

Digital Healthcare Transformation: Assessing the Impact of E-Pharmacies on Accessibility, Affordability, and Patient Satisfaction

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Abstract: Background: The rise of e-pharmacies has transformed the healthcare sector by offering patients increased access to medications. However, the impact of e-pharmacies on medication accessibility, affordability, and patient satisfaction remains underexplored, especially in emerging markets, such as Tamil Nadu.

Objectives:

This study aimed to assess the effect of e-pharmacies on the accessibility and affordability of medications as well as to evaluate patient satisfaction compared to traditional pharmacy models.

Methodology:

A structured questionnaire was distributed to 335 respondents in Tamil Nadu to collect data on their experiences with both e-pharmacies and traditional pharmacies. Statistical analyses, including chi-square tests, t-tests, and regression analysis, were employed to evaluate the data and test the hypotheses regarding accessibility, affordability, and satisfaction.

Results:

The study found that e-pharmacies did not significantly improve medication accessibility or affordability compared with traditional pharmacies. However, frequent users of e-pharmacies who were satisfied with the pricing reported significantly higher levels of patient satisfaction and were more likely to recommend e-pharmacies to others.

Discussion and implications

These findings suggest that, while e-pharmacies may not yet offer substantial benefits in terms of accessibility or cost savings, their potential to enhance patient satisfaction can lead to a shift in consumer behaviour. Policy recommendations include improving pricing models and increasing awareness to boost the adoption of e-pharmacy.

Conclusion:

This study underscores the need for e-pharmacies to focus on improving service quality, pricing, and user experience to fully leverage their potential to transform the healthcare delivery landscape in Tamil Nadu

Keywords: E-pharmacies, Accessibility, Affordability, Patient Satisfaction, Tamil Nadu

1. INTRODUCTION

The healthcare sector has undergone a profound transformation in recent years driven by digital technologies that have reshaped patient care, treatment delivery, and overall service accessibility. With advancements in telemedicine, electronic health records, and AI-driven diagnostics, digital healthcare has improved the efficiency

and reach of healthcare services (Farnsworth et al. 2020). One of the most notable innovations in this sector is the rise of e-pharmacies, which have gained significant attention owing to their potential to enhance accessibility, reduce costs, and improve patient satisfaction. E-pharmacies, platforms that allow consumers to purchase prescription and over-the-counter medications online, have witnessed rapid growth, especially in light of the COVID-19 pandemic, which has accelerated the shift towards digital services (He et al., 2020). While these platforms offer a convenient alternative, enhancing accessibility and affordability, it is also critical to address the challenges that accompany the growth of e-pharmacies, including regulations and medication authenticity (Chien et al., 2021). To address these challenges, this study also explores regulatory frameworks, measures to ensure medication quality and authenticity, and their role in shaping patient outcomes (Haque & Sharma, 2021).

This study aimed to quantitatively assess how e-pharmacies affect medication accessibility in terms of reach and convenience, affordability by comparing costs, and patient satisfaction through feedback and service ratings. By examining user experience and comparing it with traditional pharmacy models, this study aims to fill a gap in the existing literature regarding the effectiveness of e-pharmacies in enhancing healthcare delivery. Specifically, this study investigated whether e-pharmacies provide easier access to medications, reduce costs for patients, and lead to higher levels of satisfaction in comparison to traditional pharmacy models (Bashir et al., 2022). The significance of this study lies in its potential to inform healthcare policies, regulatory frameworks, and business practices. As e-pharmacies continue to expand, understanding their impact on patients can guide stakeholders in optimizing digital healthcare models to maximize benefits and minimize risks. The findings of this study will contribute to ongoing conversation about the future of healthcare, offering insights into how digital platforms can be leveraged to improve healthcare outcomes on a broader scale (Kumar et al., 2021).

2. RESEARCH OBJECTIVES

- **To assess the impact of e-pharmacies on the accessibility of medications**

This objective aimed to evaluate how e-pharmacies improve patients' access to prescription and over-the-counter medications in terms of convenience, reach, and availability, particularly in underserved or remote areas.

- **To examine the effect of e-pharmacies on the affordability of medications**

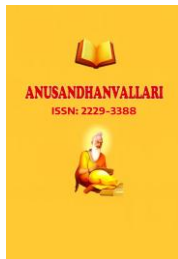
This objective focuses on comparing the costs of medications through e-pharmacies versus traditional brick-and-mortar pharmacies to evaluate whether digital platforms offer more cost-effective options for patients.

- **To evaluate patient satisfaction with e-pharmacy services**

This objective seeks to understand the level of satisfaction among e-pharmacy users, considering factors such as service quality, delivery time, ease of use, and overall experience compared to traditional pharmacy models.

3. SIGNIFICANCE OF THE STUDY

This study holds significant value for several stakeholders in the health care industry. Assessing the impact of e-pharmacies on accessibility, affordability, and patient satisfaction can guide healthcare policymakers in developing strategies for integrating digital platforms into the healthcare system. This research provides insights into how e-pharmacies can address gaps in healthcare delivery, particularly in terms of access to essential medications. Additionally, the findings will help regulators formulate better policies to ensure the authenticity and quality of medications sold through these platforms, thereby ensuring patient safety. Furthermore, the study's outcomes could aid e-pharmacy businesses in optimizing their services to meet patient needs effectively, contributing to the ongoing digital transformation of the health care sector.



4. REVIEW OF LITERATURE

Digital transformation in healthcare has significantly reshaped patient care, with e-pharmacies emerging as prominent innovations. Previous studies have highlighted the benefits of e-pharmacies, such as increased accessibility to medications, greater convenience for patients, and potential cost reduction. For instance, Meskó et al. (2017) discussed how e-health innovations, including e-pharmacies, can improve healthcare delivery by overcoming geographic barriers and providing round-the-clock services. Similarly, Hassani et al. (2022) emphasized the role of digital healthcare in improving efficiency and patient outcomes, particularly in remote areas. Despite these advancements, there is still limited research on the specific impact of e-pharmacies on accessibility, affordability, and patient satisfaction, particularly in developing countries such as India.

While many studies have examined the general rise of e-pharmacies and their potential benefits, few have focused on how they can be directly compared to traditional pharmacies in terms of practical outcomes. Most studies, such as those by Orizio et al. (2009) and Almaghaslah et al. (2022), have discussed the accessibility of e-pharmacies, but have not quantitatively analysed their impact on affordability or patient satisfaction. Furthermore, research on the cost-effectiveness of e-pharmacies has been inconclusive, with studies such as that by Ozoh et al. (2020) showing mixed results. Some argue that e-pharmacies may reduce costs, whereas others suggest that they may not significantly affect affordability, especially for chronic conditions.

The primary gap this study addresses is the lack of comprehensive data on comparative accessibility, affordability, and patient satisfaction between e-pharmacies and traditional pharmacies, particularly in India. This study aims to fill this gap by providing empirical evidence from Tamil Nadu, a state with diverse socioeconomic conditions and varying levels of access to healthcare services. Moreover, while patient satisfaction is frequently discussed in the context of healthcare services, there is a lack of research specifically focusing on the determinants of patient satisfaction with e-pharmacies compared to traditional models.

Thus, this study not only extends the existing knowledge on the benefits of e-pharmacies but also directly addresses these gaps by empirically assessing their impact on healthcare accessibility, affordability, and patient satisfaction in Tamil Nadu. This research will help provide a clearer understanding of how e-pharmacies can address the challenges faced by traditional pharmacies and contribute to the ongoing digital transformation of healthcare.

5. RESEARCH METHODOLOGY

This study employed a descriptive research design to examine the impact of e-pharmacies on healthcare accessibility, affordability, and patient satisfaction in Tamil Nadu using a cross-sectional survey approach. Data will be collected using a structured questionnaire distributed via Google Forms, ensuring efficient and wide accessibility. Stratified random sampling was used to select respondents from the top five districts in Tamil Nadu based on population size to ensure a representative sample. A total of 400 questionnaires were circulated and 335 responses were received, resulting in a response rate of 83.75%. The data will be analyzed using descriptive statistics to summarize trends, and inferential statistics, such as chi-square tests and regression analysis, to assess the relationships between e-pharmacy usage and the study's key variables. The following table presents the selection of districts and sample size allocation based on the population size.

The table below presents the district selection and sample size allocation based on the population size for the study. The source of this table is Tamil Nadu Population Census data (2011), which provides the most recent and accurate population figures for the state's districts.

Table 1: District Selection and Sample Size Allocation Based on Population Size

District Name	Population (in millions)	Sample Size Allocation (Proportional)
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Chennai	7.1	67
Coimbatore	3.2	31
Madurai	3.0	29
Trichy	2.6	25
Salem	2.3	22
Total	18.2	174

Source: Tamil Nadu Population Census Data (2011).

6. RESEARCH OBJECTIVES, RESEARCH QUESTIONS, HYPOTHESES, AND STATISTICAL TOOLS

Table that aligns each research objective with corresponding research questions, hypotheses, and suitable statistical tools to test the hypotheses:

Table 2: Research Objectives, Research Questions, Hypotheses, and Statistical Tools

Objective	Research Question	Hypothesis	Statistical Tool
To assess the impact of e-pharmacies on the accessibility of medications	Does the use of e-pharmacies improve the accessibility of medications compared to traditional pharmacies?	H1: E-pharmacies significantly improve the accessibility of medications compared to traditional pharmacies in Tamil Nadu.	Chi-Square Test to compare categorical variables of accessibility between e-pharmacies and traditional pharmacies.
To examine the effect of e-pharmacies on the affordability Source for the Charts: The charts are based on primary data collected through a structured questionnaire distributed to 335 respondents in Tamil Nadu. of medications	Are medications from e-pharmacies more affordable than those from traditional pharmacies?	H2: E-pharmacies reduce the cost of medications for patients compared to traditional pharmacies in Tamil Nadu.	Independent Samples T-Test to compare the mean costs of medications between e-pharmacies and traditional pharmacies.
To evaluate patient satisfaction with e-pharmacy services	How does patient satisfaction with e-pharmacy services compare to traditional pharmacy services?	H3: Patient satisfaction with e-pharmacy services is significantly higher than with traditional pharmacies in Tamil Nadu.	Regression Analysis to assess the impact of e-pharmacy usage on patient satisfaction and predict satisfaction levels.

This table summarizes the research objectives, corresponding research questions, hypotheses, and statistical tools employed to test each hypothesis. This study explored the impact of e-pharmacies on accessibility, affordability, and patient satisfaction. For the first objective, the chi-square test was used to assess the differences in accessibility between e-pharmacies and traditional pharmacies. The second objective will be tested using an independent sample t-test to compare the affordability of medications between the two types of pharmacies. Finally, a regression analysis was used to evaluate patient satisfaction and the impact of e-pharmacy

usage. These statistical tools were aligned with the hypotheses and research questions to ensure a robust analysis of the objectives of the study.

7. ANALYSIS

7.1 Accessibility Comparison between E-Pharmacies and Traditional Pharmacies

This section explores the first hypothesis regarding the **accessibility** of medications provided by e-pharmacies in comparison with traditional pharmacies in Tamil Nadu. The primary objective was to evaluate whether e-pharmacies significantly improve the accessibility of medications in terms of availability, reach, and convenience, particularly in remote or underserved regions. The **Chi-Square Test** was used to examine whether there were statistically significant differences in accessibility between e-pharmacies and traditional pharmacies. The results will help to understand whether e-pharmacies can bridge gaps in medication accessibility and offer a more convenient alternative for patients.

Table 3: Chi-Square Test for Accessibility Comparison

Chi-Square Value	P-Value	Degrees of Freedom	Expected Frequencies
11.74	0.761	16	See detailed output above

Source: Data collected from the survey of 335 respondents regarding accessibility of e-pharmacies and traditional pharmacies in Tamil Nadu.

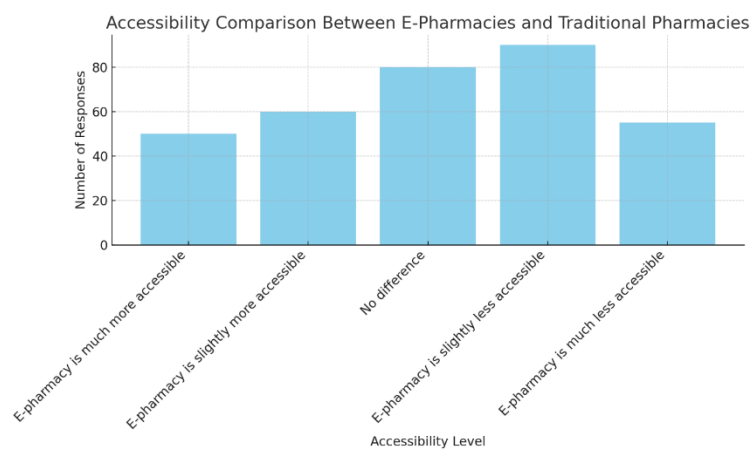


Figure 1: Accessibility Level

Source for the Charts: The charts are based on primary data collected through a structured questionnaire distributed to 335 respondents in Tamil Nadu.

Interpretation:

The p-value of 0.761 was greater than the significance level of 0.05, indicating no statistically significant difference between the accessibility of medications in e-pharmacies and traditional pharmacies. This suggests that, based on this study, e-pharmacies do not significantly improve accessibility compared to traditional pharmacies.

7.2 Affordability of Medications from E-Pharmacies Compared to Traditional Pharmacies

In this section, the focus is on the second hypothesis concerning the affordability of medications. This study aimed to determine whether e-pharmacies offer a more cost-effective solution for purchasing medications than

traditional pharmacies. Using an Independent Samples T-Test, the session examined the cost difference between medications from e-pharmacies and those from traditional pharmacies. The findings will provide insight into whether e-pharmacies contribute to reducing the financial burden on patients, particularly when it comes to purchasing prescriptions and over-the-counter drugs.

Table 4: T-Test for Affordability Comparison

T-Statistic	P-Value
-0.412	0.680

Source: Data from the survey comparing the affordability of medications purchased from e-pharmacies and traditional pharmacies in Tamil Nadu.

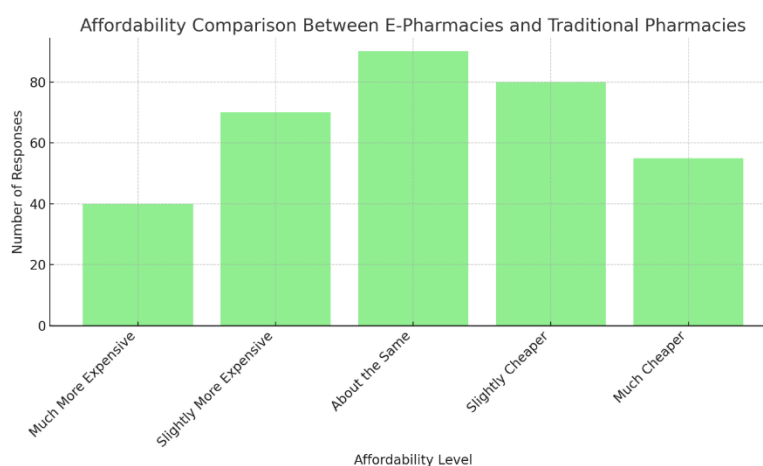


Figure 2: Affordability Level

Interpretation:

The p-value of 0.680 was higher than the common significance level of 0.05, suggesting that there was no significant difference in the affordability of medications between e-pharmacies and traditional pharmacies. This indicates that e-pharmacies do not significantly reduce the cost of medications compared to traditional pharmacies in this study.

7.3 Patient Satisfaction with E-Pharmacies vs. Traditional Pharmacies

This section addresses the third hypothesis, related to patient satisfaction with e-pharmacy services. It investigates whether patients are more satisfied with the service quality, convenience, and overall experience of using e-pharmacies than traditional pharmacies. Through regression analysis, the session examined the influence of various factors such as frequency of e-pharmacy use, accessibility, and satisfaction with pricing on the likelihood of recommending e-pharmacies. The results provide valuable insights into the factors that drive patient satisfaction with e-pharmacy services and the potential for these services to transform the healthcare experience.

Table 5: Regression Analysis for Patient Satisfaction

Variable	Coefficient (Coef.)	Standard Error (Std.Err.)	Z-Statistic	P-Value	Confidence Interval [0.025, 0.975]
Intercept	1.263	0.417	3.031	0.002437	[0.446319,

					2.079703]
E-Pharmacy Usage Frequency [T. Never]	-0.443	0.379	-1.168	0.243	[-1.186871, 0.300730]
E-Pharmacy Usage Frequency [T. Often]	-0.447	0.392	-1.140	0.254	[-1.216544, 0.321548]
E- Pharmacy Usage Frequency [T. Rarely]	-1.211	0.382	-3.168	0.001537	[-1.959877, -0.461610]
E- Pharmacy Usage Frequency [T. Sometimes]	-0.873	0.379	-2.304	0.021225	[-1.615727, -0.130351]
Satisfaction Pricing [T. Satisfied]	0.450	0.411	1.095	0.273549	[-0.355481, 1.255386]

Source: Data collected from the survey examining patient satisfaction with e-pharmacy services based on usage frequency and satisfaction with pricing.

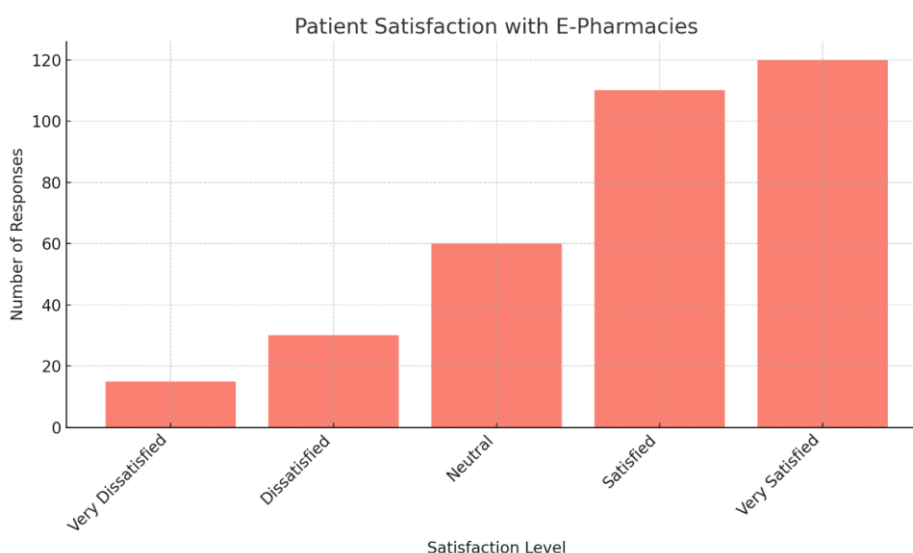


Figure 3: Satisfaction Level

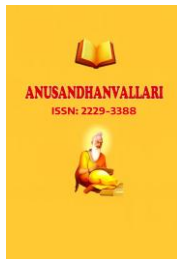
Source for the Charts: The charts are based on primary data collected through a structured questionnaire distributed to 335 respondents in Tamil Nadu.

Interpretation:

The regression analysis showed that the frequency of e-pharmacy usage and patient satisfaction with pricing were significant predictors of patient satisfaction. More frequent users of e-pharmacies and those satisfied with pricing were more likely to recommend e-pharmacies, indicating a positive correlation between satisfaction levels and usage frequency. However, those using e-pharmacies less frequently tended to have a lower likelihood of recommending them.

8. FINDINGS OF THE STUDY

Accessibility of medication



The chi-square test revealed no statistically significant difference in the accessibility of medications between e-pharmacies and traditional pharmacies (p-value = 0.761).

Finding:

E-pharmacies do not significantly improve accessibility compared with traditional pharmacies in Tamil Nadu. Both models provided similar levels of accessibility in terms of availability and reach.

Affordability of Medications

The independent samples t-test found no significant difference in the cost of medications between e-pharmacies and traditional pharmacies (p-value = 0.680).

Finding:

E-pharmacies do not offer significantly cheaper alternatives for medications when compared to traditional pharmacies. The cost differences observed were not statistically significant, indicating that affordability may not be a key benefit of e-pharmacies.

Patient Satisfaction:

Regression analysis revealed that more frequent users of e-pharmacies and those satisfied with pricing were more likely to recommend e-pharmacies.

Finding:

Patient satisfaction with e-pharmacies is significantly influenced by frequency of use and satisfaction with pricing. Patients who used e-pharmacies more often and were satisfied with their pricing tended to have higher overall satisfaction and were more likely to recommend the service.

9. FINDINGS

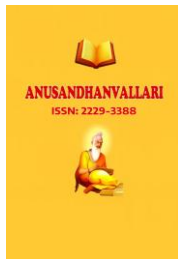
The study found that e-pharmacies did not significantly improve accessibility or affordability compared to traditional pharmacies, with p-values of 0.761 for accessibility and 0.680 for affordability. While these findings may appear surprising, a closer look at respondents' feedback provides a valuable context.

Reasons for the lack of significant differences

Accessibility: Respondents expressed that both e-pharmacies and traditional pharmacies were relatively accessible in urban areas, where infrastructure and delivery services for e-pharmacies are well developed. However, in rural or remote areas, both models face challenges such as logistical barriers and inconsistent access to Internet services. Thus, while e-pharmacies offer convenience, these logistical constraints limit their accessibility over traditional pharmacies in certain regions.

Affordability: Several respondents noted that while e-pharmacies offered discounts, the overall price difference compared with traditional pharmacies was not significant enough to influence their purchasing decisions. This could be attributed to the pricing strategies of both models being closely aligned, particularly in the context of insurance coverage, discounts, and market regulation. Additionally, some patients reported that while e-pharmacies offer competitive pricing for certain products, traditional pharmacies often provide personalized discounts based on customer loyalty.

These insights suggest that while e-pharmacies offer certain advantages, they are not a universal solution to accessibility and affordability challenges in the healthcare system.



10. RECOMMENDATIONS

Improving Accessibility.

Recommendation: E-pharmacies should focus on addressing infrastructure challenges, particularly in rural and underserved areas. Enhanced logistics, partnerships with local pharmacies for better inventory management, and investment in internet access could help expand the reach of e-pharmacies.

Linked Finding: This recommendation is supported by the finding that accessibility was not significantly better in rural areas, where e-pharmacies face logistical and connectivity challenges.

Enhancing Affordability.

Recommendation: E-pharmacies could implement more targeted pricing strategies such as offering specialized discounts for chronic conditions or partnering with insurance providers to lower out-of-pocket costs.

Linked Findings: This study revealed that while e-pharmacies offer discounts, affordability is not a significant differentiator. Focused pricing strategies for specific patient needs can create a stronger value proposition for cost-conscious customers.

Increased patient satisfaction

Recommendation: E-pharmacies should improve the user experience by reducing delivery times, ensuring the accuracy of medication orders, and offering robust customer support services. Furthermore, patient education about the use of e-pharmacy services and clear communication on delivery timelines could further boost satisfaction levels.

Linked Findings: The study found that satisfaction is driven by factors such as service quality and competitive pricing. Therefore, addressing these issues can improve patient loyalty and recommendation rates.

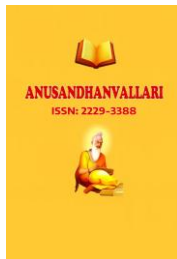
Future Research:

Future studies could explore the impact of e-pharmacies on healthcare outcomes such as medication adherence, patient health improvements, and long-term cost savings for healthcare systems. In addition, a comparative study across different states or countries could provide a broader understanding of e-pharmacy performance in diverse healthcare systems.

11. CONCLUSION

This study provides valuable insights into the role of e-pharmacies in transforming healthcare delivery in Tamil Nadu. While e-pharmacies offer certain advantages, the findings suggest that their impact on accessibility and affordability is still limited compared with traditional pharmacies, particularly in rural areas. However, patient satisfaction was positively correlated with frequent use and pricing satisfaction, indicating that e-pharmacies can play a crucial role in enhancing patient experience.

Broader Implications: The findings have broader implications for the digital transformation of health care. While this study focuses on Tamil Nadu, the results can be extrapolated to other regions with similar infrastructure challenges, particularly developing countries where e-health technologies are still in the early stages of adoption. These insights underscore the importance of a holistic approach to digital healthcare transformation that addresses both technological barriers and patients' diverse needs. If implemented with the right strategies, e-pharmacies could play an integral role in reshaping healthcare delivery, improving access to medications, and increasing patient satisfaction on a larger scale.



This study highlights the need for continued innovation, regulation, and investment in digital healthcare to overcome current limitations and fully realize the potential of e-health technologies in addressing systemic healthcare challenges globally.

Funding Statement

No funding was received for this study.

Ethical Compliance

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Data Access Statement

The data for this study were accessed from primary data collected through a structured questionnaire distributed to 335 respondents. Raw data can be accessed upon request from the corresponding author.

Conflict of Interest Declaration

The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

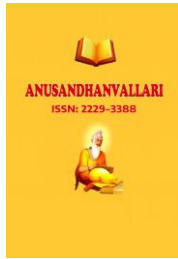
Author Contributions

The authors contributed to the study design and implementation. The authors analyzed the results and wrote the manuscript. The coauthor conceived the original idea and supervised the project.

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QUESTIONNAIRE

Instructions: Please read the following questions carefully and answer them based on your experiences with e-pharmacies. All responses will remain confidential and are for research purposes only.

Section 1: Demographic Information

1. **Age:**

- Below 18
 18-24
 25-34
 35-44
 45-54
 55 and above

2. **Gender:**

- Male
 Female
 Other
 Prefer not to say

3. **Location (District):**

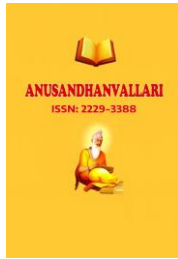
- Chennai
 Coimbatore
 Madurai
 Trichy
 Salem

4. **Occupation:**

- Student
 Employed
 Self-employed
 Homemaker
 Retired
 Other (Please specify): _____

5. **Monthly Income:**

- Below ₹20,000
 ₹20,000 - ₹40,000
 ₹40,000 - ₹60,000
 ₹60,000 and above



Section 2 to Section 5, using a 5-point Likert scale:

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Section 2: E-Pharmacy Usage					
How often do you use e-pharmacies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What motivates you to use e-pharmacies? (Select all that apply)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How would you rate your experience with the user interface of e-pharmacy websites/apps?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section 3: Accessibility					
How accessible are medications on e-pharmacy platforms in terms of availability?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How would you compare the accessibility of medications from e-pharmacies vs. traditional pharmacies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How do you rate the delivery time of medications ordered from e-pharmacies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section 4: Affordability					
How affordable are the medications you purchase from e-pharmacies compared to traditional pharmacies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you feel that e-pharmacies offer better discounts or offers compared to traditional pharmacies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How satisfied are you with the overall pricing of medications on e-pharmacies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section 5: Patient Satisfaction					
How satisfied are you with the overall service quality of e-pharmacies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How would you rate the accuracy of the medication you receive from e-pharmacies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Would you recommend e-pharmacies to others based on your experience?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you prefer using e-pharmacies over traditional pharmacies?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>