Article Type: Review
J Name: Modern Phytomorphology
Short name: MP
ISSN: ISSN 2226-3063/ eISSN 2227-9555
Year: 2025
Volume: 19
Page numbers: 47-50
DOI: 10.5281/zenodo.200121
(10.5281/zenodo.2025-19-PDFNo.)
Short Title: E-pharmacy: Evaluating its impact on patient accessibility and medication adherence

REVIEW ARTICLE

E-pharmacy: Evaluating its impact on patient accessibility and medication adherence

Anas A. Alhur[1]*, Anas Alshehri[2], Gadah Ojaimi[3], Walaa Alasiri[4], Amal Alqasem[5], Lama Alqaraawi[5], Abdulsalam Althobaiti[6], Renad Alqhtani[2], Turki Menwer[7], Nasser Alqahtani[8], Fai Alzahrani[3], Rana Alshaer[9], Ahmed Ajeibi[10], Yazeed Alsomair[11], Taiba Altowq[12]

[1]Department of Health Informatics, College of Public Health and Health Informatics, University of Hail, Hail, Saudi Arabia
[2]Department of Pharmacy, King Khaled University, Saudi Arabia
[3]Department of Pharmacy, Almujtama Pharmacy, Saudi Arabia
[4]Department of Pharmacy, King Fahad Hospital Al Bahah, Saudi Arabia
[5]Department of Pharmacy, Qassim University, Saudi Arabia
[6]Department of Pharmacy, Albaha University, Saudi Arabia
[7]Department of Pharmacy, Prince Sultan Military Medical City, Saudi Arabia
[8]Department of Pharmacy, Prince Sattam bin Abdulaziz University (PSAU), Saudi Arabia
[9]Department of Pharmacy, Taif University, Saudi Arabia
[10]Department of Pharmacy, Najran Armed Forces Hospital, Saudi Arabia
[11]Department of Pharmacy, Aldawaa Medical Services, Saudi Arabia
[12]Department of Pharmacy, Armed Forces Hospital Southern Region, Saudi Arabia

***Corresponding author:** Anas Ali Alhur, Department of Health Informatics, College of Public Health and Health Informatics, University of Hail, Hail, Saudi Arabia
E-mail: Anas.ali.alhur@gmail.com

Received: 13.01.2025**,** Manuscript No**:** mp-25-158438 | **Editor Assigned:** 16.01.2025**,** Pre-QC No. mp-25-158438(PQ) | **Reviewed:** 31.01.2025**,** QC No. mp-25-158438(Q) | **Revised:** 06.02.2025**,** Manuscript No. mp-25-158438(R) | **Accepted:** 12.02.2025| **Published:** 18.02.2025

Abstract

E-pharmacies have emerged as innovative platforms, transforming the pharmaceutical landscape through digital technologies that enhance access to medications and improve adherence rates. By employing tools such as Artificial Intelligence (AI), blockchain, and telepharmacy, these platforms address key logistical and geographical barriers. However, despite their growing relevance, e-pharmacies continue to face significant challenges, including fragmented regulatory frameworks, data privacy concerns, and disparities in digital literacy. This review aims to provide a comprehensive evaluation of their role in healthcare delivery, analyzing their benefits and limitations while identifying opportunities for future advancements.

Keywords: E-pharmacy, Medication accessibility, Medication adherence, Digital health technologies, Artificial Intelligence in healthcare, Blockchain in pharmaceuticals, Telepharmacy, Healthcare digital transformation, Regulatory challenges, Data privacy in e-health, Digital disparities, Supply chain transparency, Internet of Things (IoT) in healthcare, Patient engagement, Public health impact of e-pharmacies

Introduction

The integration of e-pharmacies into healthcare systems marks a pivotal step in the ongoing digital transformation of healthcare services globally. Recent advancements in technologies such as AI, blockchain, and telepharmacy have significantly enhanced access to pharmaceutical services, addressing longstanding

challenges related to medication accessibility and adherence (Gopal et al., 2019; Furtner et al., 2022). The critical importance of e-pharmacies became even more apparent during the COVID-19 pandemic, as they ensured uninterrupted access to essential medications amidst widespread lockdowns and logistical disruptions (Seo et al., 2023).

These platforms are particularly beneficial for underserved populations, where traditional pharmacy infrastructure remains insufficient (Miozza et al., 2024). Nonetheless, the adoption and integration of e-pharmacies are hampered by various challenges, including regulatory inconsistencies, cybersecurity risks, and inequalities in digital literacy and access (Ullagaddi., 2024; iu et al., 2024). This review provides a detailed analysis of the transformative impact of e-pharmacies on healthcare systems, highlighting their contributions to improving accessibility and adherence, the challenges encountered, and potential future developments.

Literature Review

Enhancing accessibility

Overcoming geographical and logistical barriers: E-pharmacies have been instrumental in mitigating geographical and logistical barriers to accessing medications. These platforms allow patients to conveniently order medications online and have them delivered to their homes, significantly reducing the need for physical travel, particularly in remote and underserved areas (Alhur., 2024). Furthermore, telepharmacy services enhance accessibility by providing remote consultations, allowing patients to receive pharmaceutical care without visiting healthcare facilities physically (Viegas et al., 2022).

During the COVID-19 pandemic, e-pharmacies played a critical role in ensuring medication availability, even amidst global disruptions to supply chains (Seo et al., 2023). Blockchain technology has also contributed significantly by ensuring the authenticity of medications and reducing the prevalence of counterfeit drugs in the supply chain (Ricciardi et al., 2019). For instance, a study conducted by Harbin Pharmaceutical Group demonstrated that integrating blockchain into pharmaceutical logistics significantly improved operational efficiency and medication access in underserved regions (Alhur., 2023).

Improving medication adherence

Medication adherence is a crucial determinant of treatment outcomes. E-pharmacies have made remarkable progress in addressing this issue through features such as automated reminders, refill notifications, and personalized medication plans, all of which have been shown to improve adherence rates among patients (Alhur., 2023).

AI-driven analytics play a pivotal role in identifying patients at risk of non-adherence, enabling targeted interventions and personalized support strategies (Klimanov et al., 2021). Additionally, telepharmacy services complement these efforts by providing real-time counseling and educational resources, empowering patients to better manage their medications (Alhur et al., 2024). Research indicates that patients utilizing telepharmacy services report higher satisfaction levels and improved adherence, primarily due to the convenience and personalized care these platforms provide (Alhur et al., 2023). Moreover, integrating e-pharmacies with Electronic Health Records (EHRs) facilitates seamless care coordination, further addressing gaps in medication adherence (Viegas et al., 2022).

Challenges

Despite their numerous advantages, e-pharmacies face several challenges that hinder their widespread adoption. Regulatory inconsistencies across regions remain a significant hurdle, as providers must navigate varying legal requirements that complicate their operations (Miozza et al., 2024). Data privacy and cybersecurity concerns are equally pressing, with patients demanding robust measures to safeguard their sensitive health information (Ullagaddi., 2024).

The digital divide, particularly among elderly populations and those in low-income regions, exacerbates disparities in access to e-pharmacy services. Moreover, the risk of counterfeit medications entering digital supply chains underscores the need for stringent quality assurance mechanisms (Ricciardi et al., 2019). Addressing these challenges necessitates collaborative efforts involving policymakers, healthcare providers, and technology developers.

Future opportunities

Emerging technologies present significant opportunities for e-pharmacies to overcome existing barriers and enhance their capabilities. Blockchain can enhance supply chain transparency and medication traceability, ensuring both authenticity and safety. Similarly, AI and the Internet of Things (IoT) can optimize inventory management, predict patient needs, and enable personalized care delivery (Ricciardi et al., 2019).

Integrating e-pharmacies with telemedicine platforms and broader digital health ecosystems could establish seamless healthcare delivery models, improving patient engagement and outcomes (Alhur et al., 2023). Additionally, collaborations with educational institutions could foster digital literacy, empowering both patients and healthcare professionals to utilize these platforms effectively (Ricciardi et al., 2019).

Discussion

E-pharmacies exemplify the potential of digital health innovations in addressing medication accessibility and adherence. Their success, however, hinges on a comprehensive approach that integrates technological advancements with ethical, regulatory, and social considerations.

Regulatory standardization

Harmonizing regulations across regions is critical for the global adoption of e-pharmacies. Policymakers must balance fostering innovation with ensuring patient safety by addressing issues such as counterfeit medications and data security (Alhur et al., 2023; Alhur., 2023; Klimanov et al., 2021; Alhur et al., 2024) .

Technological advancements

AI, blockchain, and IoT offer immense potential to enhance e-pharmacy operations. For example, AI-driven predictive analytics can identify adherence risks, while blockchain ensures supply chain integrity. Telepharmacy services, supported by IoT, enable real-time monitoring and counseling, further enhancing patient engagement (Alhur., 2024).

Addressing digital inequities

Bridging the digital divide is essential for equitable adoption of e-pharmacies. Initiatives to improve digital literacy, such as training programs and subsidies for digital devices, can enhance access for underserved populations (Ullagaddi., 2024). User-friendly platform designs with multilingual support can further mitigate barriers related to digital literacy.

Public health impact

E-pharmacies have the potential to significantly improve public health outcomes by enhancing access to essential medications and fostering adherence. Their integration with public health initiatives could lead to more efficient and equitable healthcare systems (Alhur et al., 2024).

Conclusions

E-pharmacies represent a transformative shift in pharmaceutical care, addressing critical challenges in medication accessibility and adherence. By overcoming regulatory, technological, and ethical challenges, they hold the potential to play a central role in creating equitable and efficient healthcare systems. Future research should prioritize the development of standardized frameworks, foster technological innovation, and ensure equitable access to e-pharmacy services.

References

Alhur A, Alhumaid S, Alhuthayfi G. (2024). Food-herbal interactions: A comprehensive review. *Adv Biores*. **15:**270-274. [Google Scholar]

Alhur A, Hedesh R, Alshehri M. (2023). Incorporating technology in pharmacy education: Students' preferences and learning outcomes. *Cureus*. **15:**50158. [Google Scholar][Crossref]

Alhur A. (2023). Integrating digital health into medical curricula: A review of current practices and future directions. *Int J Biosci*. **23:**34-43. [Google Scholar][Crossref]

Alhur A. (2024). Exploring digital competencies in health informatics: A qualitative study of final-semester undergraduate students at the University of Hail. *Chin Sci Bull*. **69:**2693. [Google Scholar]

Furtner D, Shinde SP, Singh M. (2022). Digital transformation in medical affairs sparked by the pandemic. *Pharm Med*. **36:**1-10.[Google Scholar][Crossref]

Gopal G, Suter-Crazzolara C, Toldo L, Eberhardt W. (2019). Digital transformation in healthcare – architectures of present and future information technologies. *Clin Chem Lab Med*. **57:**328-335. [Google Scholar][Crossref]

Klimanov D, Tretyak O, Goren U, White T. (2021). Transformation of value in innovative business models: The case of pharmaceutical market. *Foresight STI Gov*. **15:**52-65. [Google Scholar]

Liu H, Lin H, Li T. (2023). Impact of digital transformation on financial performance of pharmaceutical enterprises: A case study of Harbin Pharmaceutical Group. *Digit Manag Innov*. **82:**70-84. [Google Scholar][Crossref]

Miozza M, Brunetta F, Appio FP. (2024). Digital transformation of the pharmaceutical industry: A future research agenda for management studies. *Technol Forecast Soc Change*. **207:**123580. [Google Scholar][Crossref]

Ricciardi W, Barros PP, Bourek A, Brouwer W, Kelsey T, Lehtonen L. (2019). How to govern the digital transformation of health services. *Eur J Public Health*. **29:**7-12. [Google Scholar][Crossref]

Seo I, Yang HK, Kim SH. (2023). Digital transformation shift in global pharmaceutical industry going through the Covid-19 pandemic era. *Asian J Innov Policy*. 12:54-74. [Google Scholar][Crossref]

Ullagaddi P. (2024). Digital transformation in the pharmaceutical industry: Enhancing quality management systems and regulatory compliance. *Int J Health Sci.* **12**:31-43. [Google Scholar][Crossref]

Viegas R, Dineen-Griffin S, Söderlund LÅ, Acosta-Gómez J, Guiu JM. (2022). Telepharmacy and pharmaceutical care: A narrative review by International Pharmaceutical Federation. *Farm Hosp*. **46:**86-91. [Google Scholar][Crossref]