

“REVIEW ON TELEPHARMACY AND DIGITAL HEALTH INTERVENTIONS”

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ABSTRACT

By overcoming obstacles like geographic distance, a lack of healthcare providers, and restricted access in underserved areas, the combination of telepharmacy and digital health interventions has completely changed the way pharmaceutical care is delivered. Pharmacists can now manage prescription therapy, improve adherence, and improve patient outcomes through remote consultations and monitoring by utilizing technologies such as electronic health records (EHRs), remote dispensing units (RDUs), mobile health applications, and artificial intelligence (AI). Synchronous, asynchronous, and hybrid telepharmacy approaches cover a range of clinical needs and provide prompt, individualized, and economical care. Despite obstacles pertaining to data security, legal requirements, and infrastructure, telepharmacy is still developing as a significant and scalable solution for contemporary healthcare delivery.

KEY WORDS

Medication therapy management, clinical decision support, digital health, telepharmacy, remote dispensing units, artificial intelligence in pharmacy, mobile health (mHealth), electronic health records, therapy adherence, chronic disease management, teleconsultation, pharmacist-led care, digital therapeutics, and behavioral health.

INTRODUCTION

In order to meet the changing needs of patients, pharmaceutical care a crucial part of the healthcare system has experienced a major increase of duties and responsibilities in recent years [1]. HCPs can readily access patient data, interact with patients, and keep an eye on illness management using their smartphone or tablet computer [2,3,4]. The potential to expand healthcare's reach is presented by recent developments in digital technology. For instance, more and more people in distant locations with little access to healthcare can now get prompt interventions from medical professionals who are stationed far away. Using their smartphones, mobile applications, and accessible software, several doctors may effortlessly access patient data, interact with patients, and keep an eye on illness management [5,6,7,8,9]. The pharmacist is not physically present at the pharmacy operations or patient care point, which is a common characteristic of telepharmacy services. Wide coverage of pharmaceutical services, including in underserved areas due to geographic or economic issues, is one of the benefits of

telepharmacy services. Some possible drawbacks of telepharmacy include a reduction in the face-to-face interaction between medical staff and patients, issues with assessing medication delivery, and a higher risk to the confidentiality and integrity of patient data [10,11]. In their daily work, pharmacists respond to inquiries about testing, vaccinations, and drug interactions. These conversations can be conducted with patients at their homes via telepharmacy. The increasing understanding, use, and appreciation of telepharmacy is good. The reason for this is straightforward: telepharmacy significantly improves patient care [12]. Patient safety and results can be improved via telepharmacy. According to the results of a 2017 systematic analysis, clinical telepharmacy interventions in an outpatient or ambulatory context generally improved outcomes pertaining to patient self-management, disease management, and adherence in the treatment of chronic illnesses [13]. Telepharmacy's efficacy as a technique to lower adverse drug occurrences in hospitals has also been established [14].

A Variety of Telepharmacy Models

There are various approaches for implementing telepharmacy, each one suited to certain situations and requirements. The three main models are hybrid, synchronous, and asynchronous.

Real-time Telepharmacy(synchronous)

Real-time Telepharmacy Pharmacists and patients or other healthcare professionals can communicate in real time using video conferencing, phone calls, or live chat platforms in synchronous telepharmacy. Pharmacists may perform in-depth consultations, respond to inquiries, and offer real-time pharmaceutical guidance because to this model's instant communication capabilities. This interaction's instantaneity is especially helpful in acute care scenarios where prompt guidance and action are essential. A useful method for preserving a human connection with patients which is crucial for fostering trust and guaranteeing adherence to treatment plans synchronous telepharmacy can replicate the in-person experience. [15]

asynchronous telemedicine (asynchronous telepharmacy)

In asynchronous telepharmacy, sometimes referred to as store-and-forward telepharmacy, medical information and questions are sent to a pharmacist, who examines them and gets back to you later. This technique is more flexible and convenient for both patients and pharmacists because it does not require both

parties to be present at the same time. For routine medication reviews, prescription verifications, and answering non-urgent inquiries, asynchronous telepharmacy is especially helpful. Additionally, pharmacists can use it to treat chronic diseases by reviewing patient data, keeping an eye on drug adherence, and periodically offering advice and comments. [16]

Telemedicine that is hybrid (Hybrid telepharmacy)

Hybrid telepharmacy offers a flexible method of providing remote pharmacological care by fusing aspects of synchronous and asynchronous methods. In addition to using store-and-forward techniques for normal follow-ups and non-urgent encounters, this strategy enables pharmacists to perform real-time consultations as needed. By combining the best features of both strategies, the hybrid model ensures continuous, comprehensive treatment while preserving flexibility. To create a treatment plan, for example, a pharmacist may perform an initial synchronous consultation and then employ asynchronous techniques for follow-up monitoring and modifications. This approach works especially well for controlling chronic illnesses, where regular interventions and constant communication are crucial. [17]

RDUs, OR REMOTE DISPENSING UNITS

RDUs are automated drug delivery devices that are situated far away and are watched over by chemists using telepharmacy. They are intended to give underprivileged or rural communities safe and efficient access to prescription drugs.[18]

Elements of an RDU

Cabinet for the storage and administration of medications, Patient input via a touchscreen interface, Using video conferencing to consult with a pharmacist remotely, Biometric and barcode authentication, Electronic prescription access in real time.[19]

Benefits

Makes pharmacological treatment more accessible in places lacking pharmacies, Improves Drug Abuse adherence by guidance from pharmacists, lowers the expenses associated with running actual pharmacy locations, permits important medications to be available around-the-clock, aids in maintaining care continuity during emergencies or pandemics.[20]

Difficulties

Needs dependable power and internet infrastructure, Insufficient in-person communication could affect patient trust. Different countries have different regulations. Both personnel and patients require education and training, hazards to data and medication security.[21]

Use in Practice

Ontario, Canada: RDUs are used in First Nations communities with pharmacist oversight from urban centers. United States: Deployed in Veterans Affairs clinics, correctional facilities, and rural hospitals. During COVID-19: Helped maintain medication access with minimal physical contact.[22]

Future Outlook

Integration with AI for predictive analytics in medication usage. Expansion into mobile RDUs or vending-style systems. Potential in low- and middle-income countries (LMICs) to close healthcare gaps.[23]

APPLICATIONS IN PHARMACY PRACTICE

Digital platforms also support real-time communication, remote monitoring, and electronic health record integration, which enhances pharmacists' ability to contribute to disease management, adherence support, and overall healthcare quality improvement. Telepharmacy bridges the gap by enabling access to expert medication management and consultation services without the constraints of geographical barriers. The integration of telepharmacy and digital health technologies into pharmacy practice has greatly expanded the scope and reach of pharmaceutical care. These innovations allow pharmacists to provide a wide range of clinical services remotely, ensuring continuous, accessible, and patient-centered care.[24]

Management of Medication Therapy (MTM)

Through virtual platforms, telepharmacy allows pharmacists to provide MTM services that assist patient education, medication review, and adherence evaluation. MTM using telemedicine has demonstrated decreased medication-related issues and better results in the management of chronic diseases [24]

Systems for Clinical Decision Support (CDSS)

Pharmacists can receive real-time notifications about drug interactions, allergies, and dosage problems through CDSS systems. In hospital and community

pharmacy settings, this promotes evidence-based decision-making and improves medication safety.[25]

Pharmacogenomics and Customized Treatment

In customized medicine approaches, pharmacists use genetic information to guide drug selection and dosage, minimizing side effects and optimizing therapeutic success.[26]

Utilizing Artificial Intelligence (AI) in Drug Monitoring and Dispensing

AI-powered monitoring tools and automated dispensing systems are two examples of pharmacy technologies that improve patient safety and workflow effectiveness. [27]

DIGITAL HEALTH TECHNOLOGIES IN PHARMACY

Pharmacy practice is changing as a result of digital health technology, which give pharmacists the means to provide safer, more effective, and more individualized healthcare services. Artificial intelligence (AI), chatbots, wearable technology, mobile applications, electronic health records (EHRs), and digital therapies are some examples of these technologies.

Applications for Mobile Health (mHealth)

Patients and pharmacists can remotely manage medical issues with the help of mobile health apps. Features like digital prescriptions, chronic disease tracking, medication reminders, and direct interaction with medical professionals are all available through these apps. They increase patient involvement and drug adherence, particularly in the management of chronic care.[28]

Health Devices That Are Wearable

Vital indications including blood pressure, heart rate, and glucose levels can be tracked by wearable technology, such as smartwatches and fitness trackers. With the use of this real-time data, pharmacists can monitor side effects, customize drug therapy, and identify early warning indicators of difficulties, all of which allow for prompt interventions.[29]

EHRs, or electronic health records

Pharmacists may view a patient's complete medical history, test results, and prescription drugs thanks to EHR integration with pharmacy systems. This makes

it easier to identify any drug interactions, conduct thorough medication reviews, and work with other medical specialists.[30]

Learning and Artificial Intelligence

AI is being utilized more and more in pharmacies for personalized treatment, fraud detection, drug interaction screening, and patient behavior prediction. Large datasets can be analyzed by machine learning algorithms to improve operational effectiveness and assist in clinical decision-making.[31]

Virtual assistants and chatbots

AI-powered chatbots can assist with refill scheduling, answer questions about medications, and offer details about drug interactions. They improve patient access to pharmaceutical treatment without putting a strain on pharmacists by acting as round-the-clock support resources.[32]

Digital Medicine (DTx)

Evidence-based treatments that are administered through software to assist prevent or treat medical conditions are known as digital therapies. To supplement pharmacological therapy, pharmacists can provide DTx remedies for diabetes, hypertension, and mental wellness.[33]

CLINICAL AND ECONOMIC OUTCOMES

In contemporary pharmacy practice, telepharmacy and digital health technology have become revolutionary tools, especially when it comes to increasing patient outcomes, lowering systemic costs, and improving healthcare delivery. These approaches tackle important issues including prescription non-adherence, restricted access to treatment in rural locations, and resource inefficiencies by facilitating remote pharmaceutical care, electronic monitoring, and virtual consultations. Clinical advantages include better chronic illness management, better therapeutic results, and fewer medication-related mistakes. Digital health strategies have proven to be financially advantageous by reducing readmissions to hospitals and maximizing the use of medical resources. Assessing the clinical effectiveness and financial impact of these innovations is crucial for their long-term adoption as healthcare systems move toward value-based care.[21]

Better Patient Results and Adherence to Medication

Mobile apps, remote monitoring, and teleconsultations are examples of digital health tools that facilitate ongoing patient education and involvement. Research

indicates that telepharmacy services greatly enhance prescription adherence, especially when it comes to managing chronic illnesses.[34]

Decrease in Medication Mistakes

Errors in prescription and dispensing are less likely when telepharmacy and electronic prescribing are used. Reduced rates of adverse medication events have been associated with real-time pharmacist interventions during remote order verification.[35]

Improved Care for Chronic Illnesses

Pharmacists can remotely monitor illnesses including diabetes, hypertension, and asthma with the help of digital therapies. Digitized pharmacist-led interventions have been shown to improve blood pressure management and glycemic control.[36]

Economic Efficiency and Cost Savings

By lowering emergency room visits, hospital readmissions, and travel fees for patients in remote areas, telepharmacy contributes to lower healthcare costs. Optimized resource allocation and operational efficiency are advantageous to health systems [37]

Better Access to Healthcare

Telepharmacy ensures that patients in remote or underprivileged locations obtain timely pharmacological care by bridging the gap. This model lessens healthcare access inequities by geography.[38]

High Patient Satisfaction

High Patient Satisfaction Convenience, time savings, and regular pharmacist communication are cited as important elements in studies that show high patient satisfaction with digital health services.[21]

BARRIERS AND CHALLENGES IN TELEPHARMACY AND DIGITAL HEALTH

The development of digital health and telepharmacy technology has created new opportunities to enhance access to healthcare, especially in remote and underserved areas. There are challenges in incorporating these advances into

standard pharmacy practice, nevertheless. Widespread adoption is severely hampered by a number of factors, including worker preparedness, technological limits, and legal and regulatory restrictions. The quality, effectiveness, and sustainability of digital pharmacy services may be impacted by these problems, underscoring the necessity of thorough policy, infrastructure development, and professional training to guarantee their successful execution.[39]

Legal and Regulatory Restrictions

One of the biggest obstacles to the adoption of telepharmacy is the absence of uniform regulations across areas. Cross-border service delivery is hampered by licensing requirements, disparate state and provincial laws, and ambiguous rules pertaining to remote prescribing and pharmaceutical dispensing.[40]

Cybersecurity and Data Privacy Issues

Concerns around data breaches and illegal access arise when handling private patient health information on digital networks. Although it can be difficult and resource-intensive, ensuring compliance with data protection requirements like HIPAA and GDPR is crucial.[39]

Limitations of the Technological Infrastructure

The deployment of digital health systems is hampered in remote or resource-constrained environments by inadequate internet connectivity, antiquated technology, and a lack of IT assistance. This has an impact on patients' access to services as well as pharmacists' capacity to provide them.[22]

Employee Education and Opposition to Change

A large number of pharmacists are not formally trained on digital platforms and telehealth tools. Integration attempts are slowed by resistance to implementing new technologies, especially among older practitioners or in traditionally organized health systems.[21]

Funding and Reimbursement Gaps:

Providers' financial incentives are diminished by telepharmacy services' restricted reimbursement rules. Adoption is hampered in both public and private healthcare settings by inconsistent insurance coverage and unclear billing codes.[20]

Therapy Adherence and Self-care Management

In order to achieve the best possible health results, therapy adherence and self-care management are crucial, especially for patients with long-term conditions including diabetes, hypertension, and asthma. Self-care management is the everyday actions and lifestyle choices people make to preserve their health and slow the advancement of their diseases, whereas therapy adherence is the degree to which a patient complies with recommended drug schedules and medical recommendations. Patient engagement has changed dramatically as a result of the growth of telepharmacy and digital health initiatives. Remote access to pharmaceutical treatment is made possible by telepharmacy, which offers patients prompt medication counselling, electronic reminders, and follow-up assistance. By tackling obstacles like lack of enthusiasm, forgetfulness, and a poor comprehension of the regimen, these techniques encourage improved adherence. Additionally, by providing tracking tools, AI-powered individualized support systems, and educational content, digital platforms enable patients to actively participate in their treatment. The use of digital technologies in pharmacy practice ultimately improves self-care and adherence, which results in better treatment outcomes, fewer hospitalizations, and increased patient autonomy.[41]

TELEPHARMACY'S AND DIGITAL TOOLS' ROLES

Apps for Medication Adherence

Applications for mobile health (mHealth) assist patients in monitoring side effects, tracking medication schedules, and receiving reminders. Pharmacists can examine adherence data in real time and offer prompt treatments because to these apps' frequent integration with pharmacy systems.[42]

Devices for Remote Monitoring

Pharmacists or medical teams can get real-time data from devices like glucose monitors, wearables, and smart pillboxes. This facilitates early intervention for non-adherence or deterioration and allows for remote tracking of therapy outcomes.[41]

Virtual Counselling and Follow-up

Telepharmacy allows pharmacists to provide remote medication counseling, especially for patients with chronic diseases like diabetes, hypertension, or asthma. Scheduled follow-ups via video calls or messaging platforms enhance accountability and support.[43]

AI-driven Customization

By examining patient behavior and forecasting the likelihood of non-adherence, artificial intelligence can customize adherence tactics. AI-powered chatbots increase patient autonomy and engagement by answering questions and sending reminders.[44]

Interventions in Education

Pharmacists can use digital platforms to distribute customized instructional materials (modules, infographics, and films) that help patients better understand and motivate themselves to treat their conditions.[45]

TELETHERAPY & BEHAVIORAL HEALTH

A branch of telehealth called teletherapy uses digital tools including messaging apps, video conferencing, and smartphone apps to provide psychological and behavioral health services remotely. This strategy has grown in importance as a means of tackling the escalating mental health problem, especially in underprivileged or rural areas where access to in-person behavioral health services is restricted. Mental health diseases such as substance use disorders, anxiety, depression, and illnesses linked to stress can all be diagnosed, treated, and managed with the help of teletherapy. Through digital platforms, pharmacists who are frequently among the most approachable medical professionals are taking on a more cooperative role in behavioral health. They help by providing counselling services, keeping an eye on the adherence to psychotropic medication, and collaborating closely with mental health specialists to guarantee continuity of care. The COVID-19 epidemic hastened the uptake of teletherapy by emphasizing its advantages for patient involvement, ease, and scalability in the provision of mental health services. Through improved accessibility, prompt intervention, and a decrease in the stigma attached to seeking mental health treatment, the incorporation of teletherapy into digital health ecosystems shows promise in improving behavioral health outcomes. [46, 47,48, 49]

Significance in Mental Health Emergencies

Globally, the prevalence of mental illness is rising, especially in the wake of COVID-19, and there is a greater need for scalable mental health care. Accessible and stigma-free care choices are provided by teletherapy.[48]

Pharmacists' Function in Teletherapy

Pharmacists help with mental health by: tracking compliance with psychiatric

drugs, delivering medication therapy management (MTM) remotely, Teaching patients on the usage of psychiatric drugs, taking part in care teams that are multidisciplinary.[50]

Clinical Performance

Research indicates that for a number of mental health issues, teletherapy is just as successful as in-person treatment. Comparable treatment results and high patient satisfaction have been noted [51].

Benefits of teletherapy include:

lowering stigma, travel time, and appointment delays; improving accessibility in rural and distant places; and facilitating continuity of care in the event of a public health emergency. [49]

CONCLUSION

By increasing access to pharmaceutical care, particularly in rural and underserved areas, telepharmacy and digital health interventions have changed the traditional landscape of pharmacy practice. By combining technologies like electronic health records (EHRs), mobile health (mHealth) applications, remote dispensing units (RDUs), and artificial intelligence, pharmacists are now able to provide medication therapy management, adherence monitoring, and patient counseling beyond physical boundaries. All things considered, telepharmacy models synchronous, asynchronous, and hybrid offer flexibility in addressing diverse clinical needs, improving patient engagement, safety, and health outcomes. Additionally, teletherapy has demonstrated promise in behavioral health, further solidifying the pharmacist's role in multidisciplinary care teams. Despite these demonstrated benefits, there are still important obstacles to overcome, such as regulatory and legal restrictions, a lack of technological infrastructure, worries about data privacy, and gaps in workforce training. Resolving these issues through policy reform, infrastructure investment, and educational support is crucial to maintaining progress. All things considered, telepharmacy remains a vital and innovative tool in providing equitable, cost-effective, and patient-centered healthcare, with further development anticipated through the integration of AI, wearable technology, and digital therapeutics.

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