over-the-counter medications.

“Digital health technologies are reshaping healthcare delivery by improving accessibility and efficiency”^[2]

Despite these benefits, the rapid growth of e-pharmacy platforms has created various concerns, most notably over the quality of information offered to customers. In traditional pharmacy settings, pharmacists play an important role in helping patients by giving accurate drug information such as dose directions, side effects, and possible drug interactions. However, in the internet context, direct engagement is frequently limited or nonexistent.

The proliferation of e-pharmacy services in India can be better understood by looking at the overall trend in their usage over the last few years. With rising digital penetration and shifting consumer tastes, a considerable transition from traditional pharmacies to online platforms has occurred. The increased need for home delivery of medicines, particularly during public health emergencies, has contributed to this trend. This trend emphasizes the expanding role of e-pharmacy services in the current healthcare system.

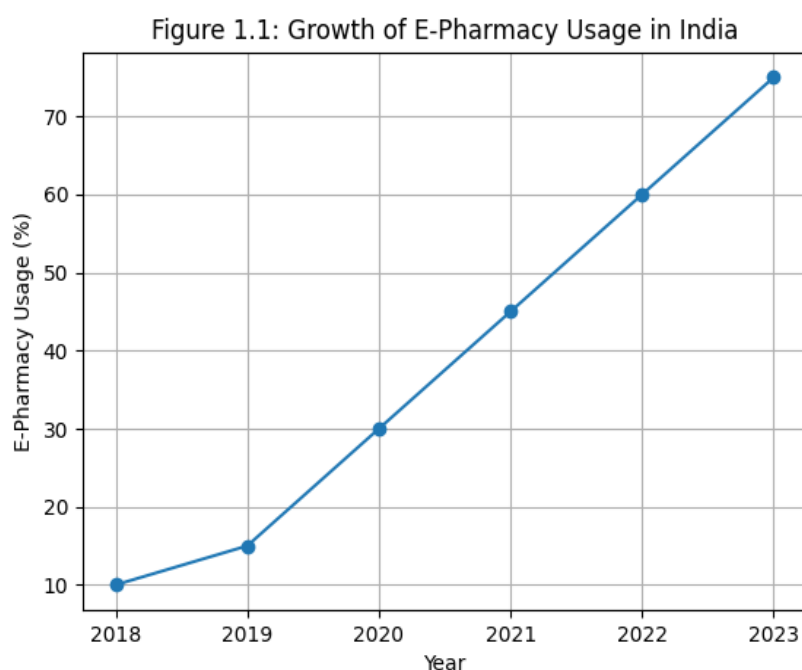


Fig.1: Growth of E-Pharmacy Usage in India (2018–2023).

One of the most significant issues associated with e-pharmacy platforms is variability in drug-related information across different websites. Research indicates that online pharmacies often provide incomplete and untrustworthy information, potentially leading to incorrect prescription use and health risks.^[3] For example, omitting information concerning drug interactions or contraindications may result in harmful drug reactions, particularly among patients with chronic conditions.

Furthermore, regulatory frameworks for e-pharmacies in India are constantly emerging. Unlike traditional pharmacies, which are heavily regulated by established rules, e-pharmacy platforms frequently operate in a partially regulated environment. This causes gaps in monitoring and enforcement, resulting in differences in service quality and compliance.^[4]

Another important concern is the lack of transparency on many e-pharmacy sites. Essential information such as pharmacy licensing, verification, and the availability of

certified pharmacists is frequently not properly stated. This makes it difficult for customers to determine the trustworthiness and legitimacy of these platforms.

In addition, the online aspect of e-pharmacy services raises questions about prescription validation and data protection. Inadequate prescription verification systems and data protection procedures can lead to misuse of prescription medications and potential breaches of sensitive patient information.^[5]

The concept of information quality becomes especially important in this scenario. Information quality is defined as the accuracy, completeness, dependability, and relevance of data delivered to users. High-quality information is critical to ensure safe and effective pharmaceutical use. Research shows that "the quality of healthcare information directly influences patient outcomes and safety"^[6]

As a result, the purpose of this study is to assess the information quality of Indian e-pharmacy websites while

also identifying the associated risks and problems. By examining critical factors such as drug information accuracy, openness, prescription management, and data protection, the study hopes to provide insights into the current state of e-pharmacy services and suggest modifications to improve patient safety.

2. METHODOLOGY

2.1 Study design and approach

This qualitative and descriptive study assessed the quality of information on e-pharmacy websites.^[7] This study is commonly used in healthcare research to evaluate non-numerical data, including content quality, transparency, and system practices.^[8] This technique evaluates drug-related information, prescription management, and data privacy practices across many platforms.^[9] Analytical frameworks are often used in pharmacoepidemiological investigations to detect gaps and improve healthcare service quality.^[10]

2.2 Selection of E-Pharmacy Websites

The e-pharmacy websites were chosen based on their popularity, accessibility, and frequency of use by users. Widely utilized platforms were selected to guarantee that the study accurately reflects real-world usage patterns and user experiences. The inclusion criteria took into account the availability of drug-related information, prescription upload systems, and operational

transparency. Digital health researches typically use these selection strategies to guarantee findings are representative and relevant.^[11]

2.3 Evaluation Parameters

We examined e-pharmacy websites on important information quality factors such as correctness, completeness, transparency, prescription control, and data privacy.^[12] These criteria are critical for determining the trustworthiness and safety of drug-related information presented to consumers. Evaluating such characteristics aids in finding gaps in information transmission and ensuring that online platforms satisfy appropriate healthcare standards. This approach is commonly utilized in researches that evaluate digital health services and pharmaceutical practices.^[12]

In addition to the key factors, the study took into account the clarity of drug presentation, simplicity of navigation, and accessibility of information throughout the platform. The availability of customer support services and pharmacist consultations were also identified as supporting factors for safe drug use. Additionally, the uniformity of information across different drug pages, as well as the frequency of material updates, were assessed. These considerations aid in determining the overall usefulness and dependability of e-pharmacy services.

Table 1: Evaluation Criteria for E-Pharmacy Websites.

Parameter	Description
Accuracy	Correctness of drug information
Completeness	Availability of dosage, side effects, interactions
Transparency	Display of license and pharmacist details
Prescription control	Verification of prescription
Data Privacy	Protection of user information

2.4 Data Collection Method

Data were gathered by methodically evaluating the identified e-pharmacy websites. Each platform was accessed, and drug-related information was gathered for a variety of regularly used medications.^[13] The data collection focused on ensuring the availability of critical information such as dose, indications, contraindications, and side effects. Prescription upload systems, privacy policies, and transparency issues were also investigated. The observations were manually recorded in a structured way for future study.^[13]

2.5 Data Analysis

The data was processed using a comparison approach, with each e-pharmacy platform evaluated against established parameters.^[14] The observations were grouped to discover similar trends, strengths, and shortcomings among various websites. This investigation helps to identify shortcomings in information quality, prescription processing, and data privacy standards. The findings were then analyzed to reach relevant conclusions on the safety and dependability of e-pharmacy services.^[14]

2.6 Workflow of the Study

The current study used a systematic and structured approach to assure accurate evaluation of e-pharmacy platforms. The procedure began with identifying the research problem and selecting appropriate e-pharmacy websites. This was followed by the development of evaluation parameters to assess information quality, transparency, and safety. Data were then collected from selected platforms using a similar methodology and recorded in an organized manner. The acquired data was then examined using a comparison method to uncover patterns, strengths, and shortcomings. Finally, the findings were evaluated to reach useful conclusions about the dependability and safety of e-pharmacy services.

Figure 2: Workflow Diagram of Study

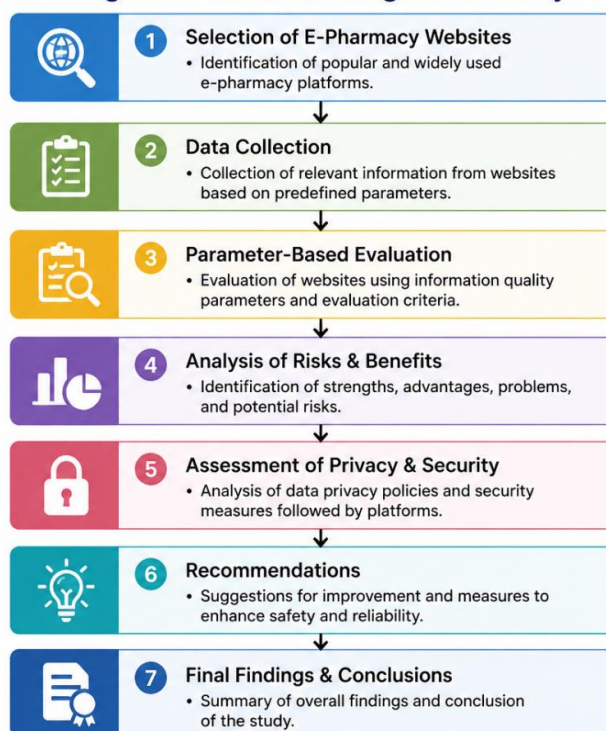


Fig 2: Workflow Diagram of the Study.

The workflow diagram depicts the logical order used in this study to ensure clarity, consistency, and reliability throughout the research process. It helps to understand how each stage contributes to the overall assessment of e-pharmacy platforms.

Problem Identification: The study begins by identifying difficulties with information quality, safety, and openness in e-pharmacy systems.

Selecting E-Pharmacy Websites: Relevant and commonly utilized platforms are chosen to guarantee that the study accurately represents real-world usage.

Define Evaluation Parameters: Key requirements for systematic assessment include accuracy, completeness, and data privacy.

Data collection: Information is acquired via evaluating drug-related content, prescription systems, and policies on certain platforms.

Data Recording and Organisation: The collected data is organized in a structured style for simple comparison and analysis.

Data analysis: A comparative technique is used to assess differences and similarities between platforms.

Identification of Gaps: Weaknesses include a lack of information, a lack of transparency, and ineffective prescription control.

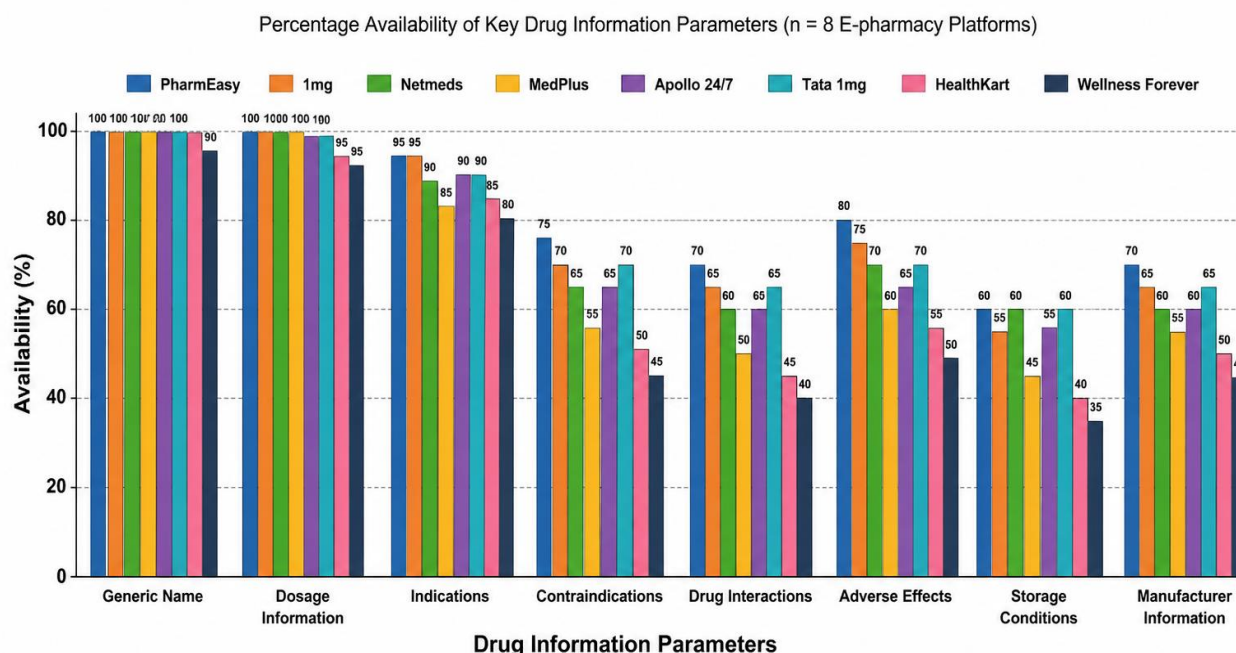
Interpreting the Results: The findings are examined to determine the overall quality and safety of e-pharmacy services.

Conclusion and Recommendation: The results are established, and recommendations are made to improve e-pharmacy practices.

2. FINDINGS AND DISCUSSION

3.1 Information Quality

E-pharmacy platforms include basic pharmacological information such name, dosage, and usage directions, however the quality of clinical information differs between websites. Important safety facts, such as drug interactions, contraindications, and adverse effects, are frequently missing or inconsistently presented.^[15] This fluctuation affects the credibility of information for consumers, potentially impacting safe medication decisions.^[15] The lack of standardized pharmaceutical material is a significant drawback in online drug information systems. Improving consistency in drug data presentation is crucial for patient safety

Figure 3. Comparison of Drug Information Completeness Across E-Pharmacy Platforms**Key Observations:**

- All platforms provide complete information for generic name and dosage.
- Information on contraindications, drug interactions and storage conditions is least available.
- Considerable variation exists in the depth of clinical information across platforms.

Note: Values represent the percentage of platforms that provided the parameter with complete and clear information.
(n = 8)

Fig.3 Comparison of Drug Information Completeness across E-Pharmacy Platforms.**3.2 Drug Information Problems**

The way that drug information is presented varies throughout e-pharmacy platforms.^[16] While some websites use simplified or promotional content, others offer scientifically accurate and comprehensive information. Users, particularly those who are not

medical professionals, become confused as a result of this inconsistency. Medication errors might be made more likely by incomplete or ambiguous pharmacological information. Consequently, pharmaceutical data formats that are validated and structured are necessary.^[16]

Table.2 Accuracy vs completeness of drug information comparison.

Accuracy	Completeness
Correctness of drug information	Availability of all required drug details
Focuses on “is it right?”	Focuses on “is everything included?”
Avoids wrong dose, wrong drug, wrong advice	Includes dose, uses, side effects, interactions, precautions
Ensures safety	Ensures full understanding
Checked with standard references	Checked by presence of all key information

3.3 Transparency Issues

Transparency is a key concern for e-pharmacy systems. Some platforms do not properly disclose licensing, regulatory permission, or drug supply information.^[17] This hinders users' ability to verify the pharmacy's authenticity.^[17] Lack of openness can undermine trust in digital healthcare systems.^[17] Improving accountability requires strong disclosure practices and regulatory compliance.^[17]

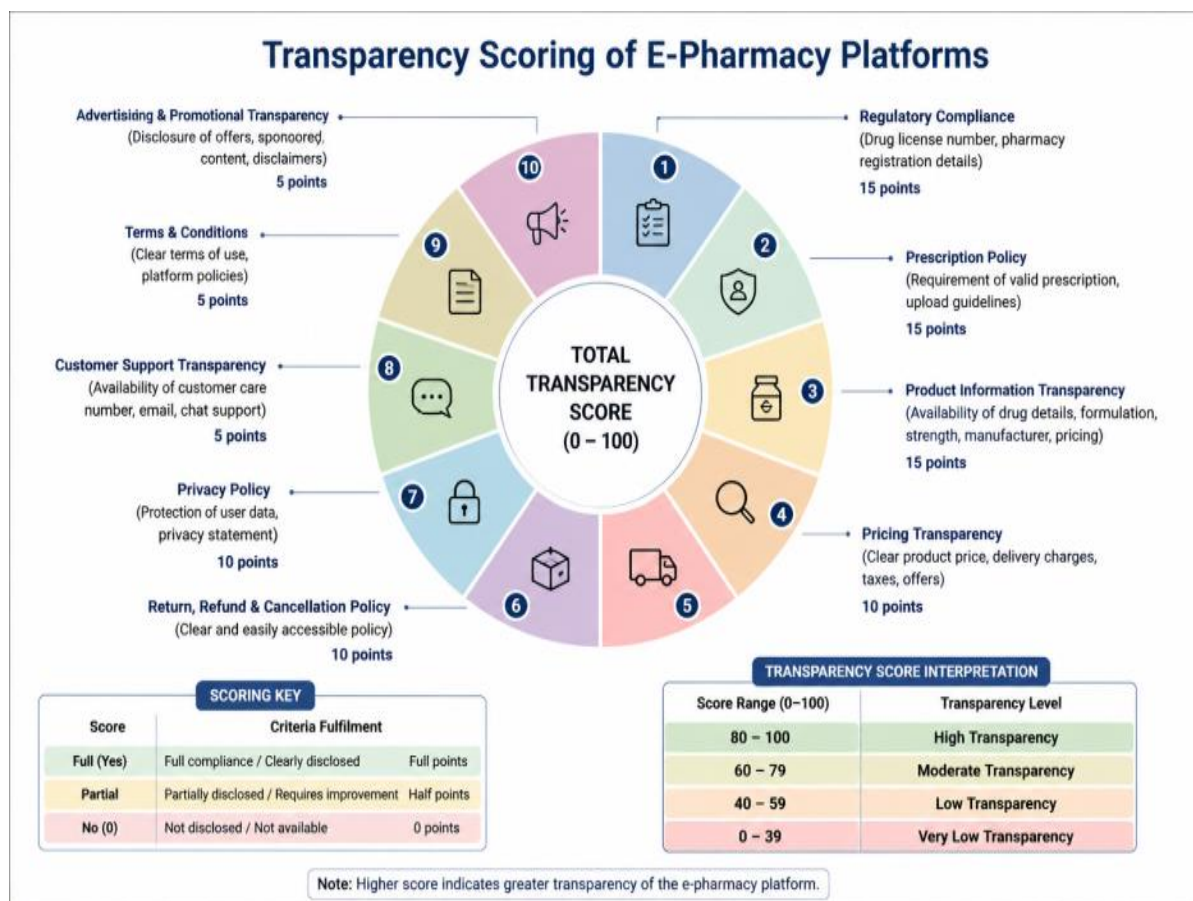


Fig.4 Transparency score of E-Pharmacy Platforms.

3.4 Prescription Issues

Prescription validation processes differ greatly between platforms.^[18] Some systems require pharmacist permission for strict digital verification, whereas others employ weak or manual checks. This inconsistency

raises the danger of self-medication and incorrect drug delivery. Inadequate prescription control can result in misuse of prescription-only medications. A standardized and rigorous prescription validation system is crucial for safety.^[18]

Table 3: Prescription verification methods.

S. No	Platform type	Prescription	Verification	Pharmacist involvement	Strength Level
1	Mandatory	Strict check	Yes	Yes	High
2	Mandatory	Basic check	Limited	Limited	Moderate
3	Optional	Minimal	Rare	Rare	Low
4	Not required	None	No	No	Low
5	Not required	None	No	No	Very Low

3.5 Data Privacy

E-pharmacy platforms acquire sensitive personal and medical information from users. Not all platforms have robust encryption or explicit privacy policies.^[19] This poses hazards for data loss, unauthorized access, and abuse of health information. Users are typically ignorant of how their data is retained or shared⁵. Improving cybersecurity is crucial for safeguarding patient privacy.^[19]

increases these risks. Patients may unintentionally obtain inadequate or hazardous medications. Strong authentication and monitoring methods are necessary to mitigate these dangers.

3.6 Risks

E-pharmacy systems pose dangers including counterfeit drugs, improper distribution, and lack of pharmacist supervision.^[20] Fraudulent websites increase the risk of unsafe medicine delivery. Weak regulatory oversight



Fig.5 Risk classification in e-pharmacy systems.

3.6 Advantages

E-pharmacy systems provide significant benefits for current healthcare delivery. They greatly increase access to medicines, particularly for patients in rural and distant places where physical pharmacies may be scarce. These platforms decrease the need for travel and waiting time by offering convenient home delivery services. They are especially useful for people with chronic conditions who require frequent and consistent medication supplies. In addition, e-pharmacies frequently offer a broader selection of items, competitive price, and easy comparison possibilities. Overall, they promote patient convenience, treatment adherence, and the effectiveness of pharmaceutical care services.

3.7 Recommendations

Establishing and enforcing rigorous regulatory frameworks is crucial for improving the safety and effectiveness of e-pharmacy systems. Standardization of drug information across all platforms is critical for

ensuring that patients receive accurate, thorough, and clinically validated information. To avoid drug misuse, registered pharmacists should be required to participate in prescription evaluation and order verification. Strong prescription validation mechanisms, such as digital verification and sufficient paperwork, are required to decrease the risk of self-medication. Furthermore, strong cybersecurity measures such as data encryption and secure storage procedures must be used to safeguard critical user information. Transparency could also be enhanced by prominently showing license information, regulatory approvals, and drug supply data. Finally, public awareness programs should be conducted to educate users about safe online medicine purchasing and the risks associated with unverified platforms.^[21]

Table 4: Proposed Improvements for E-Pharmacy Systems.

S. No	Area	Issue identified	Recommended improvement
1	Regulation	Weak enforcement	Strict regulatory policies
2	Drug information	Incomplete data	Standardized information format
3	Prescription	Poor verification	Mandatory digital validation
4	Pharmacist role	Limited involvement	Ensure pharmacist review
5	Data privacy	Weak security	Strong encryption & protection
6	Transparency	Lack of details	Display license & source info
7	User Awareness	Low awareness	Conduct education programs
8	Monitoring	Poor control	Continuous system monitoring

3. CONCLUSION

The current study was conducted to assess the overall effectiveness of e-pharmacy platforms in terms of information quality, openness, prescription management, and data privacy. With the rapid expansion of digital healthcare services, e-pharmacies have become an essential component of modern drug distribution networks. The purpose of this study was to conduct a critical analysis of these platforms in order to understand both their benefits and the potential risks connected with their use.

The study's findings clearly show that e-pharmacies provide various benefits that help to increase healthcare accessible.

These platforms make it easy for users to order drugs from the comfort of their own homes, saving them time and effort. They also provide a diverse choice of pharmaceutical products, convenient pricing comparison, and doorstep delivery services. These qualities are especially useful for patients living in rural places, the elderly, and those with mobility challenges. Furthermore, a digital feature such as online prescription uploads and the availability of basic pharmacological information demonstrates the increasing integration of technology into healthcare services.

However, despite these advantages, the study discovered numerous significant limits and obstacles connected with e-pharmacy platforms. One of the primary problems is the inconsistency and incompleteness of drug-related data. In many cases, critical information such as dose, contraindications, side effects, and drug interactions were not provided.

This lack of thorough information may result in incorrect medication use, lower therapeutic efficacy, and an increased risk of adverse drug responses.

Another important concern identified in this study is the absence of stringent prescription verification systems. Although many platforms allow you to input prescriptions, the level of validation is sometimes confusing or insufficient. This increases the likelihood of prescription-only medicinal misuse and encourages self-medication activities. Such activities can have major health repercussions and add to the rising problem of irrational drug use.

In addition to these obstacles, the study emphasizes the significance of patient education and appropriate use of e-pharmacy services. Many users rely extensively on online platforms without sufficient knowledge of drugs, increasing the risk of self-medication and abuse. The lack of direct connection with healthcare providers contributes to an inaccurate understanding of drug use. To reduce the hazards connected with e-pharmacy use, patient education must be improved, as well as appropriate digital health practices promoted.

Furthermore, the future of e-pharmacy is heavily dependent on the establishment of robust regulatory frameworks and constant monitoring mechanisms. Government authorities and healthcare groups must work together to develop common criteria for online pharmaceutical services. The addition of skilled pharmacists, stricter verification methods, and enhanced data security measures can considerably improve the safety and reliability of these platforms. With adequate regulation and knowledge, e-pharmacies have the potential to be a highly effective component of modern healthcare delivery systems.

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