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E-Pharmacy: Transforming Access to Medicines While Safeguarding Patient and Public Health

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Abstract: E-pharmacy—the sale, dispensing and delivery of medicines through internet-based platforms—has expanded rapidly alongside digital payments, electronic prescriptions, telemedicine and app-based commerce. Legitimate e-pharmacies can improve convenience, medicine availability, price transparency and continuity of treatment, particularly for people with chronic diseases, mobility limitations or limited access to local pharmacies. Their public health value became especially visible during the COVID-19 pandemic, when remote ordering reduced unnecessary travel and supported uninterrupted medicine supply. However, the same digital marketplace can facilitate prescription bypass, inappropriate self-medication, unlawful advertising, antimicrobial misuse, diversion of controlled medicines and distribution of substandard or falsified products. Evidence concerning clinical outcomes remains limited: most research examines consumer intentions, platform characteristics or regulatory compliance rather than medication adherence, treatment outcomes, safety events or cost-effectiveness. In India, e-pharmacies operate within the general framework of the Drugs and Cosmetics Act and Rules, pharmacy regulations, telemedicine guidance and data-protection legislation, but a dedicated, fully implemented regulatory framework remains incomplete. This creates uncertainty concerning licensing, prescription validation, interstate jurisdiction, pharmacist accountability, data use and rapid-delivery models. A proportionate regulatory approach is required—one that distinguishes licensed, auditable e-pharmacies from illicit online sellers while preserving legitimate access benefits. Future systems should incorporate interoperable electronic prescriptions, pharmacist-led review, medicine traceability, pharmacovigilance, privacy-by-design, algorithmic transparency and mechanisms for identifying misuse. E-pharmacy should be developed as a regulated extension of pharmaceutical care rather than merely as an e-commerce channel.

Keywords: e-pharmacy; online pharmacy; digital health; access to medicines; pharmaceutical regulation; patient safety

INTRODUCTION

The digital transformation of healthcare has extended beyond teleconsultation and electronic medical records to the prescribing, dispensing and delivery of medicines. An e-pharmacy, also described as an online or internet pharmacy, enables users to search for medicines, upload or transmit prescriptions, make electronic payments and receive pharmaceutical products through home delivery or designated collection points. Some platforms provide additional services, including pharmacist counselling, refill reminders, price comparison, laboratory booking and teleconsultation.

The rise of e-pharmacy has been driven by widespread smartphone use, expanding digital-payment systems, consumer preference for convenience, growth of chronic disease treatment and the increasing normalization of remote healthcare. The COVID-19 pandemic accelerated this transition by creating an immediate need for contact-minimizing access to medicines. Consumer research indicates that

convenience, privacy, lower prices, wider product availability and difficulty accessing conventional pharmacies are important reasons for purchasing medicines online.[1,2]

E-pharmacy is not a single, uniform model. At one end are licensed pharmacies that use digital platforms as an additional ordering and delivery channel while maintaining prescription verification, pharmacist supervision and regulated supply chains. At the other are anonymous or cross-border websites that sell prescription medicines without valid prescriptions, conceal their physical location or distribute unapproved and falsified products. Between these extremes are marketplace aggregators, telemedicine-linked pharmacies and rapid-delivery platforms whose legal and professional responsibilities may be less clearly defined.

The central public health challenge is therefore not whether medicines should ever be supplied online, but how legitimate digital access can be expanded without weakening safeguards traditionally built into pharmaceutical practice.

Models and Core Functions of E-Pharmacy

E-pharmacy models differ according to ownership, dispensing arrangements and relationships with prescribers. Inventory-based platforms maintain medicines in licensed warehouses or pharmacy premises and dispense directly to consumers. Marketplace or aggregator models connect users with participating pharmacies, while the platform manages search, payment and delivery. Omnichannel systems combine physical pharmacy networks with mobile applications. Telehealth-integrated models link online consultation, electronic prescribing and medicine fulfilment within a single digital pathway.

A safe e-pharmacy should perform more than order processing. Its core professional functions include confirming the identity of the patient and prescriber, validating prescriptions, identifying duplication or contraindications, ensuring pharmacist supervision, maintaining appropriate storage and transportation, documenting supply, offering counselling and enabling adverse-event reporting. Where these safeguards are absent, the platform is effectively functioning as an unregulated medicine retailer rather than a pharmacy.

The distinction is important because medicines are not ordinary consumer goods. Their benefits depend on correct diagnosis, appropriate selection, accurate dose, adherence, monitoring and recognition of adverse effects. Commercial design features that encourage impulsive purchasing, automatic substitution or repeat ordering can conflict with rational medicine use.

Evidence on Accessibility, Convenience and Consumer Experience

The clearest advantages of e-pharmacy relate to convenience and physical access. Home delivery may benefit older adults, people with disabilities, caregivers, patients requiring repeated refills and residents of areas with limited pharmacy availability. Digital catalogues may provide information on alternative brands, generic medicines, availability and prices. For conditions associated with stigma, online ordering may offer greater privacy.

A 2022 systematic review of online pharmacies selling prescription medicines found considerable variation in website characteristics, legality, prescription requirements, geographical location and consumer protections.[3] The review highlighted that legitimate services can provide convenience and potentially lower prices, but consumers may find it difficult to distinguish regulated pharmacies from unlawful vendors.

Consumer-behaviour reviews similarly show that perceived usefulness, convenience, trust, price and website quality influence willingness to purchase medicines online.[1,2] However, intention to use a platform should not be interpreted as evidence of improved health. Much of the published literature consists of cross-sectional surveys, simulated purchases or website assessments. Comparatively little research has measured whether e-pharmacy improves treatment adherence, disease control, medication-related harm or healthcare expenditure.

Home delivery may improve refill continuity by reducing travel and waiting time. Yet access can also be disrupted by incomplete prescriptions, stock-outs, delivery failures, inaccurate addresses or the inability to obtain urgent medicines immediately. Online systems may be particularly unsuitable when the patient requires clinical examination, demonstration of device use, dose titration or face-to-face counselling.

Public Health Significance

Continuity of treatment and chronic disease care

The growing burden of diabetes, hypertension, cardiovascular disease, respiratory disorders and other chronic conditions requires reliable long-term access to medicines. E-pharmacy can support scheduled

refills, automated reminders and consolidated medication histories. When linked with telemedicine and primary care, it may reduce treatment interruptions and facilitate remote follow-up.
Nevertheless, a filled prescription is not equivalent to appropriate use. Adherence is influenced by adverse effects, affordability, health beliefs, regimen complexity, communication with healthcare providers and perceived treatment benefit. E-pharmacy may remove logistical barriers but cannot independently address all causes of non-adherence.

Access in rural and underserved settings
Digital ordering may appear especially valuable in remote regions where pharmacy density is low. In practice, its impact depends on internet access, digital literacy, reliable transport, functional addresses, electricity and last-mile logistics. Cold-chain products, insulin and temperature-sensitive medicines require validated storage and transportation systems. A poorly regulated delivery network may undermine medicine quality even when the original product is authentic.
Digital systems may therefore complement—but should not replace—local pharmacy and primary healthcare infrastructure. In areas with limited connectivity, assisted ordering through community health workers, primary care facilities or licensed pharmacies may be more equitable than app-only models.

Price transparency and affordability
Online platforms can permit price comparison and may offer discounts, subscriptions or generic alternatives. This may reduce out-of-pocket expenditure for some patients. However, aggressive discounting can also encourage unnecessary purchasing, distort competition and concentrate market power in a small number of platforms. Once market consolidation occurs, initial discounts may not translate into sustained affordability.
Recommendations generated through commercial algorithms may prioritize sponsored products, higher-margin brands or bundled purchases rather than clinically appropriate and cost-effective options. Price transparency must therefore be accompanied by transparency regarding substitution, sponsorship and ranking practices.

Medicine Safety and Quality Risks
Substandard and falsified medicines
Illicit online sellers provide a highly adaptable channel for substandard and falsified medical products. WHO notes that the risk of receiving illegal, unregistered, substandard or falsified products is substantially higher when medicines are purchased from unauthorized websites or vendors that conceal their physical location.[4]
WHO has estimated that approximately one in ten medical products in low- and middle-income countries is substandard or falsified, although this estimate refers to sampled products in the broader medicine supply and should not be interpreted as the prevalence among all online purchases.[5]
Risks include incorrect active ingredients, wrong strength, contamination, expired products, misleading packaging and medicines containing no therapeutic ingredient. Consumers cannot reliably determine authenticity from website appearance, reviews or packaging alone. Digital pharmacy regulation must therefore include supply-chain documentation, batch traceability, licensed procurement, recall capability and enforceable liability.

Prescription bypass and self-medication
A fundamental concern is whether prescription-only medicines can be obtained without meaningful clinical authorization. Cross-sectional investigations of online pharmacies have demonstrated that some vendors supply medicines without appropriate prescriptions or rely on inadequate questionnaires.[6] During and after the COVID-19 pandemic, medicines promoted through social media and public speculation were readily obtainable from certain online sellers despite uncertain benefit and potential harm.
Prescription upload alone is not sufficient. Platforms must verify whether the prescription is authentic, current, complete, issued by an authorized practitioner and appropriate for the person placing the order. Repeated reuse of the same scanned prescription, alteration of images and ordering from multiple platforms can permit excessive procurement.

Antimicrobial resistance
Unrestricted online sale of antibiotics may worsen self-medication, incomplete treatment, use for viral illness and inappropriate selection of broad-spectrum agents. This has implications beyond individual

consumers because antimicrobial resistance affects communities and health systems. E-pharmacies should maintain auditable records of antibiotic sales, reject invalid prescriptions and avoid promotional language that treats antibiotics as ordinary retail products.

Controlled and high-risk medicines

Sedatives, opioids, psychotropic medicines and other controlled products carry risks of dependence, overdose and diversion. These medicines require stricter identity verification, prescription controls and quantity limits. Ultra-fast delivery models are particularly concerning when commercial speed is prioritized over pharmacist review.

Indian Perspective and Regulatory Landscape

India has experienced rapid expansion of app-based pharmacies, teleconsultation services and medicine-delivery platforms. E-pharmacy may help patients compare prices, locate medicines and obtain refills without repeated travel. These benefits are particularly relevant in a country with substantial out-of-pocket health spending, a large chronic disease burden and marked geographical variation in access to pharmaceutical services.

Evidence Summary and Recommended Safeguards

Domain	Potential public health benefit	Principal risk or uncertainty	Recommended safeguard
Geographic access	Home delivery for rural, mobility-limited and chronically ill patients	Digital exclusion, unreliable logistics and delayed urgent treatment	Low-bandwidth platforms, assisted access and defined delivery standards
Convenience	Reduced travel, waiting time and repeated pharmacy visits	Replacement of professional interaction by automated transactions	Mandatory access to a registered pharmacist
Medication continuity	Refill reminders and scheduled delivery	Automatic refills despite changed treatment or adverse effects	Periodic prescription renewal and medication review
Affordability	Price comparison, discounts and generic options	Predatory discounting, sponsored ranking and market concentration	Transparent pricing, substitution rules and competition oversight
Prescription processing	Electronic documentation and auditable transactions	Forged, reused or incomplete prescriptions	Secure interoperable e-prescriptions and prescriber authentication
Medicine quality	Centralized procurement and traceability in regulated systems	Counterfeit, expired or improperly stored medicines	Licensed supply chains, batch tracking, recalls and temperature monitoring
Antimicrobial stewardship	Digital audit of antibiotic dispensing	Prescription bypass and inappropriate self-medication	Valid prescription requirement and surveillance of unusual sales
Pharmacovigilance	Automated adverse-event prompts and product recall alerts	Fragmented reporting and weak follow-up	Integration with national pharmacovigilance systems
Personalization	Refill support and tailored education	Profiling, targeted promotion and misuse of health data	Explicit consent, purpose limitation and independent audits
Rapid delivery	Timely access to routine medicines	Inadequate pharmacist review and unsafe sale of high-risk products	Risk-based minimum verification standards and exclusions

However, India's regulatory framework was developed primarily for physical premises. Online sale continues to be governed principally through the Drugs and Cosmetics Act, 1940, the Drugs Rules, 1945, the Pharmacy Act, 1948 and applicable pharmacy-practice requirements. These instruments regulate licensing, prescription medicines, storage, dispensing and professional responsibilities but do not comprehensively address platform architecture, interstate transactions, digital prescription reuse, algorithmic promotion or online marketplace liability.[7]

Draft amendments published in 2018 proposed registration of e-pharmacies, maintenance of transaction records, confidentiality requirements, restrictions on specified medicines and operation through licensed premises. These proposals represented an important attempt to create a dedicated framework, but a comprehensive final e-pharmacy regime has not been fully operationalized. Consequently, uncertainty persists regarding uniform licensing, central versus state jurisdiction and responsibility when the platform, dispensing pharmacy and patient are located in different states.[8]

India's Telemedicine Practice Guidelines recognize electronic prescribing within defined professional and clinical limits. They also distinguish medicines that may be prescribed during different types of teleconsultation and reinforce the responsibility of the registered medical practitioner.[9] E-pharmacy systems should not circumvent these safeguards by arranging token consultations merely to authorize a predetermined purchase.

Health and prescription data collected by e-pharmacies can reveal diagnoses, reproductive health needs, mental health treatment, chronic conditions and household medication patterns. The Digital Personal Data Protection Act, 2023 establishes a general framework for lawful digital-data processing, consent and obligations of data fiduciaries.[10] E-pharmacies should apply privacy-by-design principles even where detailed sector-specific rules are still evolving. Prescription data should not be repurposed for unrelated advertising, credit profiling or insurance decisions without a valid legal basis and transparent consent.

Recent Advances

Electronic prescriptions and interoperable records

Secure electronic prescriptions can reduce illegibility, prevent repeated use and allow real-time authentication. Integration with longitudinal health records may enable detection of duplicate therapy, allergies and drug interactions. However, interoperability should not become unrestricted data sharing. Access must be role-based, logged and limited to information necessary for dispensing.

Artificial intelligence and automated review

Artificial intelligence is being introduced for prescription reading, inventory forecasting, customer support, substitution and identification of potentially unsafe orders. These systems may reduce processing errors, but automated interpretation of handwritten prescriptions can generate incorrect medicine or dose selections. High-risk decisions require pharmacist confirmation, and algorithms should be validated across languages, prescription formats and clinical settings.

Track-and-trace technologies

Serialization, barcodes, QR codes and digital supply-chain records can strengthen product authentication and recall management. Their value depends on accurate data entry and end-to-end participation by manufacturers, wholesalers, pharmacies and delivery partners. A visible QR code alone cannot guarantee authenticity if the underlying database is incomplete or vulnerable to duplication.

Digital pharmacovigilance

E-pharmacies can send targeted safety alerts, identify recalled batches and facilitate adverse-drug-reaction reporting. Transaction histories may help detect unusual purchasing patterns or clusters of complaints. Such monitoring should be used for safety rather than undisclosed commercial profiling.

Challenges and Limitations

The evidence supporting e-pharmacy remains weaker than market growth might suggest. Studies commonly measure satisfaction, intention to purchase or website compliance rather than clinical outcomes. Users are often younger, educated and digitally connected, limiting generalizability. Research rarely compares e-pharmacy with strengthened local pharmacy delivery or other access interventions.

Regulatory enforcement is complicated by cross-border websites, rapidly changing domain names, social-media sales and unclear platform liability. Illicit sellers can imitate accreditation logos and consumer

reviews. Even licensed platforms may rely on multiple warehouses, delivery partners and third-party sellers, making accountability diffuse.

Commercial conflicts also deserve attention. Platforms that combine prescribing, dispensing, diagnostic testing and product promotion may benefit financially from increased utilization. Without separation of functions and independent oversight, the system may encourage unnecessary consultations, tests or medicines.

Equity remains a major concern. Older adults, people with low literacy, persons with visual or cognitive impairment and households without reliable digital access may be disadvantaged. Maintaining offline alternatives is essential.

Future Directions and Policy Priorities

A future-ready e-pharmacy framework should establish a searchable national registry of authorized platforms linked to identifiable licensed premises and responsible pharmacists. Consumers should be able to verify legitimacy through a government-maintained system rather than relying on platform claims.

Electronic prescribing standards should prevent alteration and repeated use while allowing legitimate refills. A risk-based model is preferable: over-the-counter products, routine chronic-disease refills, antibiotics, controlled medicines and cold-chain products should not be subject to identical safeguards.

Regulators should define minimum requirements for pharmacist availability, counselling, storage, delivery time, temperature monitoring, substitution, returns, recalls and grievance redressal. Advertising practices, search rankings and sponsored recommendations should be transparent. Deep discounts should be evaluated for their impact on irrational medicine use and market competition.

Research should progress from consumer surveys to pragmatic comparative studies examining adherence, treatment continuity, medication errors, adverse events, antimicrobial use, equity and cost-effectiveness. Independent mystery-shopping studies can evaluate prescription compliance, but they should be complemented by clinical and supply-chain outcomes.

Finally, e-pharmacy policy should support rather than displace community pharmacists. Hybrid models may allow local pharmacies to participate in digital ordering and home delivery while retaining trusted professional relationships. The objective should be an integrated pharmaceutical-care system, not a contest between digital and physical retail.

CONCLUSION

E-pharmacy can improve convenience, medicine availability, price visibility and treatment continuity, particularly for people who face geographical, mobility or time-related barriers. However, its benefits are not automatic. Weak prescription controls, counterfeit products, inappropriate antibiotic access, unsafe rapid delivery, commercial manipulation and misuse of sensitive data can convert convenience into substantial public health risk.

The appropriate policy response is neither an unrestricted digital marketplace nor a blanket rejection of online dispensing. E-pharmacy should be recognized as a regulated form of pharmaceutical practice. Licensing, pharmacist accountability, secure electronic prescribing, supply-chain traceability, privacy protection, antimicrobial stewardship and pharmacovigilance must be embedded into platform design. India has an opportunity to develop a balanced framework that preserves innovation while placing patient safety and rational medicine use above transaction volume and delivery speed.

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