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Exploring the Role of Clinical Pharmacists, Nursing and Technician in Optimizing Pharmacotherapy for Geriatric Patients in Ambulatory Care Settings

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Abstract

Optimizing pharmacotherapy for geriatric patients in the ambulatory care setting is paramount. Geriatric patients' multi-morbidity, poly-pharmacy, and medication exposure increase the risk of adverse drug events and other medication-related problems. Optimized pharmacotherapy in geriatric patients can improve compliance, minimize adverse drug reactions, etc. Clinical pharmacists, nurses and technician are critical in optimizing pharmacotherapy in the ambulatory care setting. They review a geriatric patient's medication comprehensively. Still, they also educate the patients on the medications and work with other healthcare providers to design a treatment plan as per the requirements of a patient. Overall, the barriers to optimized pharmacotherapy for geriatric patients in ambulatory settings consist of the lack of access to healthcare services, communication between healthcare providers, and the absence of geriatrics-specific education for pharmacists. To address these challenges, future directions could encompass the creation of pharmacist-led programs in workplace settings, integration with home-based pharmacists in primary care teams, and the use of technology in electric health records (EHRs) and data management to decrease medication errors and enhance adherence among geriatric adults. Optimizing pharmacotherapy for geriatrics is vital for improving overall health outcomes and reducing healthcare costs, with clinical pharmacists, nurses and technician being at the forefront of these efforts.

Keywords: Geriatric patients, Ambulatory care, Pharmacist, Nurses, Technician, Optimal pharmacotherapy

1.1. Drug Information Services: Disease Management: Medication history and reconciliation MTM Collaborative Drug Therapy Management (CDTM):

2. Introduction

With an increase in the world's population, the number of aged people is also increasing. Thus, healthcare systems worldwide will encounter the challenge of managing chronic diseases and multiple medications in elderly individuals (1, 2). Owing to such challenges there is a need for optimization of care provided to older adults and to increase the formation of effective inter-professional healthcare teams (3). Medicines management encompasses the entire process of selecting, acquiring, delivering, prescribing, administering, and reviewing

medications to achieve desired patient outcomes (4). To enhance medicine management, it is essential to prioritize patient-centered care through effective collaboration among healthcare professionals and the active involvement of patients in decisions regarding the medications (5). Pharmacists and pharmacy technicians play crucial roles in patient care, particularly within a collaborative healthcare framework. One of the fundamental components in the care of geriatric patients is the prescription of medicines(6). There has been evidences suggesting that the use of medicine in the above-mentioned population is inappropriate (7, 8). This may be a result of many factors such as complexities of prescribing and patient and health system factors. The pharmacokinetic parameters are also altered in geriatric patients. This perhaps can lead to unwanted deleterious effects which include Adverse Drug Events (ADEs), an increase in the utilization of healthcare services and cost (9).

The increased complexity of caring for elderly individuals has led to a heightened need for primary care services. This coupled with challenges in recruiting and retaining staff in the primary care workforce, especially general practitioners (GPs) and practice nurses, has placed significant strain on general practice(10). Pharmacists have higher knowledge and expertise about medicines they have been increasingly participating in primary care delivery models such as patient-centred medical homes (11). These models emphasize team-based care that is patient-centered, comprehensive, coordinated, and easily accessible, with a strong emphasis on ensuring quality and safety. Various methods for improving medication use in older individuals have been identified and assessed. These include educational methods, medication assessments, computerized decision support systems, collaborative team efforts, geriatric evaluation and management teams, and the involvement of pharmacists (12). Pharmacists have taken leading roles or actively participated in many of these strategies. Pharmacists have the flexibility to engage with practices in various capacities, such as integrating a clinical pharmacist into their practice or establishing a cooperative partnership with a local retail pharmacist (13). Additionally, clinical pharmacists can provide valuable support to practice. They frequently take on roles in disease management, particularly for chronic conditions commonly treated with medications (14, 15). Examples include addressing cardiovascular disease risk factor, hypertension, dyslipidemia, diabetes, heart failure, chronic obstructive pulmonary diseases (COPD), and insomnia. Pharmacists play a role in chronic disease management by measuring the impact on medication adherence, disease control using clinical end-points, health service utilization (eg. Hospital admission, Emergency department visits, etc.), and health care related costs (16). Additionally, several methods for improving medication use in older individuals have been identified and assessed. These methods encompass educational strategies, medication assessments, computerized decision support systems, collaborative team efforts, geriatric evaluation and management teams, and interventions led by pharmacists (17, 18). Pharmacists have taken leading roles or actively participated in many of these strategies.

Older adults, often burdened with multiple chronic conditions and polypharmacy, are the prime candidates for pharmacist intervention. Polypharmacy involving concurrent use of multiple medications poses significant risks including potentially inappropriate medications (PIMs), anticholinergic burden, and drug-drug interactions (19, 20). Studies globally highlight the prevalence of polypharmacy and inappropriate prescribing among the elderly leading to adverse outcomes such as hospitalization, increased healthcare utilization, and patient harm like falls and fractures (21). These findings underscore the urgent need for pharmacist-led intervention to optimize medication use in this vulnerable population. This may in turn benefit both the patients as well as healthcare systems. Patient-centered medical home or ambulatory care is how medical services are provided in an outpatient setting. The present article focuses on the involvement and importance of a clinical pharmacist in the care and safety of geriatric patients in ambulatory settings.

2.1. Significance of optimized pharmacotherapy in geriatrics

The most common medical intervention performed is prescribing medicines (22). Thus, to practice effective and safe medicine, pharmacotherapy needs to go beyond prescribing (23). It requires the inclusion of drug development and manufacturing, proper testing in clinical trials, rational and safe prescribing, reliable and safe administration and use including drug effectiveness/efficacy monitoring and age-appropriate patient outcome evaluation. Treating older individuals with pharmacotherapy presents complexities compared to younger adults due to age-induced altercations in both pharmacokinetics and pharmacodynamics, alongside the complex nature of medical conditions compounded by declining physiological function (24). The utilization of multiple medications, while offering substantial therapeutic advantages, concurrently heightens the potential for adverse

drug reactions (25). The optimization of drug therapy among the elderly poses a formidable challenge to clinicians, primarily due to scarcity or limited applicability of clinical data pertinent to this demographic, compounded by the absence of age-tailored protocol and contentious issues surrounding the assessment of benefits vs risks (26).

2.2. Purpose and scope:

This review aims to investigate how clinical pharmacists contribute to improving drug therapy for elderly patients in outpatient care. It will examine the unique requirements and difficulties geriatric patients encounter with their medications. The article will discuss the interventions and methods clinical pharmacists use to improve the safety and effectiveness of medications in this group. Additionally, it will explore how pharmacist-led initiatives influence patient results, healthcare usage, and cost-effectiveness.

This review will concentrate on the distinct healthcare requirements of elderly patients receiving outpatient care, particularly focusing on how clinical pharmacists optimize drug therapy. It will analyze the medication management challenges faced by this demographic, including issues like polypharmacy, age-related physiological changes, and the presence of multiple medical conditions. The review will delve into the various interventions and services offered by clinical pharmacists, such as medication reconciliation, medication therapy management, and educating patients. Furthermore, it will explore the effects of pharmacist-led initiatives on medication adherence, adverse drug events, and the overall quality of life among elderly patients. The overarching goal of this review is to underscore the significance of clinical pharmacists in enhancing medication outcomes and the standard of care for elderly patients in ambulatory care environments.

3. Demographic trends and healthcare implications:

The geriatric population comprises individuals with age 65 and older (27). This specific population faces a multitude of chronic diseases which reflects the complex association between the aging process and underlying physiological changes (28). A study by Jaspinder Kaur et al. stated that hypertension (HTN) is accounted as the most common statistically significant cause for non-communicable diseases which led to morbidity in the geriatric population(29). It affects approximately 60.84% of geriatric individuals and presents a significant cardiovascular risk which is exacerbated by age-related vascular altercations(29). Furthermore, aging leads to changes such as being overweight and obese, increased sedentary lifestyle, increased food intake, or reduced food metabolism which increase the chances of the elderly being more prone to developing HTN (30). Thus, there is a need for diligent monitoring and management to mitigate potential complications such as stroke and heart attack (31).

Following HTN, the second most common cause of health issues among elderly individuals due to chronic non-communicable disease is musculoskeletal disorders (32). This accounts for approximately 37.69% of cases and it was found that its prevalence is higher in elderly women (41.18%) than in elderly men (35.09%). Such disorders can lead to various disabilities such as improper biomechanics, reduced mobility, and a decline in skeletal and muscular conditioning (33). These factors perhaps contribute to a decrease in functional capacity as well as the ability to adapt to physiological, physical, and psychosocial stressors.

The third-most common cause of chronic non-communicable disease morbidity as per the study by Jaspinder Kaur et. al. was anemia (35.18%)(34). Again, its prevalence was higher in women (47.06%) as compared to men (26.32%). This gender-specific prevalence is contradicted in other studies. Aging-related anemia arises from a drop in the bone-marrow-to-fat cell ratio as well as a decrease in the marrow's erythropoietin stimulation response. Thus, it is incorrect to assume that this kind of anemia is brought on by dietary deficits or is a normal aspect of aging. Dyslipidemia, more specifically hyperlipidemia (34.18%) was the fourth most common cause for the same. Jaspinder Kaur et al. found that its prevalence was higher in men (35.09%) than women (32.95%). However, in contrast to this, another study by Yamwong et. al noticed significantly higher BMI, TC, and LDL levels in women than in men (34).

The fifth common causes prevalent in the geriatric population is insomnia (32.17%), where such sleep disturbances may a result secondary to or co-morbid with medical and psychiatric illness (35). Other causes that cause lowered Quality of Life (QOL) in geriatric patients include obesity, hyperglycemia, hyperuricemia, depression, and dementia (36). In later stage of life, overweight or obese people frequently develop a range of chronic diseases and disabilities such as diabetes, heart disease, high blood pressure, metabolic syndrome,

difficulty with everyday tasks, and lower self-reported QOL rating (37). As a result, the burden of disease increases with age. Figure 1. Shows the prevalence of chronic diseases in the elderly population.

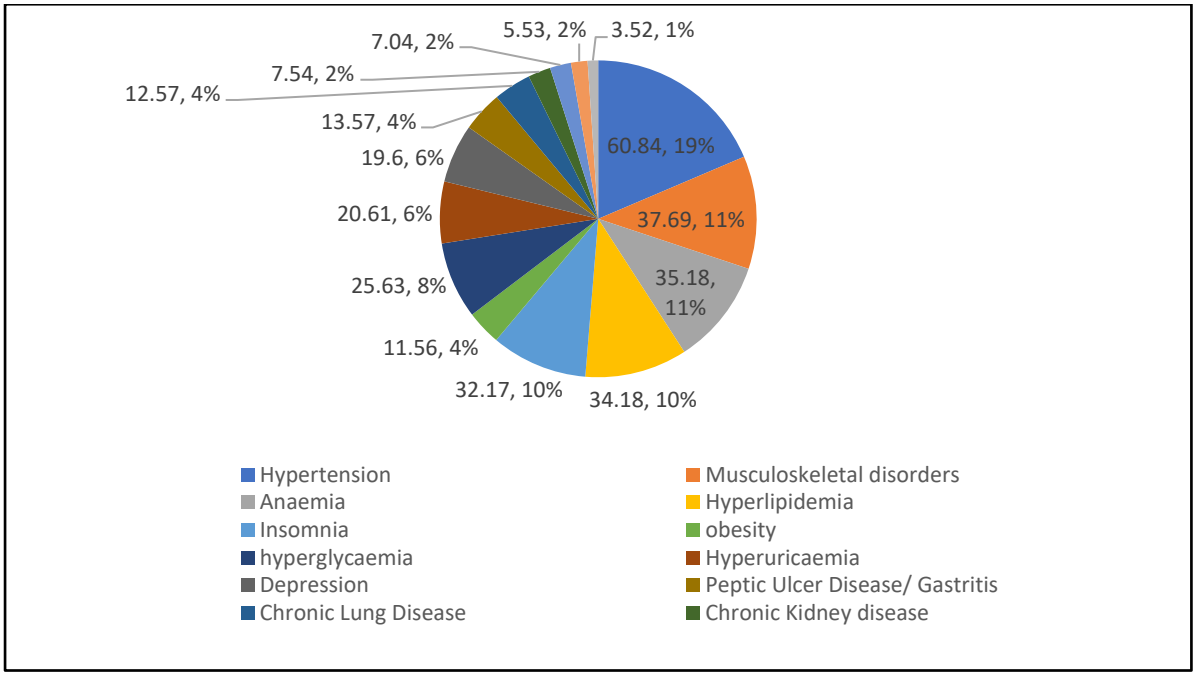

Figure 1: Prevalence of chronic diseases in geriatric population (Actual percentage, relative percentage)

The aging population has special consequences for healthcare that call for specialized methods to meet the complex requirements of elderly people(38). As people age, they frequently face an increased frequency of chronic illnesses, functional impairments, and complicated medical presentations, which calls for all-encompassing and coordinated care (39). Elderly individuals frequently exhibit several comorbidities, necessitating interdisciplinary cooperation between medical professionals to maximize treatment and reduce the risk of negative consequences (40). Furthermore, age-related physiological changes emphasize the need for individualized treatment planning and close monitoring to guarantee therapeutic efficacy and reduce adverse medication reactions (41). These changes include diminished organ function and changed drug metabolism. Furthermore, social isolation, caregiver stress, and cognitive impairment are among the social and cognitive obstacles that older patients commonly face (42). These issues can have a substantial impact on the experiences and results of their treatment. In this situation, ambulatory care is essential for addressing the various healthcare requirements of elderly people since it offers easily accessible, patient-focused services that support early diagnosis of health problems, preventive interventions, and continuity of care (43).

3.1. Specific needs of geriatric populations:

Physiological changes brought on by aging may affect one's general health and quality of life (44). Elderly people frequently have complex care demands that call for an all-encompassing and individualized strategy. It is essential to comprehend the unique healthcare requirements of senior citizens to deliver efficient and considerate treatment (45). The purpose of this study is to examine the special healthcare requirements of older adults and to suggest methods for addressing those needs.

Preventive Care: Keeping older persons healthy and happy depends on preventative care (46). Immunizations are essential for preventing infectious diseases. Examples of these are pneumococcal and influenza vaccinations for early detection and treatment, routine health screenings are essential for diseases including cancer, diabetes, and hypertension (47). Exercise regimens and home safety evaluations are two examples of fall prevention tactics that assist minimize the risk of falls and related injuries common in older adults (48).

Mental health support: Depression and anxiety are prevalent mental health issues among the elderly population, raising serious concerns (49). Regular screening for these disorders should be done by healthcare professionals,

who should also offer suitable therapies such as medication management and counseling. Promoting general well-being and quality of life in older individuals requires addressing mental health issues (50). Participating in worthwhile hobbies and receiving social support can also help to preserve mental health.

Social Determinants of Health: Several social factors, such as housing, social support, and healthcare access, have a big influence on older individuals' health outcomes (51, 52). When a patient needs support services or community resources, healthcare providers should evaluate these criteria and make the necessary connections (53, 54). Assuring older patients' well-being also requires including family members and caregivers in the caregiving process (55). Improving senior populations' health and quality of life can be achieved through addressing socioeconomic determinants of health (51).

4. Pharmacists, nurses and technician role and intervention in ambulatory care settings:

Geriatric ambulatory care facilities provide a variety of outpatient services to meet the healthcare needs of senior citizens while promoting their overall health and well-being (56). These environments include community health centers, outpatient clinics, and specialty geriatric clinics (57). Healthcare professionals concentrate on managing chronic diseases, addressing age-related health conditions, and providing preventative treatment in these settings (58). In-depth geriatric evaluations are frequently carried out to examine the physical, cognitive, and functional condition of older adults (59). This enables the creation of individualized care plans. In ambulatory care for the elderly, pharmacists are essential because they offer medication management services such as patient education, pharmaceutical treatment management, and drug reconciliation (60). Furthermore, to address the complicated healthcare needs of elderly patients, interdisciplinary teams made up of doctors, nurses, social workers, and other healthcare professionals work together (61). Ambulatory care pharmacists can work in diverse settings, they apply similar skill sets across various practices (62). The roles of pharmacists, nurses and technician in ambulatory care settings include the following (63):

- Medication history and reconciliation
- Medication therapy management
- Drug information services
- Disease management
- Administration
- Preventive care/ wellness screening
- Direct patient care
- Coordination of care
- Patient adherence
- Patient educations

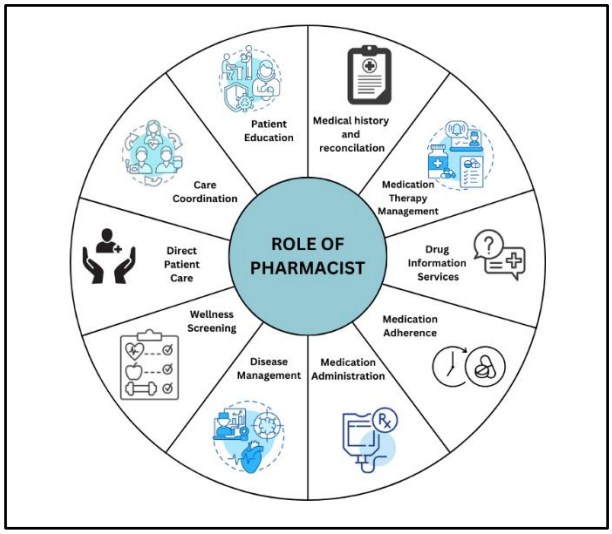

Figure 2: Role of pharmacist in ambulatory care.

4.1. Medication history and reconciliation

Nurses should have a complete medication history—a list of all the medications a patient is currently taking before beginning to manage a new patient (64). Both prescription and over-the-counter drugs, as well as dietary supplements and herbal products, should be included in a patient's medication history (65). It's possible to add injectable medications and vaccines to the list. It's critical to record the patient's drug regimen, including the method, frequency, and timing of administration (66). Furthermore, it is important to document any drug allergies and adverse drug responses (67).

Medication reconciliation, which entails comparing a patient's current prescription regimen with their medical record to discover anomalies and guarantee correct medication lists, is one of the key responsibilities of pharmacists in ambulatory care (68). To minimize the possibility of prescription errors and adverse drug events, pharmacists work in conjunction with other healthcare professionals to settle disagreements and update medication lists (69).

The process of medication reconciliation may begin after the information regarding history has been acquired and documented (70). According to the Joint Commission, medical reconciliation is defined as:

"The process of comparing a patient's medication orders to all of the medications that the patient has been taking. This reconciliation is done to avoid medication errors such as omissions, duplications, dosing errors, or drug interactions. It should be done at every transition of care in which new medications are ordered or existing orders are rewritten. Transitions in care include changes in setting, service, practitioner, or level of care." (71)

A pharmacist searches the patient's medicine list for disparities as part of medication reconciliation (72). Throughout this task, the pharmacist could discover a few potential mistakes: Inappropriate or redundant medication therapy, interactions between drugs and diseases, drug-drug interactions, or inaccurate dosages (73). Pharmacists can assist in resolving these and other mistakes that might have gone overlooked by requesting and carefully reviewing a complete drug history (74).

4.2. Medication Therapy Management:

Medication therapy management (MTM) is a range of activities aimed at helping patients manage their prescriptions and improving their health outcomes (75). This procedure involves technician, pharmacists and other healthcare providers like nurses who provide patient care (76). Many patients may qualify for MTM; yet, the patients who gain the most from MTM services are those who are elderly, those who take several drugs, and those who have complicated or multiple illness states (77). Pharmacists can assist these patients who may find it more challenging to manage their pharmaceutical regimens (78).

MTM services in ambulatory care are patient-specific and generally provided as one-on-one patient meetings through appointments (79). A patient's doctor or healthcare professional may recommend them to an ambulatory pharmacist (63). The services provided for the same may either be face-to-face or over a phone call. However, the former method is preferred by pharmacists as it allows them to visually assess the patient for probable health issues (80). MTM appointment usually consists of three major processes: reviewing pharmaceutical therapy, creating an action plan, and making referrals to other medical professionals (81).

a) Medication therapy review:

To find any issues relating to medicine, pharmacists examine patient data and prescription regimens a thorough medication history will enable the pharmacist to determine whether the patient's issues or side effects are related to their pharmaceutical regimen. The pharmacist may also discuss patient adherence at this time and point out any obstacles that might be keeping patients from taking their prescriptions as prescribed (82). It is the pharmacist's job to determine the cause of medication-related problems because any problems the patient may be having could be caused by improper usage of the meds rather than the drug therapy itself (83).

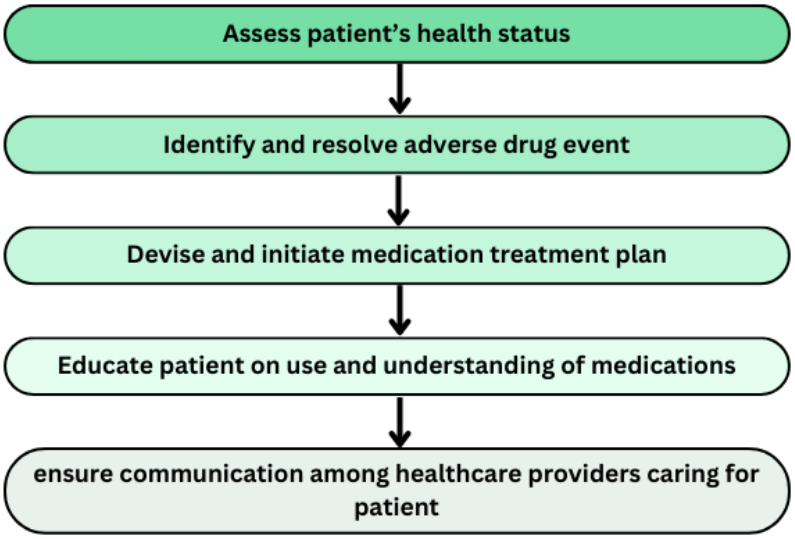

Figure 3: Process of Medication Therapy Management

b) Developing a plan:

The pharmacist works with the patient and healthcare provider to identify drug-related issues and then develops a plan of action to address them (84, 85). This could entail increasing insufficient pharmacological therapy, changing dosages, or stopping ineffective or unpleasant therapy (86). Therapeutically equivalent substitutes may be used in place of discontinued drugs. To treat untreated medical conditions, more drugs may be introduced, and dosage adjustments may be made in accordance with patient requirements. It is crucial to talk about and explain to the patient any changes in medication therapy (87).

c) Referral:

Referrals to other healthcare practitioners are part of the medication therapy management services when felt necessary. If a patient's care requires more than the pharmacist can deliver in the scope of their employment, these providers should be consulted. The patient should be referred to the proper provider in these situations (88).

4.3. Drug Information Services:

To give patients and healthcare professionals reliable information, ambulatory care pharmacists and nurses frequently provide drug information services (63). To make sure the data is accurate, they consult primary literature and drug databases. Patients can better manage their health by learning about their conditions and prescription drugs, and healthcare professionals can provide better patient care by receiving drug information (13).

4.4. Disease Management:

Chronic illnesses are treated with a variety of drugs (89). The responsibility of managing patients' prescription schedules falls on pharmacists, and nurses this has an immediate effect on the treatment of chronic illnesses (14, 90). A common component of this treatment is having patient consultations with pharmacists, which can happen in a variety of locations, including neighborhood pharmacies, doctor's offices, nurses and pharmacist-run disease management clinics (91). Pharmacists independently administer primary care at clinics run by pharmacists while adhering to physician procedures (92). This may include scheduling blood tests, modifying medication schedules, and keeping track of patient's progress (93).

In ambulatory care, the pharmacist may focus on providing services related to a single disease state such as diabetes, or around various multiple conditions associated with high-risk medications like warfarin (94). Pharmacists work in collaboration with other healthcare professionals to obtain better patient outcomes (95).

Collaborative Drug Therapy Management (CDTM):

Collaborative drug therapy management (CDTM) is a structured practice wherein pharmacists collaborate with other healthcare professionals like nurses and technician to optimize patient care (96). Pharmacists are empowered to perform specific patient care functions related to drug therapy, such as adjusting medication doses, monitoring therapeutic outcomes, and ordering laboratory tests, under collaborative practice agreements (CPAs) or protocols (97). These agreements, established between pharmacists and authorized prescribers like physicians, delineate the pharmacist's responsibilities and scope of practice (98).

The utilization of CDTM presents various benefits, such as improved patient access to treatment owing to the availability of pharmacists and prompt drug management services (99). Additionally, it can enhance medication therapy, lower adverse drug events, and increase medication adherence, all of which can lead to better patient outcomes (100). Furthermore, CDTM may lower healthcare costs, improve patient outcomes overall, and raise patient satisfaction. Utilizing pharmacists' knowledge of medicine administration, CDTM is an effective strategy for improving patient care (101).

Table 1: Benefits of CDTM.

Potential problems	**Pharmacist and Nures intervention**
Adverse drug reaction	Pharmacists and Nurses can address side symptoms, spot drug interactions, and pinpoint incorrect dosages or prescriptions.
High healthcare costs	Pharmacists and Nurses can address side symptoms, spot drug interactions, and pinpoint incorrect dosages or prescriptions. Able to recognize inappropriate drugs
Patient non-compliance	Ensuring patient's adherence to medication may help prevent hospital admissions
Limited patient access to healthcare practitioners	Pharmacists may assist in patient care, reducing the burden on physician.

4.5. Administration:

In ambulatory care settings, pharmacists and technician are essential in helping elderly people receive their medications. Through a variety of initiatives, they guarantee the efficient and safe use of pharmaceuticals. Comprehensive medication evaluations are carried out by pharmacists, who take into account several issues such as drug interactions, modifications in dosage for hepatic or renal impairment, and suitability of therapy for the aged population (102).

4.6. Coordination of care:

The transition of care:

Moving a patient from one care environment to another, such as from a hospital to a home or between healthcare institutions, is known as a transition of care (103). Patients must get ongoing care during these changes. All relevant healthcare practitioners must coordinate in order to prevent adverse outcomes, including prescription errors (104, 105). Research has indicated that a notable proportion of patients encounter medication mistakes during shifts, which may have detrimental effects.

To help with care transitions, pharmacists and nurses work closely with other medical professionals. To cut down on errors, they gather and reconcile entire medication histories. To improve adherence, pharmacists also inform patients about their ailments and prescriptions. Following discharge, they offer prompt follow-up to address concerns and assist in managing new diagnoses (106). Medication therapy management (MTM) and counseling services can be combined by pharmacists to lower emergency room visits, readmissions, and hospital admissions. Patients and the healthcare system both gain from their medication-specific strategy, which enhances the value of care transitions (107).

4.7. Patient adherence:

Through a variety of techniques, pharmacists and nurses play a critical role in enhancing drug adherence in ambulatory settings. They educate patients on the value of taking their prescriptions as directed, the advantages of doing so, and the possible consequences of not taking them as directed. Additionally, pharmacists provide advice on how to take medications correctly, including how much to take and how to administer it.

Pharmacists can also check prescriptions to find and fix problems with side effects, complicated regimens, or cost (108). These are some of the obstacles to adherence that need to be addressed. They work together with patients to create individualized adherence strategies that may involve frequent follow-up to assess success and the use of medication adherence tools (such as pill organizers and reminder apps)(109). To guarantee integrated treatment and enhance drug therapy for better adherence and health outcomes, pharmacists also collaborate closely with other healthcare professionals.

5. Case studies highlighting effective interventions:

This article mentions various roles of clinical pharmacists in ambulatory care settings. Thus, is supported by findings from various studies with diverse research methodologies. Through the integration of study data from various approaches, we can present the complex roles and responsibilities that pharmacists play in improving various aspects of healthcare such as medication administration, patient adherence, and interdisciplinary teamwork. The following table-2 lists various studies focusing on the impact of pharmacists in ambulatory care.

Table 2: Studies indicating the impact of pharmacists and nurses on the patient outcome in ambulatory care.

Study conducted by	Type of Study	No. of patients	Objective	Results/outcome	Ref.
Patrick Nguyen et. al	Retrospective quasi-experimental study	227	Impact of a Pharmacist's and nurses presence for the detection of drug-related problems (DRP) in an Interdisciplinary geriatric-ambulatory Clinic	Increased number of DRPs detected in older patients	(110)
Matej Stuhec et. al	retrospective observational multicentric pre-post study	246	Impact of clinical pharmacist and nurses medication reviews on the quality of pharmacotherapy in patients with polypharmacy	Improved quality of psychopharmacotherapy by reducing the total number of medications, PIMs, and pXDDIs.	(111)
Xin Wang et. al	Retrospective cohort study	N/A	impact of pharmacist-led medication therapy management (MTM) performed on ambulatory elderly patients with chronic diseases	Increased number of DRPs detected and solved and improvement in clinical outcomes and cost-saving effect	(112)
Christina DeRemer et. al	Retrospective, single-center	624	Impact of physician pharmacist and nurses collaborative management	Increasing the overall clinic and provider productivity and expanding care access for patients	(113)
Elaine Yung et. al	Retrospective, multi-centric	N/A	To determine the total cost avoidance of pharmacist interventions associated with the prevention or management of ADEs in pediatric ambulatory care clinics To describe and quantify pharmacist interventions related to the prevention and management of	Optimization of healthcare cost savings through the prevention and management of ADEs	(114)

			ADEs in pediatric ambulatory care clinics		
Anan Sadeq Jarab et. al	Randomized controlled trial	171	To assess glycaemic control and medication adherence in T2DM patients in an out-patient pharmacist-led pharmaceutical care program	Reduction in A1c at 6 months along with improved secondary biomarkers.	(115)

Patrick Nguyen et. al conducted a retrospective quasi-experimental study where they compared two groups, one with a pharmacist and one without a pharmacist, to compare the impact of a pharmacist's presence on detection of drug-related problems (DRPs) in an interdisciplinary geriatric-ambulatory clinic. The study involved 227 participants which were ambulatory patients with age 65 years or above. The primary outcome measure of the study was stated to be DRP detected by the interdisciplinary team during the patient evaluation process. The study concluded that the involvement of a pharmacist in an interdisciplinary team in an ambulatory geriatric-care clinic led to an increased number of DRPs detected in older patients (110).

Another study by Matej Stuhec et. al was a retrospective observational multi-centric pre-post study to assess the impact of clinical pharmacist medication reviews on the standard of care for psychogeriatric primary care patients who have an excessive amount of polypharmacy. The study participants were geriatric patients who were treated with one psychotropic and ten or more medications. It included 246 patients receiving 3294 medications. The outcome measures of this study were: the number of medications, potentially inappropriate medications (PIMs), potential drug-drug interactions that should be avoided (pXDDIs), and adherence to treatment guidelines. The study showed that interventions by clinical pharmacists significantly improved psychopharmacotherapy as it reduced the total number of medications, PIMs, and pXDDIs as well as led to better treatment guidelines adherence (111).

Anan Sadeq Jarab et. al conducted a randomized controlled trial on 171 patients to assess the impact of pharmacist-led pharmaceutical care intervention programs on glycemic control in type-2 diabetes mellitus (T2DM) patients and other parameters. 85 patients were randomly assigned to the intervention group and 86 patients were assigned to usual care. The primary outcome measure was glycaemic control (A1c) and secondary outcomes included blood pressure, lipid values, self-reported medication adherence, and self-care activities for patients with T2DM. This study implicated that patients receiving pharmacist-led pharmaceutical care noted a reduction in A1c at 6 months along with improved secondary biomarkers as compared to the group receiving usual care (116).

A systematic review was done by Carmela Bou Malham and her colleagues to have an insight into impact of pharmacist-led intervention on patient care in an ambulatory care setting. They conducted literature search from various sources like MEDLINE, Embase, and Cochrane Library. The impact of the pharmacist-led intervention was categorized into adherence review (AR), clinical medication review (CMR), and prescription review (PR), and this review demonstrated that CMR can be quite helpful in managing drug-related issues as well as financial concerns. AR has a major positive impact on patient compliance. To assist decision-makers in choosing relevant interventions that result in significant improvements in patient care, larger, standardized, and properly planned intervention studies are required (117).

6. Review of outcomes related to medication optimization:

Medication optimization in ambulatory care geriatric patients, facilitated by pharmacists and and nurses, yields several key outcomes. These include:

- Reduction of Medication-related problems (MRPs)
- Improved medication adherence
- Enhanced therapeutic outcomes

- Cost-saving
- Improved disease management
- Enhance patient satisfaction and quality of life
- Prevention of polypharmacy
- Improved functional status of patient

Medication optimization in ambulatory care geriatric patients by pharmacists and and nurses leads to several benefits. Therapeutic results and Medication-related problems (MRPs) are enhanced with the optimization of medication therapy by pharmacists in older patients (118). Pharmacists play a vital role in spotting and fixing drug interactions and adverse events, which in turn improves patient safety (119). Medication reconciliation and review are two known strategies that ensure the path to reach this goal by verifying that the patients are taking the right prescriptions at the right times.

Medication optimization leads to improvement in medication adherence of older patients which is one of the major outcomes. Pharmacists encourage their patients to stick to their prescribed medication regimen by offering helpful tools like pill organizers and reminder systems which results in better treatment outcomes. This, pharmacists, make a substantial contribution to improving patient outcomes by removing adherence hurdles that are associated with patient's non-compliance (16).

Furthermore, drug optimization leads to better disease management and the prevention of disease development in elderly people. By decreasing problems and enhancing general health, pharmacists help in the management of chronic illnesses like hypertension, diabetes, and heart disease. In addition, Patient-specific health, this proactive approach to illness management lessens the strain on the healthcare system by reducing the frequency of expensive complications and hospital stays (120).

Another outcome of drug optimization important in the favour of patients is cost savings. Pharmacists help minimize healthcare expenditures for consumers and healthcare systems by decreasing the number of MRPs and hospitalizations required as a consequence of MRPs. There is also a reduction in the use of healthcare resources and overall healthcare cost when medication optimization is implemented which results in increased effectiveness and economy of the healthcare system. It contributes to enhanced patient satisfaction and a better quality of life. Pharmacists help the patient understand the treatment plan and thus encourage the patient to take an active role in managing their health. This encouragement when combined with improved medication adherence and disease management, leads to a better quality of life for geriatric patients (121).

Additionally, as the number of needless prescription is reduced by medication optimization, it aids in the prevention of polypharmacy. This further reduces the risks related to polypharmacy such as adverse effects and drug interactions by enhancing patient safety and quality of life. Overall, pharmacists' medication optimization for elderly ambulatory care patients leads to better health outcomes, such as lower rates of morbidity and mortality. It enhances senior patients' general quality of life and draws attention to the vital role pharmacists play in maximizing pharmaceutical therapy and enhancing patient outcomes in this susceptible demographic.

6.1. Effect on hospitalization rates, morbidity, and patient satisfaction:

The involvement of pharmacists in an interdisciplinary healthcare system in an ambulatory care setting highlights several key findings regarding hospitalization, morbidity, and patient satisfaction. It was found that pharmacists' consultation was associated with a lower mortality risk which in turn benefits the high-risk population. Broader interventions lead to reduced hospitalization (122). The patient's satisfaction also increases as the patient receives direct care from the pharmacists which improves their understanding of their disease, drugs received by them as well as any drug-related problems (123). Furthermore, patients have easy access to other healthcare professionals as a pharmacist is a part of the interdisciplinary healthcare team. Thus, pharmaceutical care intervention overall reduces the number of hospitalizations due to MRPs as well as reduces morbidity and improves patient satisfaction by improving patient QOL.

7. Barriers to Effective Pharmacotherapy:

A) Polypharmacy

The concurrent use of multiple medications is one of the major barriers to effective pharmacotherapy in geriatric patients. Geriatric patients are highly susceptible to developing multiple chronic conditions. This in turn may lead to multiple medications being prescribed for the management of these conditions. A number of medications increase the risk of drug interactions, ADRs, medication non-adherence and medication errors also increases. Furthermore, the pharmacokinetic and pharmacodynamic age-related changes in geriatric patients make them more susceptible to such risks. Thus, the number of inappropriate medications should be reduced (1).

B) Age-related physiological changes:

Another significant barrier is age-related physiological changes in geriatric patients. Changes in pharmacokinetic parameters such as drug absorption, distribution, metabolism, and excretion and changes in pharmacodynamics leads to altered drug response and thus, increases the risk of ADRs and drug interactions. With the increase in age there is a decrease in renal and hepatic function, alterations in receptor sensitivity, and changes in body composition which affects the safety and efficacy of medications in geriatric patients. Similarly, changes in the nervous system may impact psychoactive medications, whereas changes in gastrointestinal functions may affect the absorption of oral medications (24).

C) Comorbidity burden:

The geriatric population have complex health issues. Therefore, they are required to have multiple medication prescriptions. Thus, comorbidity and polypharmacy are directly associated with each other. Managing such comorbidities while minimizing drug interactions and adverse effects may be a challenge to the existing healthcare system (1).

D) Cognitive impairment:

Cognitive decline in geriatric patients involves conditions like dementia where the patient is unable to understand medication instructions adhere to prescribed regimens or communicate effectively with their healthcare providers. Thus, this presents itself as another major challenge to effective pharmacotherapy. This further can lead to medication errors, suboptimal treatment outcomes, and increased risk of ADEs. Cognitive impairment leads to decreased recognition of side effects of the medicine by the patient. This, leads to under-reporting and potentially delaying necessary interventions. It also leads to non-adherence as patients may have difficulty managing such a complex medication regimen (124).

E) Functional limitation:

Functional limitations in geriatric patients can hinder effective pharmacotherapy, impacting medication handling, attending appointments, and obtaining medications. These limitations can also increase the risk of medication errors, leading to underdosing, overdosing, or missing doses. To address these limitations, healthcare providers should consider the patient's abilities and provide support, such as using easy-to-open packaging, large print instructions, or involving caregivers in medication administration. This approach ensures that geriatric patients receive the full benefits of pharmacotherapy (125).

F) Limited access to healthcare:

Limited access to healthcare is a major obstacle for geriatric patients, preventing them from accessing essential services like medication management and monitoring. Factors such as geographical distance, lack of transportation, financial constraints, and inadequate health insurance coverage can hinder the diagnosis and treatment of medical conditions, leading to delayed diagnosis and poor medication adherence. This can result in suboptimal treatment outcomes and an increased risk of medication-related problems. To address this, healthcare systems should consider telemedicine, mobile health clinics, and home-based services. These strategies can overcome geographical and transportation barriers, allowing geriatric patients to receive necessary services, including medication management. Collaboration with community resources and social services can also help improve access to medications for geriatric patients. Other barriers include financial constraints, health literacy, etc. (126)

7.1. Identification of common barriers in ambulatory settings:

Several barriers can act as a hindrance in effective patient care and pharmacotherapy in ambulatory care. Limited time acts as a significant challenge. This occurs when healthcare providers may not have sufficient time to conduct thorough medication reviews, education, and counseling. Additionally, communication may also be one of the challenges, such as language barrier or health literacy issues can lead to misunderstanding and non-adherence to treatment plans. In an ambulatory system, the patient receives care from an interdisciplinary healthcare team which

involves care from multiple providers, leading to potential gaps in medication management and coordination (127). This may also lead to difficulty in medical reconciliation. Financial limitations are also another significant barrier, since individuals with limited financial sources or insufficient insurance coverage may find it hard to manage the cost of medical services and prescription drugs. Health information technology (HIT) such as system outages, interoperability problems, and confidentiality concerns may also affect drug management. Patient-related barriers include non-adherence to medication regimen, misunderstanding of instructions, and decreased concerns about the side effects of the drug. Addressing these barriers requires improved communication strategies, health literacy efforts, streamlined care coordination, and greater access to resources for patients and healthcare providers (128).

To improve pharmacotherapy in ambulatory care, healthcare providers can implement strategies such as time management, communication improvement, care coordination, financial assistance programs, health information technology optimization, standardized medication reconciliation processes, patient education, and resource allocation. These strategies optimize time, improve communication, reduce errors, and support patient adherence. Financial assistance programs can help patients access medications they might not be able to afford, while health information technology can streamline medication management and coordination. Allocating resources for these strategies can lead to better patient outcomes (129).

8. Advancement and future directions:

In the future, pharmacists will need to play a bigger part in the ambulatory care of older patients. To optimize medication administration and enhance patient outcomes, they ought to be part of interdisciplinary care teams and collaborate closely with physicians, nurses, and other medical specialists. For senior patients, they can offer full medication management, which includes help with adherence, medication review, and reconciliation. Telemedicine services, electronic health records, and prescription management software are examples of technology that can improve pharmacists' ability to offer treatment. For older individuals with restricted access to healthcare institutions, pharmacists can also administer medications and provide remote monitoring. They can also design and carry out evidence-based medication administration protocols and recommendations, advocating for legislative reforms to enhance senior patients' access to and safety from drugs, and taking part in studies to determine optimal medication therapy methods. This expansion of pharmacists' role in geriatric patient care will prioritize collaboration, technology integration, and evidence-based practice (13, 130).

9. Discussion and conclusion:

Healthcare systems face enormous obstacles as the number of senior people worldwide rises, especially when it comes to handling chronic illnesses and the intricacies of taking numerous drugs. Because of this population change, it is imperative that interprofessional healthcare teams be formed and that older adult care be optimized. Reaching the intended patient outcomes depends on effective drug management, which encompasses a number of activities including prescription, administration, delivery, acquisition, and review. Good teamwork among medical providers and patient participation in prescription decision-making are key components of patient-centered care. Pharmacy technicians and pharmacists are essential to patient care, particularly in frameworks of collaborative healthcare. They are useful in primary care delivery models like patient-centered medical homes because of their in-depth understanding of medications. However, complicated prescribing and changed pharmacokinetic parameters in this population might result in improper medication use in older patients, which can lead to adverse drug events and higher healthcare expenses. The elderly have a greater need for primary care services, but general practitioners are facing difficulties in attracting and keeping qualified personnel.

Pharmacists and nurses play a crucial role in optimizing medication use in older individuals, particularly for chronic conditions. They contribute significantly to disease management by reducing medication usage, potentially inappropriate medications, and drug-drug interactions. Pharmacists also facilitate medication use in ambulatory care geriatric patients, reducing medication-related problems, improving adherence, enhancing therapeutic outcomes, and saving costs. They also prevent polypharmacy, improve functional status, and enhance patient satisfaction and quality of life. By ensuring proper prescriptions, pharmacists reduce complications and hospitalizations, lowering healthcare costs and improving overall healthcare system effectiveness.

In conclusion, pharmacists and nurses play a crucial role in optimizing medication use and improving outcomes for geriatric patients in ambulatory settings. Their involvement in interdisciplinary healthcare reduces hospitalization, morbidity, and improves patient satisfaction. Strategies to overcome barriers to effective patient care and pharmacotherapy in ambulatory care include time management, communication improvement, care coordination, financial assistance programs, HIT optimization, standardized medication reconciliation processes, patient education, and resource allocation. Pharmacists will continue to play a crucial role in older patient care, collaborating with medical specialists and physicians to optimize medication administration and patient outcomes.

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Authors Contribution

All authors are contributing and involved in the manuscript writing, it editing for the preparation of preparation of final draft.

Conflict of interest statement

Authors declare they do not have any conflict of interest.

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