# Telepharmacy Consulting: Applications and Advancements in Chronic Disease Management

Jonathan Crandall

Department of Biomedical Sciences, California Baptist University

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Dr. Dennis K. Bideshi, Ph.D., M.A., M(ASCP), M(CLS)

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**Student interest:**

I'm especially drawn to telepharmacy because it offers a way to make healthcare systems more efficient and accessible. Working as a pharmacy technician has given me firsthand insight into how pharmacies operate, including the strengths and challenges of current systems. Experiencing the workflow up close, I see where technology could improve processes, reduce the workload on staff, and make patient care more seamless. Telepharmacy, by allowing remote support for tasks like medication management and patient counseling, has the potential to alleviate some of the pressures in traditional pharmacy settings.

With my background in both pharmacy and a focus on the computer science and systems in place, I'm interested in how telepharmacy can automate routine processes, giving healthcare teams more time to focus on patient-centered care. I see telepharmacy as a powerful tool for reaching patients in underserved areas, supporting chronic disease management, and enhancing the quality of care. This research allows me to explore these possibilities in depth. I seek to combine my interest in healthcare and technology to understand how telepharmacy could help create more effective and higher quality pharmacy systems.

I envision countless opportunities for pharmacy to evolve with the rise of remote services. These innovations have the potential to streamline patient care, alleviate the workload on pharmacists, and reduce costs for both providers and patients. The idea of contributing to a system that is more efficient, accessible, and cost-effective, benefiting everyone involved, generates a great interest for me and fuels my passion for exploring telepharmacy's possibilities.

**Abstract:**

This paper explores the applications and advancements of telepharmacy, with a particular focus on chronic disease management. Telepharmacy, a branch of telehealth specific to pharmacy practice, leverages technology to allow pharmacists to provide services remotely, expanding access to care and supporting healthcare systems in underserved areas. The COVID-19 pandemic accelerated the adoption of telepharmacy, highlighting its potential as an essential component of healthcare delivery. As chronic diseases like diabetes, hypertension, and cardiovascular conditions continue to rise, telepharmacy offers a practical solution for providing consistent medication management, patient counseling, and real-time monitoring, which are critical to effective disease control.

Research demonstrates that telepharmacy can enhance medication adherence, reduce hospital readmissions, and lower healthcare costs, benefiting both patients and providers. Technological tools such as Clinical Decision Support Systems (CDSS) and wearable health devices play a key role in telepharmacy's effectiveness, allowing pharmacists to make data-driven decisions and adjust treatment plans based on real-time patient health data. This integration of technology enables pharmacists to identify potential complications early, personalize medication regimens, and engage patients in their own care.

However, challenges remain, including regulatory barriers, privacy concerns, and the need for improved digital literacy among patients. This paper examines these limitations and calls for further research to refine telepharmacy practices, with a focus on regulatory alignment and data security measures. By addressing these issues, telepharmacy can continue to evolve as a sustainable, accessible healthcare model that bridges gaps in care and improves outcomes for

patients with chronic illnesses. The study ultimately highlights telepharmacy's role in transforming pharmacy practice, making healthcare more accessible, efficient, and patient-centered.

**Objectives:**

1. **To examine the current applications of telepharmacy**
2. **To explore the role of technological tools**
3. **To identify the limitations and challenges associated with telepharmacy**
4. **To evaluate patient and provider perspectives on telepharmacy**
5. **To propose areas for future research and development**

## Introduction

Telepharmacy, a subset of telehealth within pharmacy practice, has evolved into a solution for improving healthcare, particularly in managing chronic diseases such as diabetes, hypertension, and cardiovascular conditions. Telepharmacy involves pharmacists using electronic information and telecommunications technology to provide patient care services remotely, thus expanding the reach of pharmacy services far beyond traditional settings. Initially conceptualized to serve rural and underserved communities, telepharmacy has since evolved into a global healthcare modality, driven by advancements in communication systems and the rising demand for convenient, patient-centric care (Saeed et al., 2024). This model supports crucial pharmacy functions, including medication therapy management, adverse event monitoring, patient counseling, and even remote oversight of pharmacy operations. According to the American Society of Health-System Pharmacists (Pedersen et al., 2021), telepharmacy holds immense potential to improve patient outcomes, enhance safety, and foster collaboration within healthcare teams by allowing pharmacists to deliver services directly to patients in geographically remote or underserved areas (Begnoche et al., 2022).

The COVID-19 pandemic promoted telepharmacy's adoption, transforming it from a supplemental service into an essential healthcare field for many. Social distancing measures and the necessity for remote healthcare delivery started the immediate growth in telepharmacy research, with studies showing an average annual growth rate of 8.07% (Saeed et al., 2024). Bibliometric analyses reveal that telepharmacy has progressed through distinct developmental phases which are listed as: emergence, take-off, expansion, and future trajectory which can be

seen in its increasing importance in healthcare systems. These developments have broadened telepharmacy's applications, including remote clinical interventions, medication therapy management, and patient counseling. Additionally, innovations such as videoconferencing, automated dispensing devices, and remote monitoring tools have enhanced telepharmacy's capacity to manage complex medication regimens effectively and improve patient outcomes (Saeed et al., 2024).

As we see the number of chronic diseases rise, we also see that so does the demand for continuous, accessible, and adaptable care. Telepharmacy has shown considerable promise in meeting these demands by bringing about consistent medication management and patient monitoring, both of which are needed in the successful management of chronic conditions. Through telepharmacy, pharmacists can support patients' adherence to medication regimens and make necessary adjustments in real-time, ensuring treatment efficacy while minimizing risks. The ASHP highlights that telepharmacy not only improves access to care but also helps achieve cost-effective healthcare delivery by reducing hospital readmissions and emergency room visits, which are often associated with poorly managed chronic diseases (Begnoche et al., 2022). These advantages are the main aspects of telepharmacy's significant role in supporting healthcare systems that face limitations in physical pharmacy access, particularly in rural areas (Manuel, 2022).

Technological advancements are also critical to telepharmacy's effectiveness in chronic disease management. Telepharmacy platforms increasingly incorporate clinical decision support systems (CDSS) and remote monitoring tools, allowing pharmacists to detect potential complications early and personalize medication therapies to meet each patient's unique needs. For example,

pharmacists can use real-time health data collected through wearable devices or mobile applications to track a patient's progress, adjusting medications or offering counseling as necessary to optimize outcomes. This technological integration aligns with the ASHP's Practice Advancement Initiative 2030, which emphasizes the need for scalable telehealth systems that streamline workflow and maximize patient engagement (Begnoche et al., 2022). By embracing such innovations, telepharmacy not only enhances the quality of chronic disease management but also actively involves patients in their healthcare journey, promoting self-management and education.

Regulatory frameworks play an important role in expanding telepharmacy's reach and effectiveness. The ASHP advocates for compatible state and federal regulations that allow pharmacists to work across state lines, helping to address difficulty in developing healthcare access. Particularly in "pharmacy deserts" which are regions where pharmacy services are limited or unavailable. A loosening of these regulations would then enable telepharmacy to bridge these gaps and provide essential services. The ASHP also calls for increased research into best practices and regulatory support to ensure that telepharmacy maintains high standards of patient privacy, security, and care quality (Begnoche et al., 2022). As healthcare moves towards value-based care, telepharmacy's adaptability, especially in chronic disease management, positions it as a vital component in ensuring access for consistent patient support.

## Literature Review

### The Evolution of Telepharmacy

Telepharmacy, the provision of pharmacy care via telecommunications, has undergone significant development over the decades, particularly during the COVID-19 pandemic. Initially

designed to serve rural and underserved areas, telepharmacy emerged as a response to the lack of accessible pharmacy services in communities facing economic and logistical challenges. A pioneering example is North Dakota's 2001 pilot program, which addressed the closure of pharmacies in rural areas and demonstrated the efficacy of telepharmacy in restoring medication access and improving adherence (Gianutsos, G., 2024). This program became a model for telepharmacy's potential to mitigate the impacts of "pharmacy deserts," where individuals face significant barriers to obtaining medications and pharmacist consultations.

The pandemic continued pushing the already accelerated telepharmacy’s growth, as highlighted by a systematic review assessing telehealth effectiveness during this period (Haref, E. et al., 2024). The pandemic-induced shift to virtual healthcare marked a critical turning point, with telepharmacy playing an essential role amidst it. This transition offered a natural experiment comparing telepharmacy and in-person care, revealing generally comparable outcomes. Benefits included reduced missed appointments and improved medication adherence, particularly for patients managing chronic conditions. However, challenges, such as lower rates of up-to-date laboratory assessments, made the limitations of remote care more obvious to those trying to implement the system.

Telepharmacy has proven especially valuable in expanding access to underserved populations. Beyond rural areas, it addresses urban disparities, such as those linked to socioeconomic status and mobility challenges and provides critical services for elderly patients and shut-ins (Gianutsos, G., 2024). These applications demonstrate telepharmacy’s capacity to enhance healthcare equity by bridging gaps in accessibility.

As telepharmacy continues to evolve, its integration into comprehensive healthcare models is increasingly vital. The lessons learned during the pandemic have paved the way for improvements in telepharmacy practices, including the development of secure platforms, compliance with privacy regulations, and enhanced training for pharmacists and pharmacy technicians. While the pandemic highlighted telepharmacy's strengths, it also exposed areas needing refinement to ensure equitable and effective care delivery in a post-COVID-19 world (Haref, E. et al., 2024).

**Integration and Application**

Telepharmacy's integration into clinical settings has expanded significantly, particularly in managing chronic diseases and providing patient-centered care. Recent studies highlight the growing role of telepharmacy in improving medication adherence, reducing healthcare costs, and enhancing patient outcomes in diverse healthcare environments.

During the COVID-19 pandemic, telepharmacy gained traction as an effective tool for managing chronic diseases. A review of telehealth outcomes during this period emphasized telepharmacy's ability to support chronic disease management by reducing missed appointments and improving medication adherence rates, they mention, "For general medical care among adults' telehealth resulted in a higher rate of missed visits. For three other clinical areas: in general, medical care among patients of all ages, for women who received specialized pregnancy/prenatal/gynecological care, and in care for other specific conditions, telehealth use resulted in a lower rate of missed visits" (Haref, E. et al., 2024). Telepharmacy facilitated initial consultations and ongoing monitoring, enabling pharmacists to remotely adjust therapy regimens and counsel patients. These capabilities were particularly impactful for patients with mobility

limitations or those managing multiple comorbidities, this is where telepharmacy's potential to improve access to care for vulnerable populations came into play (Hatef, 2024).

Despite these benefits, challenges remain. Technical barriers, such as inconsistent internet connectivity and limited digital literacy among patients, can hinder the effectiveness of telepharmacy services. Not everyone is receptive to the onset of digital changes, nor are they always satisfied with the services being offered in various formats. Differences in regulations and laws between states complicate the ability to expand telepharmacy on a larger scale as well. This challenge demonstrates the need for standardized guidelines both nationally and globally, to ensure a high quality of care and simplify telepharmacy to facilitate patient satisfaction (Gianutsos, G., 2024).

**Quality Outcomes**

Comparisons between telepharmacy and traditional in-person care have also shed light on patient preferences and service quality. While many clinical outcomes, such as hospital readmission rates and adverse events, showed no clinically meaningful differences between telehealth and in-person care, telepharmacy was associated with fewer missed visits and greater medication adherence in certain populations (Haref, E. et al., 2024). These findings highlight the viability of telepharmacy as a complementary model to traditional care, particularly in underserved areas where pharmacist access is limited.

Additionally, telepharmacy's application extends beyond routine medication management. Remote patient counseling, one of its core functions, allows pharmacists to provide guidance on medication use, side effects, and lifestyle adjustments. Studies have shown that these services positively impact patient satisfaction and engagement, due to requiring less frequent

interventions (Gianutsos, G., 2024). Telepharmacy has also enabled pharmacists to play a broader role in comprehensive medication management. This change helps with solidifying telepharmacy's new place in modern healthcare. These studies show that patients are receptive to the newly implemented telepharmacy services in a diverse range of populations. This is a positive outlook for the applicability of telepharmacy services for future research.

**Application Example - UCSF**

Patient perspectives on telepharmacy have been largely positive, especially among those managing chronic conditions who benefit from the convenience and accessibility it provides. During the pandemic, academic medical centers, such as the University of California at San Francisco (UCSF), rapidly expanded telepharmacy and telehealth services to continue providing care across inpatient, outpatient, and specialty settings (Zhou et al., 2023). This shift offered insights into patient preferences, particularly for those who previously faced barriers to in-person visits, such as travel requirements, time constraints, or physical limitations.

Patient satisfaction metrics gathered at UCSF indicate a high level of acceptance of telepharmacy, with many patients valuing the reduced need for travel and the ability to receive comprehensive care from the convenience of their homes. Between March and October 2020, UCSF's Division of Cardiology reported patient satisfaction scores consistently near 100% following the transition to virtual visits (Zhou et al., 2023).

Patients with chronic illnesses particularly benefit from telepharmacy's ability to provide consistent medication counseling, adherence monitoring, and care coordination. The pandemic was helpful in seeing the value of these services as patients with comorbidities preferred telehealth to avoid infection risks associated with in-person visits. UCSF's Specialty Pharmacy,

which serves a variety of clinics, adapted its injection training and medication education sessions to a virtual format, successfully maintaining patient engagement and adherence rates comparable to pre-pandemic levels. This outcome suggests that telepharmacy can effectively meet the needs of patients with complex, ongoing care requirements, even when in-person services are limited (Zhou et al., 2023).

Despite the generally favorable response at UCSF, some challenges persisted, particularly for patients unfamiliar with digital platforms or lacking reliable internet access. UCSF's experience demonstrated the importance of addressing digital literacy and connectivity issues to ensure equitable access to telepharmacy services. Some patients do not have access to a computer. In addition, if they do have access, they do not have strong technology skills to operate email, links, attachments, portals, and websites. In addition, while telepharmacy has proven highly effective for routine consultations and education, certain high-stakes services, such as medication initiation for complex treatments, may still benefit from in-person interaction to facilitate thorough medical assessments. Patient engagement is contingent upon their digital literacy, making telepharmacy feasible however not equitable (The Frontline Pharmacist, 2021).

In summary, patient perspectives on telepharmacy reveal a strong preference for its convenience and accessibility, especially among those with chronic health needs. We see in the UCSF specialty pharmacy services that patients are utilizing telepharmacy to a similar extent compared to pre-pandemic levels. However, telepharmacy's long-term feasibility will depend on addressing technical barriers and balancing in-person and virtual services to accommodate patient preferences and clinical needs effectively (Moulaei, 2022).

**Utilizations**

In recent years, telepharmacy has played a crucial role in managing chronic diseases such as hypertension and opioid dependency, particularly during the COVID-19 pandemic when physical access to care was limited. Telepharmacy utilizes telecommunications to deliver pharmacist consultations, medication adjustments, and educational support remotely. Which clearly demonstrates its effectiveness in maintaining continuity of care and supporting medication adherence even when in-person interactions are restricted. This is especially valuable for chronic conditions, which require consistent monitoring and adjustments to ensure optimal outcomes (Bruns et al., 202., 364).

**Hypertension**

A retrospective study examining telepharmacy's effectiveness for patients with hypertension found no statistically significant differences between in-person and telepharmacy visits in achieving target blood pressure goals (≤130/80 mmHg and ≤140/90 mmHg). This finding is notable in that telepharmacy consultations can replicate the benefits of in-person pharmacist interactions, such as addressing medication adherence and assessing lifestyle modifications, thus providing a viable alternative in chronic disease management (Bruns et al., 2024., 366). For patients with hypertension, telepharmacy has proven to be as effective as face-to-face visits in supporting adherence and achieving blood pressure control, an essential component in reducing the risks associated with uncontrolled hypertension.

Telepharmacy also enables pharmacists to remotely assist patients with medication adjustments and address side effects, key components of hypertension and chronic disease management. Studies highlight that these interventions provide patients with a structured approach to

understanding their medication regimens and encourage proactive engagement with their treatment. For example, one study found that over 50% of telepharmacy participants achieved their BP goals following consultations, which suggests that remote pharmacist-led counseling on lifestyle modifications and adherence strategies could be as effective as traditional, in-person management (Bruns et al., 2024., p. 367).

**Chronic Opioid Therapy**

While telepharmacy's role in managing chronic conditions like hypertension has been established, its applications extend far beyond, encompassing other complex conditions such as chronic opioid therapy (COT). During COT programs, medications such as Methadone are slowly weaned over time, such as a small change is made every week. These programs enable patients to wean off opioid medications in a manner that minimizes their withdrawl symptoms. The Department of Veterans Affairs (VA) has utilized telepharmacy to support veterans on COT by providing virtual pharmacy services through remote monitoring and electronic health record (EHR) access. This model, which leverages pharmacy students under the supervision of licensed pharmacists, illustrates telepharmacy's potential for population health management (Carr-Lopez et al., 2021., p. 323). By enabling remote assessments of medication adherence, prescription monitoring, and controlled substance tracking, the VA has created a structured approach to managing chronic conditions among its population. This is important as the VA recognizes this as a group that often faces unique healthcare challenges, including chronic pain and higher rates of comorbid mental health issues.

Another advantage of telepharmacy in chronic disease management is its role in medication adherence and patient engagement. By facilitating remote consultations, pharmacists can engage

patients in regular discussions about their treatment plans, side effects, and lifestyle factors. This form of consistent, accessible care is invaluable for patients managing chronic diseases, as they often face challenges in maintaining adherence. For example, the VA's telepharmacy program has helped pharmacy students gain practical experience in medication adherence assessments and patient engagement. In just one year, students were able to document over 200 pain assessments and complete thousands of prescriptions monitoring activities, reinforcing the potential of telepharmacy to contribute to both patient outcomes and workforce readiness (Carr-Lopez et al., 2021., p.324).

**Rural and Underserved Communities**

Another critical aspect of telepharmacy in chronic disease management is the potential for improved access to healthcare in rural or underserved areas. As a growing specialty within telemedicine, telepharmacy has expanded rapidly in recent years to offer additions in pharmaceutical services, particularly in rural communities where pharmacist shortages are prevalent. Studies show that telepharmacy networks significantly reduce medication errors, decrease the time required for order processing, and increase the availability of after-hours consultations (Sarkar et al., 2018., p. 209). In some areas, pharmacies open earlier and stay open later than doctors' offices. In addition, many pharmacies are open on the weekends when doctors' offices are often closed Telepharmacy networks can offer even more expanded hours of operation. These networks connect rural patients to centralized pharmacist services, facilitating access to pharmaceutical care while maintaining medication safety.

For example, the implementation of telepharmacy networks in states like North Dakota and Montana has helped rural hospitals overcome staffing limitations by enabling remote pharmacists

to monitor medications, provide consultation, and ensure accuracy in medication orders. This is particularly important for chronic disease patients, who require consistent monitoring to avoid medication discrepancies and maintain stable treatment plans. The result has been a substantial reduction in medication errors, particularly during times when in-person pharmacist services were unavailable (Sarkar et al., 2018., p. 212). In states with comprehensive telepharmacy regulations, rural areas now benefit from near real-time pharmaceutical consultations that would otherwise be delayed, offering patients and healthcare providers more confidence in maintaining high standards of care (Hussain, 2023).

Telepharmacy's impact is also evident in the scalability of services, particularly in rural areas where patients frequently encounter obstacles such as long travel distances and limited access to healthcare providers. Telepharmacy networks address these gaps by connecting patients with centralized services that expedite medication order entries, consultations, and follow-ups. For instance, telepharmacy systems in rural hospitals have decreased the time required for medication order processing from over 20 minutes to under 15 minutes, demonstrating the effectiveness of remote systems in maintaining workflow efficiency (Sarkar et al., 2018., p. 210). Such time-saving measures are particularly beneficial for chronic disease patients, whose medication regimens often require timely adjustments to prevent complications (Casey, 2022).

The integration of telepharmacy in also helps reduce medication errors, a significant concern in chronic disease management. Research has shown that telepharmacy networks improve accuracy by implementing multiple checkpoints at both central and remote locations. For instance, rural hospitals in Montana report that post-telepharmacy implementation, after-hours order discrepancies were reduced by over 30%, highlighting telepharmacy's potential to enhance safety

in medication management when in-person pharmacy services are unavailable (Sarkar et al., 2018., p. 211). By reducing these errors, telepharmacy provides an added layer of reliability that can be crucial in managing chronic diseases where even small medication discrepancies can significantly impact patient outcomes.

Finally, telepharmacy holds promise as a sustainable solution for pharmacist shortages in underserved areas. National pharmacist shortages have led to decreased pharmacy hours, longer wait times, and increased workload for healthcare staff. Telepharmacy addresses these issues by enabling remote pharmacists to supplement on-site services, especially during nights, weekends, or other times when local staffing is limited. North Dakota's telepharmacy initiative, for instance, has not only improved access to care but also generated local economic benefits by creating jobs and sustaining pharmacy services in rural communities (Sarkar et al., 2018., p. 213). These economic impacts are what allow us to see telepharmacy's role not only as a healthcare innovation but also as a community-strengthening tool.

**Summary of Integration and Application**

In summary, telepharmacy's scope of practice when handling chronic disease management is vast and multifaceted. From enhancing adherence and reducing errors to expanding access in rural areas, telepharmacy offers a scalable, effective approach to managing chronic conditions. As telepharmacy continues to evolve, it creates extensive opportunities for a large array of communities, particularly for vulnerable populations, while empowering both patients and pharmacy students through remote, technology-driven care.

**Clinical Decision Support Systems (CDSS) in Telepharmacy**

In telepharmacy, Clinical Decision Support Systems (CDSS) have become pivotal tools for

enabling pharmacists to make informed clinical decisions from remote locations. CDSS offer real-time alerts, recommendations, and resources that assist pharmacists in preventing medication errors, managing drug interactions, and optimizing dosage for chronic disease management. By directly integrating CDSS into telepharmacy, healthcare providers can expand access to accurate, efficient pharmaceutical care for remote patients (Nebeker et al., as cited in Goundrey-Smith, 2013, p. 71). The advancement of telepharmacy is needed to meet the demand for systems that both automate and standardize clinical processes, making CDSS an essential component for delivering consistent, high-quality care remotely (Pathak, 2020).

CDSS in telepharmacy are structured around both active and passive decision support features, each serving distinct roles in the telepharmacy workflow. Active decision support, as detailed in (Goundrey-Smith, S. 2013). provides immediate, automatic alerts for potential drug interactions, patient allergies, or dosage adjustments. For instance, a CDSS may automatically generate a warning if a prescribed drug dosage surpasses recommended levels, thereby allowing the pharmacist to address and rectify the issue before the medication reaches the patient (Nebeker et al., as cited in Goundrey-Smith, 2013, p. 71). Such automation not only enhances medication safety but also minimizes the margin for human error, especially critical in remote setups where direct physician oversight might be limited.

On the other hand, passive decision support systems that we see as online drug databases or reference libraries can allow pharmacists to conduct targeted searches for specific information (Teich et al. 50., as cited in Goundrey-Smith, 2013, p. 73). Commonly used references like Lexi-Drugs and Micromedex enable pharmacists to access detailed drug information and guidelines, fostering an environment where pharmacists are equipped with the necessary tools to support patients with diverse and complex needs. The access to vast databases of up-to-date

pharmaceutical information has revolutionized how pharmacists operate in telehealth settings, providing "a reliable source of definitive information on a medicine" (Teich et al. 50., as cited in Goundrey-Smith, 2013, p. 73).

CDSS is particularly beneficial in chronic disease management, where ongoing, complex medication regimens are common. Conditions such as hypertension, diabetes, and asthma demand precise medication management to avoid complications. Studies have shown that CDSS integrated with electronic prescribing (EP) systems can reduce adverse drug events by over 60%, primarily by minimizing inappropriate prescribing and improving drug monitoring (Hunt et al., as cited in Goundrey-Smith, 2013, p. 73). Pharmacists can use these systems to monitor patients' medication adherence remotely, which is essential in chronic disease management, especially for patients with limited mobility or those residing in remote areas.

For example, passive systems such as the British National Formulary (BNF) provide decision support with quick access to specific drug monographs and guidance on contraindications, precautions, and dosing for chronic diseases. This access enables telepharmacists to make well-informed decisions swiftly, reducing the potential for medication-related errors. As Nebeker et al. state, CDSS systems play a "pivotal role in preventing medication errors" by facilitating a clinically comprehensive, data-driven approach to chronic disease care (Nebeker et al., as cited in Goundrey-Smith, 2013, p. 74).

Despite the transformative potential of CDSS, challenges remain in its implementation. The risk of "alert fatigue," where clinicians become desensitized to frequent notifications, poses a significant concern. In their study, Huntemann et al. found that a staggering 97% of allergy alerts were overridden due to alert fatigue, leading to a decline in the system's efficacy (Huntemann et

al. 72., as cited in Goundrey-Smith, 2013, p.72). Future development in CDSS aims to refine these alerts, ensuring they are context-sensitive and directly relevant to each patient's specific needs, thus reducing the frequency of non-essential alerts (Hunt et al., as cited in Goundrey-Smith, 2013, p. 73).

With further improvements in CDSS functionalities, telepharmacy could see even greater advancements. For instance, enhanced algorithms capable of accommodating comorbidities and adjusting recommendations based on individualized patient data could be implemented, adding a personalized dimension to remote care (Ferner and Coleman 73., as cited in Goundrey-Smith, 2013, p. 72). By continuously evolving CDSS features, telepharmacy is positioned to increase its impact on patient outcomes, ultimately driving a shift towards more accessible, safer, and high-quality remote healthcare.

**Remote Monitoring Tools in Telepharmacy**

Remote monitoring tools have introduced a new dimension to telepharmacy by enabling healthcare providers to monitor patient health conditions and device functionality from a distance. These tools are particularly valuable for patients with chronic diseases, as they allow for real-time health data collection, which can be used to make informed treatment adjustments. The advent of wearable technology and remote monitoring devices, as demonstrated during the COVID-19 pandemic, highlighted the potential of these tools to reduce hospital visits and maintain continuity of care in telehealth (Pacemaker 9).

The Totem RM device, used during the COVID-19 pandemic, exemplifies the effectiveness of remote monitoring tools in telepharmacy. As outlined in “Creation of pacemaker remote monitoring networks between hospital and pharmacies during Covid-19 outbreak” Totem was

introduced in several community pharmacies to monitor patients with cardiac implantable electronic devices (CIEDs) such as pacemakers. Patients were able to use the device for their regular follow-up (FU) appointments, transmitting data directly from their pacemakers to the hospital's central database without needing an in-hospital visit. This collaborative effort created a "hub-and-spoke" model, where pharmacies acted as satellite locations, enabling the hospital to maintain oversight on patient health remotely (Pacemaker 9).

The Totem model provided patients with the opportunity to manage their health autonomously while maintaining access to professional support. "The hub-and-spoke network may help to spread even further RM adoption, even beyond the pandemic" (Pacemaker 9). Over 18 months, Totem received transmissions from numerous patients, flagging crucial alerts, including atrial fibrillation episodes and ventricular lead issues that required timely interventions. This efficient monitoring and intervention model showcased the efficacy of remote monitoring in maintaining patient safety and treatment continuity in telepharmacy.

Wearable health technology, including devices that monitor blood pressure, glucose levels, and heart rate, provides real-time health data critical for chronic disease management. By integrating these devices into telepharmacy services, healthcare providers can monitor patients' conditions closely and adjust medications or treatments as needed. For instance, a patient with diabetes can use a wearable glucose monitor that sends data to the telepharmacist, who can make prompt adjustments to the patient's medication or provide counseling on dietary changes. This real-time data flow allows for a "more accurate record of patient response to therapy," which can be invaluable for chronic condition management (Gammon et al., as cited in Goundrey-Smith, 2013, p. 205).

Wearable devices also contribute to personalized care, allowing telepharmacists to track trends in patients' health data over time and respond preemptively to potential health risks. Telepharmacy's incorporation of remote monitoring is thus a significant advancement toward achieving a more preventative, rather than reactive, healthcare model. As discussed in a Swedish theses by Österberg, this model of care can significantly impact savings for pharmacists and patients (Österberg et al. 2015., p. 17).

Successful remote monitoring requires not only technology but also well-structured organizational models. For example, many healthcare centers now adopt a dedicated workflow where remote transmissions are reviewed by a nurse or a nurse practitioner, along with a pharmacist, before being escalated to a physician, when critical issues are detected. As observed in the HomeGuide Registry model, "collaboration between a nurse for ordinary screening and a physician for medical decisions" ensures a streamlined process that allows for timely responses to patient needs (Melissano et al., 2023). This model has been particularly effective in telepharmacy, as it reduces the workload on physicians while ensuring that remote data is processed efficiently.

Similarly, the Totem network utilized in pharmacies during the pandemic serves as an example of how telepharmacy can implement a structured support network that bridges the gap between patients and healthcare providers. In this model, pharmacists were trained to assist patients with the use of Totem, providing a user-friendly and supportive experience for patients engaging in remote follow-ups. This collaboration between pharmacies and hospitals demonstrated that "telepharmacy could maintain high levels of satisfaction and compliance" while minimizing the strain on hospital resources (Melissano et al., 2023).

**Challenges for Future Implications for Remote Monitoring Tools in Telepharmacy**

Despite the benefits, challenges remain in adopting remote monitoring on a wide scale. Barriers such as data privacy, device compatibility, and the need for patient training can hinder the effective use of these tools. Additionally, the absence of face-to-face contact with clinicians can affect patient comfort, especially for older patients who may find the technology intimidating or confusing. A recent study found that "10% of patients expressed dissatisfaction with the lack of direct clinician contact" during device checks, highlighting the need for a balanced approach that incorporates both technology and human support (Melissano et al., 2023).

Future development in remote monitoring tools aims to enhance device compatibility and integrate patient-friendly interfaces that will encourage more patients to adopt these tools confidently. As remote monitoring systems evolve, telepharmacy will continue to adapt and integrate advanced tools that bring personalized, high-quality care to patients' doorsteps, particularly in underserved or rural areas where access to healthcare may be limited.

Telepharmacy offers unique strategies for personalizing medication therapy, particularly for patients with chronic conditions who require individualized treatment plans. Through remote monitoring and data analytics, telepharmacists can tailor medication regimens to patients' specific health needs and personal preferences. The ASHP advocates for using telehealth pharmacy services in ways that directly impact patient outcomes and enhance safety, encouraging telepharmacists to adapt treatments based on real-time patient data and individual responses to therapy (Begnoche et al., 2022). For example, telepharmacy enables continuous assessment of treatment efficacy through remote data collection, allowing pharmacists to make timely adjustments to medications in response to fluctuations in health markers, such as blood

pressure or glucose levels. Moreover, the growing adoption of clinical decision support systems (CDSS) within telepharmacy frameworks offers pharmacists tools to evaluate various factors, including potential drug interactions and the patient's unique medical history, ensuring that treatment is both safe and effective.

Telepharmacy's individualized approach is especially beneficial for populations facing accessibility barriers, as it extends tailored care to patients who might otherwise have limited access to healthcare facilities. Through data-driven adjustments and remote consultations, telepharmacy not only meets medical needs but also respects patient preferences regarding their care delivery. This adaptability positions telepharmacy as a promising method to uphold patient-centered care principles, even in underserved areas where personalized medication management may otherwise be challenging (Saeed et al., 2024).

A major advantage of telepharmacy is its capacity to enhance patient engagement, which is critical in chronic disease management. Telepharmacy platforms facilitate patient education and support self-management by providing convenient access to pharmacists for real-time guidance and consultation. Studies indicate that telepharmacy services, such as videoconferencing and mobile health apps, empower patients to actively participate in their care, thereby improving adherence to prescribed treatments (Saeed et al., 2024). For example, remote counseling sessions enable pharmacists to educate patients about their medications, discuss potential side effects, and provide clear guidance on disease management practices. The ASHP also notes that telepharmacy improves patient engagement by fostering consistent communication between patients and healthcare providers, which is essential for reinforcing health literacy and addressing concerns as they arise (Begnoche et al., 2022).

Additionally, telepharmacy programs that incorporate patient-friendly tools, such as reminders for medication refills and follow-up alerts, facilitate self-management and improve adherence to medication regimens. By making these resources readily available, telepharmacy encourages patients to take an active role in their healthcare, reducing the risk of complications associated with chronic diseases. This approach aligns with value-based care principles, emphasizing the importance of preventative measures and continuous support in chronic disease management (Saeed et al., 2024). Overall, telepharmacy's ability to provide accessible, ongoing educational resources and foster strong patient-provider relationships is a signal marker for its potential to transform patient engagement into the digital age.

**Privacy and Security Concerns**

One of the primary concerns with telepharmacy is the protection of patient privacy and data security. Telepharmacy platforms involve the transmission of sensitive health data over digital networks, exposing this information to risks such as unauthorized access, data breaches, and cyberattacks. Ensuring compliance with healthcare regulations, like the Health Insurance Portability and Accountability Act (HIPAA) in the United States, is critical for maintaining patient trust and safeguarding sensitive information. To address these challenges, telepharmacy platforms are increasingly incorporating encrypted data transmission and secure authentication methods to minimize risks (Skrei, A., & Rundquist, 2017). Additionally, implementing multi-factor authentication and secure server storage is essential to prevent unauthorized access. As the demand for telepharmacy grows, continual advancements in cybersecurity and regular updates to regulatory frameworks are necessary to keep pace with emerging threats (Skrei, A., & Rundquist, 2017).

Moreover, the unique nature of telepharmacy requires a different approach to handling electronic health records (EHRs) securely across various devices and locations. Unlike traditional pharmacies, telepharmacy services often operate across different states or regions, creating a complex regulatory environment. Differences in state laws regarding telepharmacy practices can continue to complicate the ability to uniformly address privacy issues. This raises the need for a standardized approach across jurisdictions. Future directions in telepharmacy must prioritize integrating secure EHR systems while ensuring that all providers and facilities adhere to consistent data protection standards (Skrei, A., & Rundquist, 2017).

**Summary**

One of the biggest things I learned from this research is just how much telepharmacy can improve access to healthcare, especially for people in rural or underserved areas. Many resources stated the importance this had on those communities. It is really interesting how it allows pharmacists to monitor patients remotely, help them stick to their medication plans, and adjust in real time. This seems like a great way to solve some of the issues I have seen in pharmacy, like how hard it can be for patients to get consistent care when they live far away or when there are not enough pharmacists in their area.

The COVID-19 pandemic showed me how important telepharmacy can be, as well as how possible it can be. During that time, it became clear that people still needed access to healthcare even if they could not go in person. Telepharmacy made it possible to keep providing care, and it showed that remote services can work really well. At the same time, I learned that there is room for improvement, such as creating systems that are easier for people to use if they are not comfortable with technology.

Another thing that stood out to me is how much potential there is for new technology in telepharmacy. Tools like artificial intelligence and decision support systems could make telepharmacy even better by helping pharmacists give more personalized and accurate care. At the same time, these tools need to be used carefully because too many alerts or overly complicated systems could actually make things harder for both pharmacists and patients.

I also learned that telepharmacy is not just about technology, it is about people. It is important to think about how to protect patient privacy, make the systems accessible, and create laws that allow telepharmacy to grow while keeping patients safe. This part really made me realize how much planning and collaboration is needed to make telepharmacy successful.

Overall, this research gave me a better understanding of how telepharmacy can make healthcare more efficient and accessible while also highlighting some of the challenges that still need to be solved. It is exciting to think about how this field could grow and how pharmacists like me could help make it better in the future.

**Personal Insights:**

Initially, I thought of telepharmacy as simply a practical way to make pharmacy services more efficient, but as I explored the topic, I realized how many layers there are to this field. The scientific method provided a framework for systematically evaluating telepharmacy's effectiveness, showing me, how evidence-based research drives the integration of new technologies in healthcare. Gathering and analyzing data taught me the importance of asking the right questions, being thorough, and carefully interpreting findings. It was eye-opening to see how even a well-intentioned innovation can have unexpected consequences if not thoroughly researched.

For example, learning about the experiences of patients, pharmacists, and healthcare providers added a human element to the research that I did not fully consider before. Hearing about challenges like accessibility barriers or concerns about patient privacy made me realize how much thought needs to go into implementing telepharmacy effectively. These real-world impacts reinforced the importance of carefully considering every factor when designing and implementing healthcare innovations. The scientific method taught me to value not just the results of a study, but also the process of getting there, from forming hypotheses to evaluating results in a way that accounts for context and variability.

This experience has also shaped my perspective on the role of future research in addressing unresolved questions within telepharmacy. For instance, the issue of protecting patient data stood out to me as a critical challenge. As telepharmacy relies heavily on digital systems, ensuring data security and privacy must be a priority. Future research should explore how to strengthen encryption technologies and authentication methods to protect sensitive health information. Additionally, there is a clear need for standardized regulations to create consistency in telepharmacy practices across different regions. Without these safeguards, telepharmacy could unintentionally introduce risks that undermine its benefits.

Another area where I see a need for more research is in understanding patient engagement and digital literacy. While telepharmacy can improve access to care, not all patients are equally equipped to benefit from these services. For instance, older patients or those in underserved communities may struggle with the technology required to participate in telepharmacy. Research should focus on how to design user-friendly platforms and provide education that empowers

patients to take advantage of telepharmacy services. This is a main consideration for quality systems being implemented.

Additionally, I was struck by the potential for artificial intelligence and advanced decision support systems to enhance telepharmacy. These tools could help pharmacists make more accurate and personalized recommendations, especially for patients with chronic conditions. However, I also learned that over-reliance on automation can create problems, such as overwhelming pharmacists with unnecessary alerts. Future research should aim to refine these systems, making them more targeted and intuitive. For example, developing algorithms that account for patient history, comorbidities, and other unique factors could help create more precise recommendations without adding unnecessary complexity.

This research has shown me how vital it is to look beyond immediate gains and consider the long-term implications of new technologies. Telepharmacy has immense potential, but its success depends on addressing key challenges like security, accessibility, and usability. As healthcare continues to evolve, the scientific method will remain an essential tool for ensuring that innovations like telepharmacy are both effective and sustainable. Overall, this experience has deepened my understanding of the mix between technology and healthcare, and it has inspired me to think critically about how my future work can contribute to improving not only my scope but ultimately provide better patient care.

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