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Medication Therapy Management on Clinical Outcomes in Chronic Disease Management: Assessment, Challenges and Future Direction

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Abstract

Medication Therapy Management (MTM) interventions have emerged as a promising approach to optimizing medication use and improving outcomes in chronic disease management. This review paper aims to provide a comprehensive overview of MTM interventions in the management of chronic diseases. The review synthesizes evidence from recent literature on the role of pharmacists in providing MTM services for various chronic conditions, including diabetes, hypertension, cardiovascular diseases, chronic kidney disease, asthma, and chronic obstructive pulmonary disease. Key components of pharmacist-led MTM interventions, such as medication reconciliation, comprehensive medication reviews, patient education and counseling, adherence monitoring, and collaboration with healthcare providers, are discussed. Furthermore, the paper explores the impact of pharmacist-led MTM interventions on clinical outcomes, healthcare utilization, medication adherence, patient satisfaction, and cost-effectiveness. It examines the effectiveness of different MTM models, such as face-to-face consultations, telehealth services, and interdisciplinary team-based approaches, in diverse patient populations and healthcare settings. Challenges and barriers to the implementation of pharmacist-led MTM interventions are also addressed, along with strategies to overcome these obstacles. The paper highlights the importance of pharmacist training, interprofessional collaboration, integration of MTM services into healthcare systems, and policy support in maximizing the benefits of pharmacist-led interventions. Overall, this review underscores the significant role of pharmacists in chronic disease management through MTM interventions and provides insights into future directions for research, practice, and policy to enhance the delivery.

Keywords: Medication Therapy Management, MTM Model, Chronic Disease Management, Clinical Outcomes, Patient care.

1. Introduction

Medication Therapy Management (MTM) represents a critical component of contemporary healthcare delivery, particularly in the realm of chronic disease management (1). Rooted in the principle of optimizing medication use to achieve therapeutic goals and improve patient outcomes, MTM encompasses a range of pharmacist-led interventions tailored to the unique needs of individuals with chronic conditions. This review article aims to provide a comprehensive overview of MTM pharmacist-led interventions in chronic disease management, including its definition, importance, the role of pharmacists, and challenges in the implementation of MTM programs. MTM is a comprehensive approach to healthcare delivery that involves pharmacist-led interventions aimed at optimizing medication use, improving patient outcomes, and enhancing the quality of care (2). MTM encompasses a range of services, including medication reviews, patient education, medication adherence counseling, and collaborative care coordination, all of which are tailored to meet the unique needs of individuals with chronic diseases (3).

MTM interventions are designed to address medication-related problems, such as adverse drug reactions, drug interactions, and medication non-adherence, with the ultimate goal of improving therapeutic outcomes and enhancing patient well-being (4). Chronic diseases, such as diabetes, hypertension, cardiovascular disease, and respiratory disorders, pose significant challenges to both patients and healthcare providers. These conditions often require long-term medication therapy to manage symptoms, prevent complications, and improve quality of life. However, suboptimal medication use, including medication non-adherence, inappropriate prescribing, and medication-related adverse events, can compromise treatment efficacy and exacerbate disease progression (5) (6). MTM plays a crucial role in addressing these challenges by providing personalized medication management services tailored to the unique needs of patients with chronic diseases. By optimizing medication therapy, promoting medication adherence, and identifying and resolving medication-related problems, MTM pharmacist-led interventions help to improve clinical outcomes, enhance patient satisfaction, and reduce healthcare costs associated with chronic disease management (7). Pharmacists play a central role in MTM pharmacist-led interventions, leveraging their expertise in pharmacotherapy, medication management, and patient care to deliver high-quality services to individuals with chronic diseases (7).

Pharmacists are uniquely positioned to assess medication regimens, identify drug-related problems, and collaborate with other healthcare providers to optimize therapy and improve patient outcomes. Through comprehensive medication reviews, patient counseling sessions, and medication adherence monitoring, pharmacists empower patients to take an active role in managing their health and adhering to prescribed treatment regimens. Moreover, pharmacists serve as valuable members of the healthcare team, providing interdisciplinary collaboration and coordination of care to ensure continuity and effectiveness of treatment for patients with chronic diseases (8). MTM pharmacist-led interventions offer a myriad of benefits for patients, healthcare providers, and the healthcare system as a whole. Improved Medication Adherence is a cornerstone benefit, with MTM interventions shown to enhance adherence rates among patients with chronic diseases, leading to better therapeutic outcomes and reduced healthcare utilization (9). Moreover, these interventions contribute to Enhanced Clinical Outcomes by optimizing medication therapy and addressing medication-related problems, resulting in improved control of conditions such as blood pressure, glycemia, and lipid levels (10).

Patient Empowerment is another significant advantage, as MTM interventions empower patients to actively participate in managing their health and medication regimens, fostering confidence, self-efficacy, and engagement in their care (9). Additionally, MTM pharmacist-led interventions have been associated with Cost Savings, stemming from reductions in hospitalizations, emergency department visits, and medication-related adverse events, thus contributing to overall healthcare cost containment (9). Despite these benefits, several challenges hinder the widespread adoption and implementation of MTM pharmacist-led interventions. Reimbursement Issues pose a significant barrier, with inconsistencies in reimbursement mechanisms creating financial challenges for service delivery. Workforce Shortages exacerbate these challenges, as a growing shortage of pharmacists trained in MTM and medication management limits the availability and accessibility of these services, particularly in underserved areas (11). Limited Interoperability between electronic health record systems and pharmacy dispensing systems complicates care coordination, hindering the seamless exchange of patient information among healthcare providers (12). Additionally, Patient Engagement remains a challenge, especially among populations

with low health literacy or cultural barriers to medication adherence and self-management, underscoring the need for tailored approaches to patient education and support (13).

Looking toward the future, several emerging trends and opportunities hold promise for advancing MTM pharmacist-led interventions in chronic disease management. Telepharmacy and Telehealth technologies offer innovative solutions, allowing pharmacists to deliver MTM services remotely, reaching underserved populations, and expanding access to care (14) (15). The shift towards Value-Based Care Models provides incentives for healthcare organizations and payers to invest in MTM pharmacist-led interventions, emphasizing quality and outcomes over volume (American Pharmacists Association, 2017) (16). Collaborative Care Models, such as accountable care organizations (ACOs) and patient-centered medical homes (PCMHs), promote interdisciplinary collaboration, creating opportunities for pharmacists to integrate MTM services into team-based care settings (17). As we navigate these challenges and opportunities, MTM pharmacist-led interventions remain a cornerstone in the holistic management of chronic diseases, poised to deliver personalized care and improve patient outcomes in the years to come.

2. Evolution of Medication Therapy Management

The evolution of MTM spans several decades and is marked by the convergence of clinical practice, policy initiatives, and advancements in pharmacy care Table 1. Rooted in the recognition of medication-related problems (MRPs) and the imperative to optimize patient outcomes, MTM has emerged as a cornerstone of modern pharmacy practice. The concept of pharmaceutical care, introduced by Hepler and Strand in 1990, laid the groundwork for MTM. Hepler and Strand emphasized the pharmacist's role in ensuring rational medication use, optimizing therapy, and improving patient outcomes through direct patient care activities. This paradigm shift in pharmacy practice underscored the importance of patient-centered care and proactive medication management (18). Throughout the 1990s, research illuminated the prevalence and impact of MRPs, including adverse drug reactions, drug interactions, and medication non-adherence. These findings highlighted the need for systematic approaches to medication management to address these issues and enhance patient safety and therapeutic efficacy.

The inclusion of MTM in the Medicare Modernization Act (MMA) of 2003 marked a significant milestone in the history of pharmacy practice (19). With the establishment of the Medicare Part D prescription drug benefit program, MTM became a mandatory component of Part D plans, aimed at improving medication use and patient outcomes for Medicare beneficiaries with multiple chronic conditions (20). This legislative mandate propelled MTM into the forefront of healthcare delivery, cementing its role as an essential service for optimizing medication therapy. In response to the MMA mandate, various MTM models and frameworks were developed to guide the provision of comprehensive medication management services. These models typically include components such as medication therapy review, personal medication record, medication-related action plan, and appropriate documentation and follow-up (21). Additionally, MTM services offered through coordinated care programs may receive grants through government initiatives to support their implementation (22).

The evolution of MTM has been characterized by ongoing efforts to enhance its effectiveness and integration into healthcare delivery systems. Challenges such as data availability, measuring outcomes, and ensuring sustainable reimbursement models remain areas of focus for researchers, policymakers, and healthcare providers alike. In recent years, advancements in technology have facilitated the delivery of MTM services, enabling pharmacists to engage with patients remotely and leverage electronic health records to streamline medication management processes. Telepharmacy and telehealth platforms have expanded access to MTM services, particularly in underserved and rural communities (23). Moreover, the COVID-19 pandemic has underscored the importance of MTM in ensuring continuity of care and optimizing medication therapy for patients with chronic conditions. Pharmacists have played a vital role in providing MTM services, conducting medication reviews, addressing medication-related concerns, and promoting adherence to therapy amid the challenges posed by the pandemic.

Looking ahead, the future of MTM holds promise for further innovation and collaboration across healthcare sectors. As healthcare delivery continues to evolve, MTM will remain a cornerstone of pharmacy practice, contributing to improved patient outcomes and enhanced quality of care (24). The history of MTM is a testament to the evolution of pharmacy practice and the enduring commitment to optimizing medication therapy for patients. From its conceptualization in the early 1990s to its integration into legislative and policy frameworks, MTM has emerged as a vital component of modern healthcare delivery (25). Moving forward, ongoing efforts to enhance

MTM effectiveness and accessibility will ensure its continued relevance in improving patient outcomes and advancing pharmacy practice.

Table 1: Overview of the evolution of MTM, including key events and developments across different decades, along with challenges and advancements.

Decade	Key Events and Developments
1990s	• Introduction of pharmaceutical care concept by Hepler and Strand • Emphasis on the pharmacist's role in optimizing therapy and improving patient outcomes
2003	• Inclusion of MTM in the Medicare Modernization Act (MMA), making it mandatory for Part D plans. • Aimed at enhancing medication use and patient outcomes for those with multiple chronic conditions.
Post-2003	• Development of various MTM models and frameworks. • Components include medication therapy review, personal medication record, and action plan. • Challenges in data availability, outcome measurement, and reimbursement models. • Advances in technology enabling telepharmacy and telehealth platforms. • Expansion of MTM services, especially in underserved areas
Covid 19	• highlighted the crucial role of MTM in ensuring continuity of care amid the pandemic

3. Pharmacist-Led Mtm Interventions

3.1 Telephonic MTM Model

The pharmacist-led telephonic MTM model represents an innovative approach to enhancing patient care and medication management, particularly in underserved or rural areas where access to healthcare services may be limited. In this model, pharmacists provide MTM services to patients remotely through telephone consultations, offering medication reviews, counseling, education, and recommendations to optimize medication therapy and improve health outcomes. The telephonic MTM model addresses several critical needs in healthcare delivery (26). Firstly, it extends the reach of pharmacy services to patients who may face barriers to accessing traditional in-person care, such as those residing in rural or remote areas with limited healthcare infrastructure. By leveraging telecommunications technology, pharmacists can connect with patients regardless of geographical location, thereby improving access to vital medication management services. Secondly, telephonic MTM facilitates proactive and continuous monitoring of patient's medication regimens, enabling pharmacists to identify and address medication-related issues in real-time (27). This proactive approach can help prevent adverse drug events, improve medication adherence, and optimize therapeutic outcomes for patients with chronic conditions, such as diabetes, hypertension, or cardiovascular diseases.

Despite its potential benefits, the telephonic MTM model faces several challenges that need to be addressed for successful implementation and sustainability. One of the primary challenges is ensuring effective communication and collaboration between pharmacists, patients, and other members of the healthcare team. Telephonic

consultations may lack the visual cues and non-verbal communication present in face-to-face interactions, making it essential to develop strategies for clear and concise communication (28). Another challenge is the potential for technological barriers, such as poor internet connectivity or limited access to telecommunication devices, especially in rural or underserved areas (29). To overcome this challenge, alternative communication methods, such as landline phones or text messaging, may need to be employed to ensure continuity of care. Additionally, maintaining patient privacy and data security is paramount in telephonic MTM, as sensitive health information is transmitted over telecommunications networks. Pharmacists must adhere to strict confidentiality protocols and ensure compliance with healthcare regulations, such as the Health Insurance Portability and Accountability Act (HIPAA), to safeguard patient privacy and confidentiality (29). Reimbursement and financial sustainability also pose significant challenges for telephonic MTM services.

Pharmacists may encounter reimbursement barriers from third-party payers or government healthcare programs, limiting the financial viability of providing MTM services remotely. Advocacy efforts are needed to advocate for fair reimbursement policies and incentivize pharmacists' involvement in telephonic MTM. Despite these challenges, the telephonic MTM model offers a wide range of applications and uses in healthcare delivery. Apart from chronic disease management, telephonic MTM can be utilized for medication reconciliation during transitions of care, post-discharge follow-up, medication adherence monitoring, and adverse drug reaction surveillance (30). Moreover, telephonic MTM can be integrated into existing healthcare delivery models, such as ACOs, PCMHs, or collaborative care teams, to enhance care coordination and continuity across the continuum of care. By leveraging technology-enabled communication platforms, pharmacists can collaborate with primary care providers, specialists, and other healthcare professionals to deliver comprehensive and patient-centered care.

3.2 App-based MTM model

The pharmacist-led app-based MTM paradigm is a new approach to delivering pharmacy services and enhancing medication management for patients (31). In this paradigm, pharmacists use mobile apps or digital platforms to perform MTM services remotely, such as medication reviews, counseling, education, and suggestions to improve medication adherence and clinical outcomes (32). The app-based MTM approach solves several essential healthcare delivery demands, particularly those related to increased digitization and patient engagement. First, it improves accessibility and convenience by allowing patients to obtain MTM services at any time and from any location, eliminating the need for in-person visits to a pharmacy or healthcare facility. This accessibility is especially useful for patients with mobility difficulties, hectic schedules, or who live in distant or neglected locations. App-based MTM allows pharmacists to adjust their services to each patient's specific requirements and preferences, resulting in more personalized and patient-centered care. Pharmacists can engage with patients in meaningful ways using interactive features like as encrypted messaging, video consultations, and medication reminders, empowering them to take an active role in their medication management, and addressing specific concerns or queries in real-time. The app-based MTM paradigm raises several issues that must be addressed before it can be implemented and used successfully.

One of the most significant difficulties is ensuring fair access to digital technology and bridging the digital divide among patient populations. Patients without smartphones, tablets, or stable internet connectivity may encounter difficulties in engaging in app-based MTM services, resulting in gaps in healthcare access and outcomes. Another problem is guaranteeing data privacy and security in app-based MTM systems, which send and store sensitive health information electronically. To protect patient confidentiality and reduce the risk of data breaches or unauthorized access, pharmacists must follow stringent data protection regulations such as the HIPAA in the United States and the General Data Protection Regulation (GDPR) in the European Union. Additionally, pharmacists may have issues with patient involvement and uptake of app-based MTM solutions. Some patients may be hesitant to use digital health technologies because of privacy concerns, usability issues, or a lack of technological knowledge. To ensure the app's favorable reception and utilization, pharmacists must devote time and resources to patient education and training. Also, interoperability and connection with existing healthcare systems and electronic health records (EHRs) present substantial obstacles for app-based MTM services. Care coordination, continuity, and collaboration rely on seamless data interchange and communication between the MTM platform and the systems of other healthcare providers.

Pharmacists must collaborate closely with healthcare institutions, software developers, and regulatory agencies to ensure app-based MTM platforms are compatible and interoperable with current infrastructure and standards. Despite these obstacles, the app-based MTM paradigm has a diverse set of applications and uses in healthcare delivery. In addition to medication management, app-based MTM can be used for drug reconciliation, adherence monitoring, health education, and remote patient monitoring for chronic illnesses including diabetes, hypertension, or asthma. Several app-based MTM systems and projects have arisen in recent years, showcasing the power of digital technology to alter pharmacy practice and improve patient care. For example, the MyTherapy app includes medication reminders, adherence tracking, and health journal tools to assist patients in better manage their prescriptions and health conditions. Pharmacists can interact with the MyTherapy platform to give patients with tailored medication counseling and support from a distance. Another example is the Medisafe app, which enables patients to establish tailored medication schedules, receive reminders, and monitor their adherence in real-time.

The Medisafe platform allows pharmacists to track patients' medication adherence, detect adherence impediments, and intervene proactively to resolve medication-related difficulties or concerns. In addition to commercial apps, healthcare organizations, and drugstore chains have created their own app-based MTM platforms for providing pharmaceutical services and engaging with patients. For example, Walgreens provides the Walgreens Connect for Wellbeing app, which allows patients to renew prescriptions, access medication information, and communicate with pharmacists for medication counseling and support (33).

3.3 Video-based MTM

The video-based MTM strategy, guided by pharmacists, is a cross between traditional face-to-face consultations and telephone conversations. Using video and audio technology, this model allows pharmacists to perform MTM services remotely, connecting with patients via computers, smartphones, or other connected devices. The American Pharmacists Association (APhA) defines telehealth as a method that uses electronic information and telecommunications technology to provide long-distance clinical treatment, patient education, and health-related activities (34). Telehealth technologies include video conferencing, mobile communication, store-and-forward imaging, and remote patient monitoring. Telepharmacy, as defined by the Model State Pharmacy Act and the National Association of Boards of Pharmacy Model Rules, is the use of telecommunications technologies to provide pharmacist treatment to patients in the United States. Pharmacists provide patient care activities that attempt to achieve illness management, symptom relief, or disease prevention outcomes, either by administering drugs or equipment. Telepharmacy services include MTM, chronic illness management (CCM), care transitions, pharmacogenomics, remote dispensing, and ambulatory care.

Companies like SinfoníaRx use proprietary technologies, such as RxCompanion™, to provide MTM services through video-based consultations and other methods (35). SinfoníaRx collaborates with the University of Arizona and clinical practitioners to remotely identify, triage, and address medication-related issues through video conferencing (36). The University of Arizona conducted research that established the feasibility and usefulness of using video conferencing in clinical pharmacy services, particularly for specialized illnesses such as epilepsy. During the trial, epileptic patients had their first comprehensive medication reviews (CMRs) via telehealth consultations, with high-risk patients receiving additional follow-up calls. Video-based MTM provides various benefits, including the convenience of remote consultations and the visual inspection capabilities of in-person engagements (37). Patients can participate from the comfort of their own homes, overcoming obstacles such as mobility challenges or travel restrictions. Pharmacists can visually verify prescription and OTC drug containers, which improves medication safety and accuracy. Furthermore, video-based consultations allow for real-time contact and involvement, increasing patient engagement and empowerment in controlling their pharmaceutical regimens. Despite these advantages, video-based MTM poses several obstacles, including protecting patient privacy and data security, overcoming technological barriers or limits, and providing fair access to telehealth services. Furthermore, regulatory and reimbursement constraints must be addressed to facilitate the wider adoption and integration of video-based MTM into pharmacy practice (38).

3.4 In-person MTM model

Direct, one-on-one conversations between pharmacists and patients in a clinical context comprise in-person MTM (39). To maximize drug therapy, pharmacists work with healthcare providers to conduct thorough medication reviews, evaluate medication adherence, educate patients, and provide patient education. This model prioritizes patient-centred treatment with an emphasis on each patient's unique requirements, preferences, and objectives (40). The in-person MTM strategy has numerous important advantages for managing chronic illnesses (41). First of all, it helps pharmacists build the kind of relationship and trust that patients need for medication management to be successful. Pharmacists are qualified to do in-depth assessments of medications, spot possible drug-related issues, and customize interventions to meet the needs of individual patients. In-person consultations enable focused instruction and counseling by enabling real-time assessment of patient understanding, medication-taking behavior, and adherence hurdles (42). Additionally, pharmacists can work in tandem with other medical professionals, such as nurses, doctors, and specialists, to coordinate and optimize better outcomes.

The application of the in-person MTM model to a variety of chronic conditions is demonstrated in several cases. Pharmacists regularly visit with patients to discuss lifestyle changes, medication adherence, and blood glucose monitoring in the context of diabetes management (43). They offer instructions on how to administer insulin, control food, and avoid hypoglycemia. Pharmacists evaluate medication adherence, track cholesterol, and blood pressure, and provide lifestyle counseling to lower cardiovascular risk factors in the context of cardiovascular disease. Additionally, pharmacists are essential in managing chronic kidney illness, monitoring renal function, minimizing drug-related problems, and optimizing medication dose (44). The in-person MTM model has significant drawbacks despite its advantages. First of all, it could need a lot of resources, including staff time and specialized knowledge for one-on-one consultations.

This might restrict accessibility and scalability, especially in rural or underprivileged areas. Furthermore, patients who struggle with transportation, time constraints, or mobility may not always be able to attend in-person sessions (45). Furthermore, patient participation and involvement in the process may be critical to the efficacy of in-person MTM. Finally, legal obstacles and payment structures may make it more difficult for in-person MTM services to be widely implemented, which would reduce their availability and sustainability. Figure 1 depicts the overview of Pharmacist led MTM interventions.

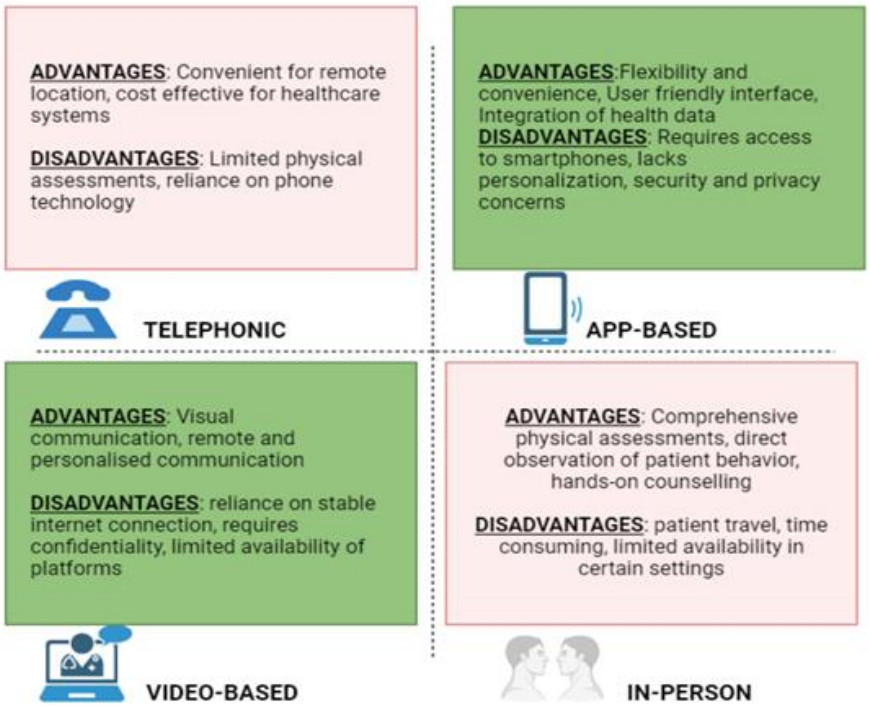

Figure 1: A comprehensive overview of four distinct MTM models: telephonic, app-based, video-based and in-person consultations, with a depiction of their advantages and disadvantages of their respective features and considerations for implementation.

4. Impact On Clinical Outcomes

In the late 1990s, two employers in Asheville, North Carolina initiated a pioneering project to support employees with diabetes (46). Specially trained pharmacists provide personalized care, education, and motivation to help employees manage their condition effectively. The program, known as the Asheville model, involved regular visits to community pharmacists, employer payment for pharmaceutical care services, and waived co-pays on diabetes medications and supplies. Pharmacists offered a range of tailored services, including goal setting, monitoring, adherence strategies, and education on diabetes management. Sonday, Bheekie, and Van Huyssteen aimed to assess the implementation of a pharmacist-led MTM intervention for stable patients with type 2 diabetes mellitus (DM) attending a diabetes club at a community day center in Cape Town, South Africa (47). Conducted over 8 months, the study employed a case study approach, combining retrospective and prospective audits of patient folders. A total of 104 patient folders were audited, predominantly representing female patients. Analysis revealed 453 MTPs, with common issues including undocumented body mass index, lack of medical indications, and unrequested laboratory tests.

The study found low prescriber acceptance of pharmacist recommendations (26.8%), indicating clinical inertia. Additionally, irrational prescribing of aspirin to patients with DM was identified (15.4%). The results underscored the pharmacist's role in identifying and addressing MTPs and optimizing medication therapy for patients with DM. However, there is a need for greater prescriber uptake of pharmacist recommendations to mitigate medication-related issues among stable DM patients in public sector healthcare facilities. Further advocacy efforts and pharmacist-led workshops are recommended to promote rational prescribing practices and enhance patient care outcomes. Clinical and financial outcomes were impressive, with reductions in HbA1c values and lipid levels, increased proportions of patients achieving optimal A1c values, and fewer emergency department visits. Employers also experienced significant cost savings and improved productivity among program participants, resulting in a favorable return on investment. Some pharmacists have embraced the use of remote disease management technology as part of their practice, facilitating patient engagement by allowing them to upload their blood glucose meter readings via the Internet on a weekly basis or during pharmacy visits.

This innovative approach enables pharmacists to bridge the gap between physician appointments and monitor patients' blood glucose levels continuously. Moreover, it empowers pharmacists to offer timely interventions and support, such as medication adjustments or lifestyle recommendations, based on real-time data. A study conducted by Huang et al. set out to systematically examine the medication management functionalities within diabetes self-management apps and assess their congruence with evidence-based criteria (48). Conducted by searching the Google Play and Apple app stores using diabetes-related terms in English, the researchers identified 3369 potentially relevant Android apps and 1799 iOS apps. Upon screening, 143 apps (81 Android and 62 iOS) were deemed eligible for inclusion and subsequently downloaded and evaluated. The findings revealed that a significant portion of the evaluated apps lacked robust medication management features conducive to enhancing medication adherence and safety.

While over half (58.0%) of the apps incorporated a medication reminder feature, other critical functionalities were less prevalent. For instance, only 16.8% of the apps included a feature to review medication adherence, and a mere 39.9% allowed users to input medication-taking instructions. Additionally, a small fraction of the apps provided informational resources about medications (5.6%) or displayed motivational messages aimed at encouraging medication adherence (4.2%). Interestingly, only two apps were found to prompt users regarding the use of complementary medicine, suggesting a significant gap in this area. During the assessment process, several issues were identified, including limited capacity for medication logging, malfunctioning reminder features, ambiguous medication adherence assessment methods, and visually distracting advertisements within the apps. These shortcomings underscore the importance of enhancing the design and functionality of medication management features in diabetes self-management apps to align more closely with evidence-based best practices.

In addition to leveraging remote monitoring technology, pharmacists have been proactive in offering educational programs to patients with diabetes (49). Collaborating with clinical dietitians, these programs are often conducted in food store pharmacies, where patients are educated on making informed food choices and understanding the impact of diet on their diabetes management. Furthermore, these sessions provide valuable insights into reading food labels, identifying healthier options, and navigating potential drug interactions that may affect blood glucose

levels. A study aimed to assess the knowledge and involvement of community pharmacists in providing counseling and health education services for patients with DM, as well as identify barriers hindering the delivery of such services (50). Conducted in six cities of Amhara regional state, Ethiopia, the study utilized a self-administered questionnaire administered to 412 pharmacists working in community pharmacies from January to March 2017.

Results indicated that community pharmacists exhibited poor knowledge and low involvement in patient counseling and health education, with significant gaps observed in areas such as promoting smoking cessation and counseling on foot care techniques. However, pharmacists were more frequently engaged in tasks like advising on the administration of antidiabetic medications and insulin handling. Lack of knowledge or clinical skills, limited access to additional training programs, and resource constraints were identified as the main barriers to providing these services. The findings underscore the need for interventions to enhance pharmacist education and training, address resource limitations, and integrate community pharmacies into public health programs to optimize their role in diabetes management.

With their specialized expertise in pharmacotherapy, pharmacists play a pivotal role in optimizing medication regimens for patients with CVD, thereby contributing significantly to improved health outcomes and enhanced quality of life. Central to pharmacist-led MTM in CVD management is the thorough assessment of medication appropriateness. Pharmacists possess a deep understanding of cardiovascular medications, including their mechanisms of action, indications, contraindications, and potential adverse effects (51). This expertise allows pharmacists to critically evaluate medication regimens, identify potential drug-drug interactions, and recommend appropriate adjustments to optimize therapy.

Moreover, pharmacists play a key role in promoting medication adherence among patients with CVD (52). Non-adherence to medication regimens is a common challenge in managing chronic conditions like hypertension, heart failure, and dyslipidemia, leading to poor disease control and increased risk of adverse outcomes (53). Through patient education and counseling, pharmacists empower individuals with CVD to better understand their conditions, medications, and treatment goals, fostering a sense of empowerment and accountability in managing their health. In addition to optimizing medication use, pharmacist-led MTM programs offer comprehensive monitoring and follow-up services for patients with CVD. Pharmacists regularly assess patients' clinical parameters, such as blood pressure, lipid levels, and heart function, to monitor disease progression and treatment efficacy (54). By tracking patients' progress over time, pharmacists can identify early signs of medication non-response or adverse effects and collaborate with healthcare providers to make timely therapeutic adjustments. In a randomized, controlled, longitudinal, prospective clinical trial, researchers evaluated a structured pharmaceutical care program for elderly patients (>65 yrs) with congestive heart failure (CHF) (55). Group A (42 patients) received education from pharmacists on disease management, lifestyle changes, and medication adherence, with dosage adjustments if needed. Group B (41 patients) received standard care. Various outcome measures including exercise capacity, blood pressure, quality of life, compliance with therapy, and healthcare facility utilization were assessed over 12 months. Patients in Group A showed improved compliance, exercise capacity, and knowledge of drug therapy compared to Group B. They also had fewer hospital admissions. Despite the small sample size, these findings suggest the benefit of structured pharmaceutical care for elderly CHF patients, warranting further research across multiple sites for additional evidence.

Furthermore, pharmacist-led MTM programs facilitate interdisciplinary collaboration and care coordination for patients with CVD (56). Pharmacists work closely with physicians, nurses, and other healthcare professionals to ensure seamless transitions of care, facilitate medication reconciliation, and address medication-related issues. This collaborative approach helps optimize patient care, minimize medication errors, and enhance overall treatment outcomes. In this study, researchers aimed to assess the impact of integrating a clinical pharmacist into the management of heart failure patients with left ventricular dysfunction (57). A total of 181 patients were randomized into intervention and control groups. The intervention group received clinical pharmacist evaluation, medication assessment, therapeutic recommendations, patient education, and follow-up telemonitoring, while the control group received usual care. Over a median follow-up of 6 months, the intervention group experienced significantly lower rates of all-cause mortality and heart failure events compared to the control group. Additionally, patients in the intervention group received higher doses of angiotensin-converting enzyme inhibitors

and had increased utilization of other vasodilators, potentially contributing to the observed improved outcomes. These findings suggest that incorporating a clinical pharmacist into the multidisciplinary heart failure team can lead to better patient outcomes, possibly due to optimized medication management and closer follow-up Figure 2.

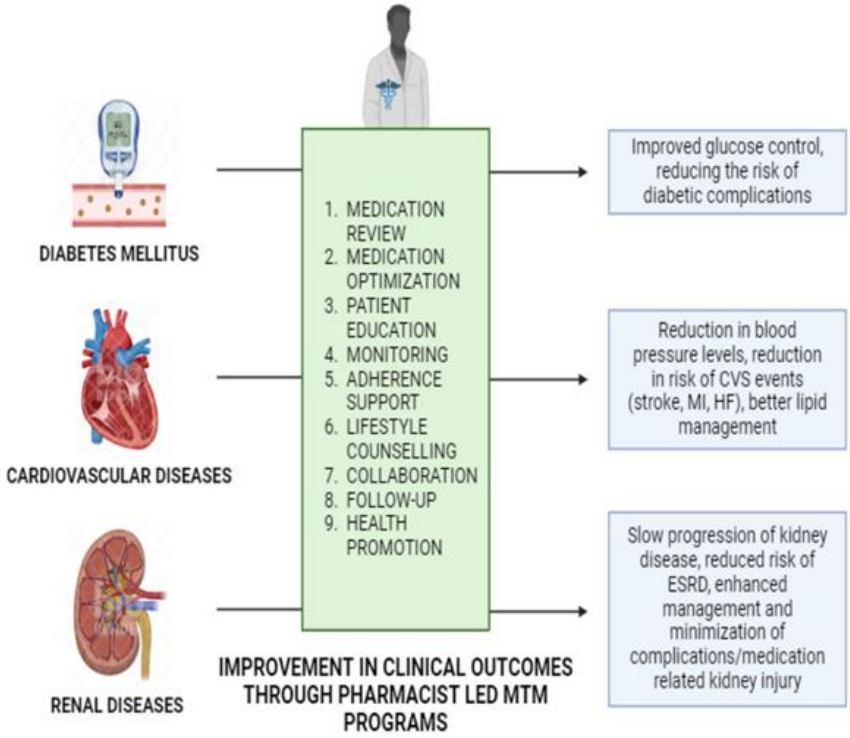

Figure 2: Clinical outcomes in pharmacist-led MTM programs for patients with type 2 diabetes mellitus, renal diseases and cardiovascular disease, suggest significant improvement in several key areas, highlighting it's value in improvement of health outcomes.

Pharmacist-led MTM programs also contribute to cost-effective healthcare delivery in the management of CVD. By optimizing medication use, promoting adherence, and preventing complications, pharmacists help reduce healthcare utilization and associated costs, such as hospitalizations and emergency department visits. Moreover, pharmacist interventions aimed at streamlining medication regimens and maximizing therapeutic benefits can lead to significant cost savings for patients and healthcare systems alike. A study aimed to evaluate the impact of MTM services on economic and clinical outcomes for patients with cardiovascular disease (CVD) (58). They analyzed data from a university-sponsored insurance plan, comparing patients who received MTM services with those who didn't. Economic outcomes were measured by pharmacy, medical, and total expenditures, while clinical outcomes included blood pressure (BP) and body mass index (BMI). Results showed that patients receiving MTM had lower expenditures compared to non-MTM patients, with a positive Return on Investment (ROI). Although clinical outcomes didn't show significant differences, more MTM patients achieved treatment goals and improved disease stages for hypertension and BMI. This suggests that MTM services can be beneficial for both economic and clinical aspects of CVD management.

Patients with kidney diseases, especially chronic kidney disease (CKD) and end-stage renal disease (ESRD), often require complex medication regimens to manage their condition and associated comorbidities (59). Pharmacists, with their specialized knowledge in pharmacotherapy, can review these regimens comprehensively. They assess the appropriateness of each medication, considering factors like renal function, drug interactions, and potential adverse effects specific to kidney diseases. The study aimed to investigate the impact of pharmacist-led Geriatric Medication Management Service (MMS) on medication use quality in older adults with CKD, considering the likelihood of inappropriate polypharmacy due to comorbidities (60). Conducted at an ambulatory care clinic in a tertiary-care teaching hospital, the retrospective descriptive study included 95 patients receiving geriatric MMS from May to December 2019. With an average age of 74.9 years and 40% having CKD Stage 4 or 5, medication

use quality was assessed in 87 patients. Following the MMS provision, both the total number of medications and potentially inappropriate medications (PIMs) significantly decreased from 13.5 to 10.9 and 1.6 to 1.0, respectively ($p < 0.001$). Additionally, the use of central nervous system-active drugs and strong anticholinergic drugs decreased. Among 354 identified drug-related problems, "missing patient documentation" was most common, followed by "adverse effect" and "drug not indicated," with the most frequent intervention being "therapy stopped." In conclusion, polypharmacy and PIMs were prevalent in older adults with CKD, but pharmacist-led geriatric MMS effectively improved medication use quality in this population.

The purpose of this study was to evaluate the effects of counseling by pharmacists on the knowledge, attitudes, and practices of dialysis patients regarding CKD (61). In a prospective pre-post study, sixty-four individuals with chronic kidney disease were enrolled. A questionnaire was used to examine the baseline knowledge, attitude, and practice. The case group received pharmacist counseling and educational pamphlets, while the control group did not receive any of these. Both groups underwent another evaluation following a one-month intervention. The case group's knowledge, attitude, and practice ratings significantly improved after counseling, as seen by the results ($p < 0.05$). This shows that improving CKD patients' comprehension and treatment of their condition can be achieved by counseling from pharmacists.

Al-Abdelmuhsin et al. aimed to evaluate patient satisfaction with counseling services provided by pharmacists among hemodialysis patients, with secondary objectives including assessing the impact of years of dialysis and comorbidities on satisfaction levels (62). Data from 138 patients were collected from the records of King Abdulaziz Medical City over four months. Most patients were aged between 51 and 75 years, had been on dialysis for 1 to 5 years, and had comorbidities. Overall, 77.5% of patients reported excellent satisfaction with pharmacy services, while 38.4% felt pharmacists provided clear medication information. Interestingly, 55.8% were unaware of how hemodialysis could affect medication efficacy. The study suggests that while patients generally expressed satisfaction with pharmacist counseling, there's a need for educational programs to increase awareness among both patients and hospital pharmacists, ultimately improving medication knowledge and patient care.

Kidney diseases alter drug pharmacokinetics and dynamics, increasing the risk of medication-related complications (63). Pharmacists play a critical role in preventing adverse drug events by adjusting drug dosages based on renal function, avoiding nephrotoxic medications, and monitoring for drug interactions that may exacerbate kidney damage or impair drug clearance. In patients with CKD, loading doses typically don't require adjustment (64). However, for maintenance dosing, guidelines recommend dose reduction, lengthening the dosing interval, or a combination of both. Dose reduction involves lowering each dose while keeping the dosing interval unchanged, maintaining more consistent drug concentrations but posing a higher risk of toxicities if the dosing interval isn't sufficient for drug elimination (65). Conversely, the extended interval method maintains normal doses but lengthens the dosing interval to allow for adequate drug elimination before redosing (66). While this approach reduces the risk of toxicities, it may increase the likelihood of subtherapeutic drug levels towards the end of the dosing interval. Dosing recommendations for specific drugs can be found in "Drug Prescribing in Renal Failure: Dosing Guidelines for Adults," categorized by three broad glomerular filtration rate (GFR) ranges (67). These guidelines cover a wide range of renal functions but don't directly align with the K/DOQI staging system. Therefore, while they serve as initial dosing guidance, further individualization of regimens based on patient response and serum drug concentrations is necessary. The study aimed to assess the awareness and implementation of Adjustment of Drug Dosage according to Renal Function (ADDR) among pharmacists in Japan, particularly focusing on community pharmacists, and to identify factors influencing ADDR implementation (68). A web-based questionnaire was administered to community and hospital pharmacists, comparing their characteristics, implementation rates of ADDR, experience with adverse drug events, awareness of ADDR, and obstacles to its implementation. Findings revealed that fewer community pharmacists had implemented ADDR compared to hospital pharmacists.

Community pharmacists reported less experience with adverse drug events due to inappropriate dosage, while hospital pharmacists encountered more severe adverse events. Moreover, community pharmacists showed lower awareness of ADDR and identified a lack of patient renal function information as a barrier to implementation. Logistic regression analysis highlighted factors influencing ADDR implementation, including routine prescriptions from nephrologists, experience with adverse events in CKD patients, and awareness of the

importance of pharmacist intervention in checking excreted drug dosages. Notably, the lack of patient renal function information did not emerge as a significant barrier. The study underscores the need for increased awareness among community pharmacists regarding the importance of patient renal function and advocates for training programs to enhance pharmacists' knowledge about adjusting drug dosages in CKD patients to prevent adverse drug events.

Error! Reference source not found.**:** Summarizes a list of a few clinical trials about pharmacist-led MTM in various chronic conditions.

NCT Number	**Study Title**	**Study URL**	**Study Status**	**Conditions**	**Interventions**	**Phases**	**Study Type**
NCT00794560	Self-management of Low Molecular Weight Heparin Therapy	https://clinicaltrials.gov/study/NCT00794560	Completed	Thromboembolism	Behavioral: patient education	Phase4	Interventional
NCT02029040	Nebulized 3% Hypertonic Saline in the Treatment of Acute Bronchiolitis	https://clinicaltrials.gov/study/NCT02029040	COMPLETED	Acute Bronchiolitis	DRUG: 3% Hypertonic Saline|DRUG: 0.9 % normal saline	NA	INTERVENTIONAL
NCT02790463	Virtual Gout Clinic	https://clinicaltrials.gov/study/NCT02790463	COMPLETED	Gout	BEHAVIORAL: Pharmacist-Led Intervention	NA	INTERVENTIONAL
NCT01942135	Palbociclib (PD-0332991) Combined With Fulvestrant In Hormone Receptor+ HER2-Negativ	https://clinicaltrials.gov/study/NCT01942135	COMPLETED	Metastatic Breast Cancer	DRUG: Palbociclib|DRUG: Fulvestrant|DRUG: Placebo|DRUG: Fulvestrant	PHASE3	INTERVENTIONAL

	e Metastatic Breast Cancer After Endocrine Failure (PALOMA-3)						
NCT03247322	mHealth Medication Safety Intervention	https://clinicaltrials.gov/study/NCT03247322	COMPLETED	Medication Compliance	OTHER: Pharmacist-led medication therapy using mHealth application	NA	INTERVENTIONAL
NCT04938648	Aligning Medications With What Matters Most	https://clinicaltrials.gov/study/NCT04938648	COMPLETED	Polypharmacy| Alzheimer's Disease and Related Dementias	BEHAVIORAL: Pharmacist-led deprescribing intervention	NA	INTERVENTIONAL
NCT00781365	Home Blood Pressure Telemonitoring and Case Management to Control Hypertension	https://clinicaltrials.gov/study/NCT00781365	COMPLETED	Hypertension	OTHER: Telemonitors and pharmacy management	NA	INTERVENTIONAL
NCT01030874	Orthostatic Hypotension Treatment in Rehab Unit	https://clinicaltrials.gov/study/NCT01030874	COMPLETED	Orthostatic Hypotension|Falls	OTHER: Medication review|OTHER: Nutrition/Salt intake|OTHER: Education|OTHER: Exercise|OTHER: Drug	NA	INTERVENTIONAL

					Recommendations		
NCT02940860	Iron Isomaltoside/Ferric Derisomaltose vs Iron Sucrose for Treatment of Iron Deficiency Anemia in Non-Dialysis-Dependent Chronic Kidney Disease	https://clinicaltrials.gov/study/NCT02940860	COMPLETED	Iron Deficiency Anaemia|Iron Deficiency Anemia|Chronic Kidney Disease	DRUG: Iron isomaltoside/ferric derisomaltose| DRUG: Iron sucrose	PHASE3	INTERVENTIONAL
NCT03377127	Impact of Pharmacy Clinic on Diabetes Management	https://clinicaltrials.gov/study/NCT03377127	COMPLETED	Diabetes Mellitus, Type 2	BEHAVIORAL: Pharmacy Managed Diabetes Clinic (PMDC)|OTHER: Standard of Care (SOC)	NA	INTERVENTIONAL
NCT02029989	Point-of-Care Testing (POCT) Detection and Management of Metabolic Syndrome in Patients With	https://clinicaltrials.gov/study/NCT02029989	COMPLETED	Hyperlipidemia| Diabetes|Hypertension	DEVICE: Glucose and lipids|DEVICE: Glycosylated Hemoglobin A1c|DEVICE: Blood Pressure and Heart Rate|DEVICE: Body mass index|DEVICE: Waist and Hip	NA	INTERVENTIONAL

	Mental Illness				circumference|BEHAVIORAL: Comprehensive Medication Management		
NCT03889418	Opioid Treatment and Recovery Through a Safe Pain Management Program	https://clinicaltrials.gov/study/NCT03889418	COMPLETED	Depression|Opioid Use|Chronic Pain|Anxiety	BEHAVIORAL: Electronic medical recorded clinical decision support [EMR CDS]|BEHAVIORAL: Stepped opioid collaborative care model [CCM]	NA	INTERVENTIONAL
NCT01750255	Effect of Pharmaceutical Care in Patients With Bipolar I Disorder (BD I)	https://clinicaltrials.gov/study/NCT01750255	COMPLETED	Bipolar Disorder	OTHER: Pharmaceutical Care|OTHER: Education	NA	INTERVENTIONAL
NCT03477838	Pharmacist-driven CGM Use in the Uninsured Population	https://clinicaltrials.gov/study/NCT03477838	COMPLETED	Diabetes Mellitus	DEVICE: FreeStyle LibrePro CGM	NA	INTERVENTIONAL
NCT03202264	Team Approach to Polypharmacy Reduction to Improve Mobility Long-	https://clinicaltrials.gov/study/NCT03202264	TERMINATED	Multi-morbidity|Medication Therapy Management|Polypharmacy	OTHER: TAPER		OBSERVATIONAL

	Term Care						
NCT00574990	Minimizing Harm From ADEs by Improving Nurse-Physician Communication	https://clinicaltrials.gov/study/NCT00574990	COMPLETED	Interdisciplinary Communication| Management, Medication Therapy			OBSERVATIONAL
NCT01504672	An Intervention Study to Reduce Drug-related Problems and Readmissions Among Old People With Dementia	https://clinicaltrials.gov/study/NCT01504672	COMPLETED	Cognitive Impairment	OTHER: Medication review	NA	INTERVENTIONAL
NCT01390272	Titrated Disease Management for Patients With Hypertension	https://clinicaltrials.gov/study/NCT01390272	COMPLETED	Hypertension	BEHAVIORAL: Booster/ low resource|BEHAVIORAL: Booster/ low resource|BEHAVIORAL: Medium/Level 1 resource intensity|BEHAVIORAL: High/Level 2 resource intensity	NA	INTERVENTIONAL

NCT02668432	Use of Amiodarone in Atrial Fibrillation Associated With Severe Sepsis or Septic Shock	https://clinicaltrials.gov/study/NCT02668432	TERMINATED	New Onset Atrial Fibrillation|Severe Sepsis|Septic Shock	DRUG: Amiodarone	PHASE4	INTERVENTIONAL
NCT04652453	Feasibility, Acceptability, and Barriers to Implementation of a Geriatrics Bundle in the ICU	https://clinicaltrials.gov/study/NCT04652453	COMPLETED	Intensive Care Unit Syndrome	OTHER: Geriatrics Bundle	NA	INTERVENTIONAL
NCT03174353	A Phase II Trial of Lanreotide for the Prevention of Postoperative Pancreatic Fistula	https://clinicaltrials.gov/study/NCT03174353	COMPLETED	Pancreatic Leak|Pancreatic Fistula|Pancreaticoduodenal; Fistula|Pancreatectomy; Hyperglycemia	DRUG: Lanreotide Prefilled Syringe	PHASE2	INTERVENTIONAL
NCT01602016	A Folinic Acid Intervention for Autism Spectrum	https://clinicaltrials.gov/study/NCT01602016	TERMINATED	Autism Spectrum Disorder|Autistic Disorder|Autism|Asperger's Syndrome|Pervasive	DRUG: Folinic Acid and placebo|DRUG: Folinic Acid	PHASE2	INTERVENTIONAL

	Disorders			Development Disorders			
NCT01143896	Hepatitis C Translating Initiatives for Depression Into Effective Solutions	https://clinicaltrials.gov/study/NCT01143896	COMPLETED	Hepatitis C|Depression	OTHER: Depression collaborative care model	NA	INTERVENTIONAL
NCT02867741	Can Group Visits Improve Outcomes of Veterans With Diabetes	https://clinicaltrials.gov/study/NCT00286741	COMPLETED	Diabetes|Hypertension	OTHER: Diabetes Group Management Visits	PHASE3	INTERVENTIONAL
NCT02849639	The INCREASE Study - Delaying the Onset of Alzheimer's Symptomatic Expression	https://clinicaltrials.gov/study/NCT02849639	COMPLETED	Alzheimer's Disease|Dementia	OTHER: Placebo|OTHER: Medication Therapy Management (MTM)|DRUG: Scopolamine patch	EARLY_PHASE1	INTERVENTIONAL
NCT02940886	Iron Isomaltoside/Ferric Derisomaltose vs Iron Sucrose for the Treatment of Iron Deficie	https://clinicaltrials.gov/study/NCT02940886	COMPLETED	Iron Deficiency Anaemia|Iron Deficiency Anemia	DRUG: Iron isomaltoside/ferric derisomaltose|DRUG: Iron sucrose	PHASE3	INTERVENTIONAL

	ncy Anemia (IDA)						
NCT01134900	Achieving Medication Safety During Acute Kidney Injury	https://clinicaltrials.gov/study/NCT01134900	COMPLETED	Kidney Failure, Acute	OTHER: Pharmacy Dashboard Review and Intervention	NA	INTERVENTIONAL
NCT02213458	Care Ecosystem: Navigating Patients and Families Through Stages of Care	https://clinicaltrials.gov/study/NCT02213458	COMPLETED	Dementia|Alzheimer Disease|Dementia, Vascular|Lewy Body Disease|Frontotemporal Lobar Degeneration|Memory Disorders	BEHAVIORAL: Navigated Care	NA	INTERVENTIONAL
NCT02694185	Secondary Event Prevention Using Population Risk Management After PCI and for Anti-Rheumatic Medications	https://clinicaltrials.gov/study/NCT02694185	ACTIVE_NOT_RECRUITING	Myocardial Ischemia|Rheumatic Diseases	OTHER: Caplan IVR	NA	INTERVENTIONAL
NCT02191111	A Cluster-randomized Controlled Knowledge Translat	https://clinicaltrials.gov/study/NCT02191111	COMPLETED	Chronic Diseases	BEHAVIORAL: Task-focused facilitation	NA	INTERVENTIONAL

	ion Feasibility Study in Alberta Community Pharmacies						
NCT02995733	Patient-Empowered Strategy to Reduce Asthma Morbidity in Highly Impacted Populations; PeRson EmPowered Asthma Relief	https://clinicaltrials.gov/study/NCT02995733	COMPLETED	Asthma	DRUG: PARTICS using QVAR	PHASE 4	INTERVENTIONAL
NCT01817777	An Open Study to Evaluate Whether Pack Size Affects Compliance of Metformin Treatment in Subjects With Type II Diabetes	https://clinicaltrials.gov/study/NCT01817777	TERMINATED	Diabetes Mellitus, Type 2	DRUG: Metformin Small Pack|DRUG: Metformin Large Pack	PHASE 4	INTERVENTIONAL

NCT00760552	Trial of Low and High-Intensity Strategies to Maintain BP Control	https://clinicaltrials.gov/study/NCT00760552	COMPLETED	Hypertension	OTHER: High-Intensity Intervention|OTHER: Low-Intensity Intervention|OTHER: All- 6-month pharmacist intervention	NA	INTERVENTIONAL
NCT00304915	HIV Translating Initiatives for Depression Into Effective Solutions	https://clinicaltrials.gov/study/NCT00304915	COMPLETED	HIV, Depression	BEHAVIORAL: Collaborative Care Interventions	NA	INTERVENTIONAL
NCT00821678	Telemedicine Outreach for Post Traumatic Stress in CBOCs	https://clinicaltrials.gov/study/NCT00821678	COMPLETED	Posttraumatic Stress Disorder	OTHER: Telemedicine Outreach for PTSD	PHASE4	INTERVENTIONAL
NCT03248947	Buprenorphine Physician-Pharmacist Collaboration in the Management of Patients With Opioid Use Disorder: CTN 0075	https://clinicaltrials.gov/study/NCT03248947	COMPLETED	Opioid Use Disorder	DRUG: buprenorphine/naloxone|OTHER: Pharmacist-administered buprenorphine/naloxone maintenance care	EARLY_PHASE1	INTERVENTIONAL

NCT01175707	Study Comparing Cubicin With Vancomycin in Treatment of Participants With Complicated Skin and Skin Structure Infections in a Home Infusion Setting	https://clinicaltrials.gov/study/NCT01175707	TERMINATED	Complicated Skin or Skin Structure Infection	DRUG: Daptomycin|DRUG: Vancomycin	PHASE 4	INTERVENTIONAL

5. Barriers and Challenges

5.1 Challenges in implementing pharmacist-led MTM programs

Pharmacist-led interventions have significant challenges in their widespread implementation due to the limited reimbursement for MTM services. For example, the expenses of thorough drug evaluations and patient counseling sessions may not be sufficiently covered by Medicare Part D reimbursement for MTM services (69). The limited reimbursement rates provided by private insurance plans might not be sufficient to cover the time and expertise needed for MTM sessions (70). Healthcare systems may occasionally experience financial difficulties that restrict the amount of money they can set aside for MTM services. This difficulty has practical ramifications since it could discourage pharmacists from providing MTM services entirely or compel them to reduce the number and range of treatments. For example, pharmacists may shorten consultation times or prioritize certain patient populations over others to optimize workflow and financial viability (71). Consequently, underserved populations, such as those in rural or low-income communities, may face even greater barriers to accessing MTM services, exacerbating existing healthcare disparities (72). Addressing this challenge necessitates advocacy for fair reimbursement policies, innovative payment models, and increased awareness of the value of pharmacist-led MTM interventions.

A major obstacle to the successful application of pharmacist-led MTM interventions in the management of chronic illnesses is the absence of interprofessional collaboration. Pharmacists often operate independently from other members of the healthcare team, such as doctors, nurses, and other allied health professionals, and have little opportunity for communication or teamwork (73). Because pharmacists might not have complete patient information at their disposal or might not be completely included in the processes of care planning and decision-making, this disjointed approach to patient care may not produce the best results. For example, without direct collaboration with physicians, pharmacists may encounter difficulties in obtaining pertinent patient medical histories, reconciling medication lists, and identifying potential drug therapy problems (74). Likewise, nurses may overlook pharmacists' recommendations or fail to communicate important patient-related information, leading to gaps in care continuity. Such challenges impede the delivery of holistic and patient-centered care and hinder the

potential benefits of pharmacist-led MTM interventions in optimizing medication therapy and improving health outcomes for patients with chronic diseases. Addressing this barrier requires fostering a culture of collaboration and teamwork within healthcare organizations, implementing interdisciplinary care models, and promoting effective communication channels among healthcare providers. Additionally, establishing formalized protocols and workflows for interprofessional collaboration and leveraging technology-enabled platforms for sharing patient information can facilitate the seamless integration of pharmacists into the broader healthcare team, ultimately enhancing the delivery of MTM services and improving patient care (75).

Pharmacist training and resource constraints pose substantial obstacles to the implementation and execution of comprehensive MTM services (76). Pharmacists must undergo specialized training to successfully review prescription regimens, identify drug-related issues, and interact with patients and healthcare professionals to improve therapeutic outcomes. However, limited chances for specialized training in MTM and pharmacotherapy may impede pharmacists' capacity to provide high-quality MTM treatments. Furthermore, resource constraints such as insufficient staffing, time constraints, and a lack of access to appropriate equipment and technologies impede pharmacists' ability to conduct MTM interventions successfully. In community pharmacy settings with high prescription volumes and limited staffing, pharmacists may struggle to dedicate sufficient time to conduct thorough medication reviews and patient consultations (77). Similarly, in underserved areas or healthcare systems with limited financial resources, pharmacists may lack access to essential resources, such as electronic health records or clinical decision support tools, which are critical for conducting comprehensive medication reviews and implementing evidence-based interventions (78). Addressing these challenges requires investment in pharmacist education and training programs, as well as allocation of resources to support pharmacists in delivering MTM services effectively, thereby enhancing patient outcomes and promoting optimal medication use.

Patient-related factors, such as low health literacy and socioeconomic disparities, present formidable challenges in the implementation of pharmacist-led MTM interventions (79). Patients with limited health literacy may struggle to comprehend medication instructions, adhere to complex treatment regimens, or effectively communicate their health concerns to pharmacists, impeding the delivery of tailored MTM services. Additionally, socioeconomic disparities, including disparities in income, education, and access to healthcare resources, can exacerbate medication-related issues among vulnerable populations. For example, individuals facing financial constraints may prioritize basic needs over medication expenses, leading to medication non-adherence or inappropriate medication use. Similarly, patients with limited access to transportation or healthcare facilities may encounter barriers to accessing pharmacist-provided MTM services, further exacerbating disparities in healthcare access and outcomes (80). Addressing these patient-related factors requires a multifaceted approach, including patient education initiatives, culturally competent communication strategies, and targeted interventions to improve health literacy and address socioeconomic barriers to medication access and adherence. Additionally, fostering partnerships with community organizations and leveraging technology to deliver remote MTM services can help bridge gaps in care for underserved populations (81).

Access barriers, such as transportation challenges and financial constraints, present formidable hurdles for patients seeking pharmacist-led MTM interventions (82). In rural or underserved areas where healthcare facilities are scarce, patients may face significant challenges in accessing MTM services due to long travel distances and limited transportation options. Moreover, financial constraints can deter patients from seeking MTM consultations, especially if they are uninsured or underinsured and cannot afford out-of-pocket expenses associated with these services. Patients with chronic diseases may prioritize essential expenses such as medications and necessities over MTM consultations, leading to delayed or forgone care. Additionally, co-payments or deductibles required by insurance plans for MTM services may pose financial burdens for patients, further exacerbating access barriers. These challenges disproportionately affect vulnerable populations, including low-income individuals, elderly patients on fixed incomes, and those with limited mobility or resources. As a result, addressing access barriers through innovative solutions, such as telepharmacy services, mobile MTM clinics, and financial assistance programs, is crucial to ensure equitable access to pharmacist-led MTM interventions for all patients, regardless of their socioeconomic status or geographic location.

Inadequate access to EHRs and clinical decision support tools (CDSTs) poses a significant challenge to effective pharmacist-led MTM programs in chronic disease management (83). EHRs play a crucial role in facilitating

comprehensive medication reviews, identifying drug-related problems, and making evidence-based recommendations (84). However, many pharmacists face limitations in accessing patient EHRs due to disparate healthcare systems, incompatible software platforms, and restricted data-sharing protocols. Without seamless access to comprehensive patient health information, pharmacists may struggle to conduct thorough medication reviews, leading to suboptimal MTM interventions and compromised patient outcomes.

Similarly, the lack of robust clinical decision support tools further exacerbates the challenges faced by pharmacists in MTM programs (85). CDSTs provide valuable real-time clinical guidance, drug interaction alerts, and dosing recommendations, helping pharmacists make informed decisions during medication reviews (86). However, inadequate integration of CDSTs into pharmacy workflows, limited functionality, and outdated software systems hinder pharmacists' ability to leverage these tools effectively (87). As a result, pharmacists may miss critical drug-related issues, increase the risk of medication errors, and compromise patient safety in MTM interventions.

Siloed healthcare systems and communication gaps present another formidable challenge to pharmacist-led MTM in chronic disease management (88). Healthcare delivery often involves multiple providers across various settings, including primary care clinics, hospitals, and community pharmacies. However, fragmented communication channels, inconsistent care coordination processes, and lack of interoperability between healthcare systems impede effective collaboration among providers (89). Pharmacists may struggle to access relevant patient information, communicate with other healthcare providers, and coordinate care seamlessly, leading to fragmented and suboptimal MTM services. Language barriers and cultural beliefs significantly impact patient engagement and adherence in MTM programs, particularly in culturally diverse populations. Limited proficiency in the local language, cultural differences, and health literacy challenges can hinder effective communication between pharmacists and patients (90). Moreover, cultural beliefs, traditions, and perceptions about healthcare and medications may influence patients' attitudes, behaviors, and treatment preferences. Pharmacists must navigate these cultural nuances sensitively and effectively to ensure patient-centered care and optimize medication outcomes in diverse patient populations.

Limited opportunities for pharmacist involvement in care planning and decision-making further hinder the integration of MTM into chronic disease management. In many healthcare settings, pharmacists may have limited autonomy, authority, or visibility in care teams, resulting in underutilization of their expertise and skillset (91). Without active engagement in care planning, medication optimization, and collaborative decision-making processes, pharmacists may struggle to influence treatment outcomes and drive meaningful improvements in patient health. Enhancing pharmacist involvement in interprofessional care teams, promoting collaborative practice agreements, and advocating for expanded scope of practice are essential strategies to overcome these barriers and maximize the impact of pharmacist-led MTM in chronic disease management (92) (Figure 3).

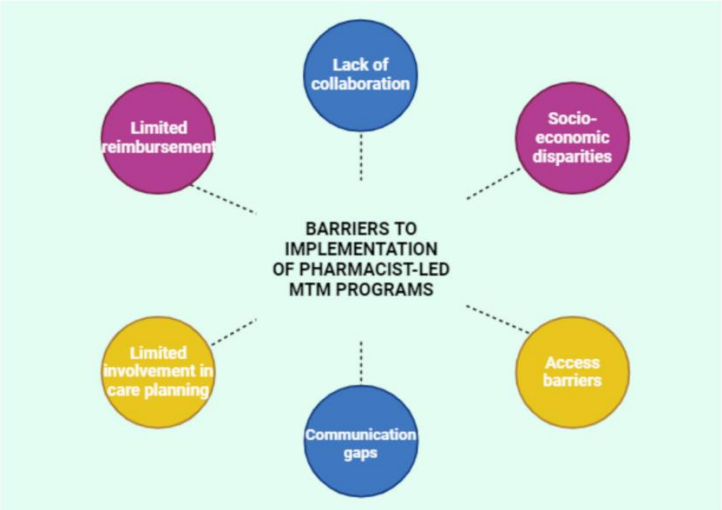

Figure 3: Various barriers hindering the successful implementation of pharmacist-led Medication Therapy Management (MTM) models in chronic disease management.

5.2 Addressing barriers to the successful integration of MTM into clinical practice

Implementing pharmacist-led MTM models within chronic disease management faces multifaceted challenges that extend beyond mere logistical hurdles (93). Foremost among these challenges is the issue of limited reimbursement and financial sustainability. In many healthcare systems, pharmacists encounter barriers due to the absence of recognition as healthcare providers, leading to inadequate reimbursement for their services. This financial shortfall not only undermines the viability of MTM programs but also compromises the quality of care provided to patients. For instance, in regions where reimbursement rates fail to cover the cost of service provision, pharmacists may struggle to allocate sufficient time and resources to patient consultations, diminishing the potential impact of MTM interventions. Wang and colleagues aimed to determine pharmacists' acceptable compensation levels for MTM services, as inadequate compensation has hindered MTM expansion among pharmacists despite its requirement under the Medicare Modernization Act of 2003 for high-risk Medicare beneficiaries (94).

Using a preference-based fractional factorial design of conjoint analysis, 1524 active pharmacists in Tennessee were surveyed. They were presented with various MTM service packages representing combinations of MTM attributes such as patient type, number of chronic conditions and medications, annual drug costs, service duration, and price of MTM services. A survival analysis model was employed to predict pharmacists' willingness to select one MTM service package over another, allowing estimation of their acceptable compensation levels. The results indicated that pharmacists were willing to accept $1.44 per minute or $86.4 per hour for MTM services. Notably, service duration and price of MTM services were significant factors influencing pharmacists' compensation preferences. Pharmacists with more years of practice tended to require higher compensation, while pharmacy ownership and previous MTM experience were associated with varying compensation needs. To encourage greater participation in MTM services, it is imperative to increase pharmacist compensation. Future research could further validate these findings and explore ways to enhance pharmacist engagement in MTM services through appropriate compensation strategies.

Moreover, effective chronic disease management necessitates seamless collaboration among diverse healthcare professionals. However, the realization of such collaboration often encounters roadblocks stemming from communication gaps, hierarchical structures, and professional territorialism. Physicians, for instance, may exhibit reluctance to refer patients to pharmacists for MTM services due to concerns regarding professional autonomy or a lack of familiarity with the scope of pharmacy practice (95). Consequently, the siloed approach to healthcare delivery perpetuates fragmented care and impedes the integration of pharmacists as integral members of the healthcare team (96). The success of pharmacist-led MTM models hinges significantly on patient awareness and engagement. Despite the pivotal role pharmacists play in optimizing medication therapy, many patients remain unaware of the breadth of services they offer beyond medication dispensing. Compounding this issue, individuals grappling with chronic conditions often confront information overload, leading to diminished engagement with MTM services. From the patient's perspective, MTM consultations may be perceived as additional burdens amidst an already complex healthcare regimen. Consequently, the underutilization of MTM services perpetuates missed opportunities for medication optimization and patient education, ultimately compromising therapeutic outcomes.

Addressing these barriers necessitates a multifaceted approach that encompasses policy reform, interprofessional collaboration enhancement, and patient education initiatives. Firstly, advocating for policy changes to recognize pharmacists as providers and secure equitable reimbursement for their services is paramount. By aligning reimbursement rates with the value pharmacists bring to patient care, healthcare systems can incentivize the integration of MTM into routine practice and ensure the financial sustainability of pharmacist-led initiatives. Moreover, fostering a culture of interprofessional collaboration through initiatives such as shared decision-making frameworks and interprovider communication platforms is essential (97). By breaking down professional silos and fostering mutual respect among healthcare professionals, collaborative care models can optimize patient outcomes and leverage the unique expertise of each team member. Additionally, prioritizing patient education and engagement efforts can empower individuals to actively participate in their healthcare journey and leverage MTM services to optimize their medication therapy (98). Utilizing patient-centered communication strategies and leveraging digital health technologies can enhance accessibility and promote patient autonomy in managing their chronic conditions.

Conclusion

To sum it up, pharmacist-led MTM programs have emerged as a valuable strategy in optimizing medication use and improving outcomes in chronic disease management. This review paper has explored various aspects of pharmacist-led MTM, including different models of delivery, clinical outcomes across several chronic diseases, and barriers to implementation. The review examined different models of pharmacist-led MTM delivery, including telephonic, video-based, and face-to-face (FTF) consultations. Telephonic MTM offers accessibility and convenience, allowing pharmacists to reach patients remotely and provide interventions such as medication reconciliation and adherence counseling. Video-based MTM expands on telephonic services by incorporating visual communication, enabling pharmacists to conduct more comprehensive assessments and patient education sessions. FTF consultations provide the most personalized and interactive experience, allowing for in-depth medication reviews, physical assessments, and direct patient engagement. However, each model has its limitations, including potential challenges with technology, patient preferences, and resource allocation. The review examined the clinical outcomes of pharmacist-led MTM in various chronic diseases, including hypertension (HTN), type 2 diabetes mellitus (DM II), cardiovascular diseases (CVD), renal diseases, and others. Clinical trials have consistently demonstrated the effectiveness of pharmacist-led MTM in improving medication adherence, reducing blood pressure, glycated hemoglobin levels, and cardiovascular risk factors, and preventing adverse drug events in patients with HTN, DM II, and CVD. Additionally, pharmacist-led interventions have shown promise in optimizing medication dosing, monitoring renal function, and preventing drug-related complications in patients with renal diseases.

Despite the positive outcomes observed in clinical trials, the review also highlighted several barriers and challenges in implementing pharmacist-led MTM. These barriers include limited reimbursement for MTM services, lack of interprofessional collaboration, insufficient pharmacist training and resources, and patient-related factors such as health literacy and socioeconomic status. To address these barriers, stakeholders must advocate for policy changes to expand reimbursement for pharmacist-led MTM services, promote interdisciplinary teamwork, enhance pharmacist education and training in MTM, and implement innovative strategies to engage patients and overcome health disparities. Pharmacist-led MTM programs hold immense potential in improving medication management and health outcomes for patients with chronic diseases. By leveraging different delivery models, optimizing medication regimens, and addressing barriers to implementation, pharmacists can play a crucial role in enhancing patient care and promoting population health. Moving forward, continued research, collaboration, and advocacy efforts will be essential in maximizing the impact of pharmacist-led MTM and ensuring equitable access to high-quality medication management services for all patients.

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Authors Contribution

All authors are involved in manuscript preparation including table, data collection, figures and final proof of manuscript.

Conflict of interest statement

Authors declare they do not have any conflict of interest.

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