Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/8rexvz71

POLYPHARMACY AND MULTIMORBIDITY IN GERIATRICS: A NARRATIVE REVIEW

Dr. Priyanka N[1]*, Ms.Boomika S[2], Ms.Harini S[3], Ms.Goverthini R[4], Ms.Vijayalakshmi C[5]

[1]Assistant Professor, Department of Pharmacology, GRT Institute of Pharmaceutical Education and Research, Tiruttani, India
[2]GRT Institute of Pharmaceutical Education and Research Tiruttani, India
[3]GRT Institute of Pharmaceutical Education and Research Tiruttani, India
[4]GRT Institute of Pharmaceutical Education and Research Tiruttani, India
[5]GRT Institute of Pharmaceutical Education and Research Tiruttani, India

1. INTRODUCTION

1.1. POLYPHARMACY:

Polypharmacy is known to be the frequent use or administration of numerous drugs or an excessive number of drugs at the same time. Depending upon the medical profession, study population, and healthcare system, different definitions of polypharmacy exist. This includes any medication a patient takes, either prescribed, over-the-counter, or complementary and alternative medication rather than prescribed due to several factors that influence compliance in the treatment plan prescribed.

1.2. CATEGORIES:

- Excessive polypharmacy (EPP): concurrent use of ten or more different drugs
- Polypharmacy (PP): the use of five to nine different drugs
- No polypharmacy: taking four or less drugs (including those taking no medicines)

1.2.1. EXCESSIVE POLYPHARMACY:

The term "hyper pharmacy" also refers to excessive polypharmacy, because it raises the risk of adverse drug responses, drug-drug interactions, prescription non-adherence, and hospitalization, it is most commonly mentioned in relation to older adults or people with chronic comorbidities.

1.2.2. POLYPHARMACY:

The use of several medications to manage coexisting medical disorders, particularly in older adults or those with chronic illnesses, is referred to as polypharmacy.

1.2.3. NO POLYPHARMACY:

When a patient is taking less than five medications at once, it is referred to as "no polypharmacy." This serves as the reference group in numerous research and clinical guidelines that compare polypharmacy- related outcomes. [1]

1.3 FACTORS INFLUENCING POLYPHARMACY:

- Drug factors
- Patient factors

1.3.1. DRUG FACTORS:

The reasons why some medications are more harmful, addictive, or therapeutic than others can be explained by the following variables.

- ✓ Prices of medicines
- ✓ Type and number of drugs

PRICES OF MEDICINES:
Drug expenditures still account for a large percentage of their healthcare costs, even though the majority have health insurances claimed; more than half of them spend more than 10% of their overall medical expenses on prescription drugs. Those who take many prescribed medications (polypharmacy) may find financial challenges particularly burdensome, which may cause them to change their treatment plans or choose less expensive generic equivalents in an attempt to save money.

TYPE AND NUMBER OF DRUGS:
Medication adherence in elderly is greatly impacted by the quantity and complexity of drugs. Adherence tends to deteriorate as the number of drug classes and the complexity of the prescription regimen rise. More than half of older adults use fewer than ten drugs, while some have been observed taking up to 27 distinct drugs. Even with fewer drugs, managing them effectively can be challenging and often results in underuse, misuse, missed doses, or incorrect administration.

1.3.2. PATIENT FACTORS
The term "patient factors" refers to a patient's unique traits, actions, and situations that may have an impact on their health and reaction to medical intervention.

- ✓ Gender
- ✓ Age
- ✓ Status of Economy
- ✓ The type and number of diseases
- ✓ Psychosocial factors

Gender:
According to certain studies, women are less likely than men to adhere to the prescribed regimen. This could be due to women are more responsible for their families and devote more time to caring for them than to themselves.

Age:
The Geriatrics have an inability in maintaining compliance to the treatment plan. This could be due to physiological factors that influence remembering name of the medications, abnormality in hearing and deterioration in vision which can impact administration and medication adherence.

Status of Economy:
The cost of drugs were not a frugal and would not spend more on medications, and older patients with polypharmacy were more burdened by the cost of drugs.

The type and number of diseases:
According to a study, medication adherence was negatively connected with cognitive impairment. This was linked to the patients with cognitive impairment to comprehend prescription instructions and recall the administration route.

Psychosocial factor:
Poor adherence may result from skepticism over the need for treatment. In an effort to improve health, this vulnerability may also result in a rise in the use of over-the-counter drugs, vitamins, and herbal therapies.[2]

1.2. CONSULTATION AND THERAPEUTIC MEASURES IN CASE OF POLYPHARMACY

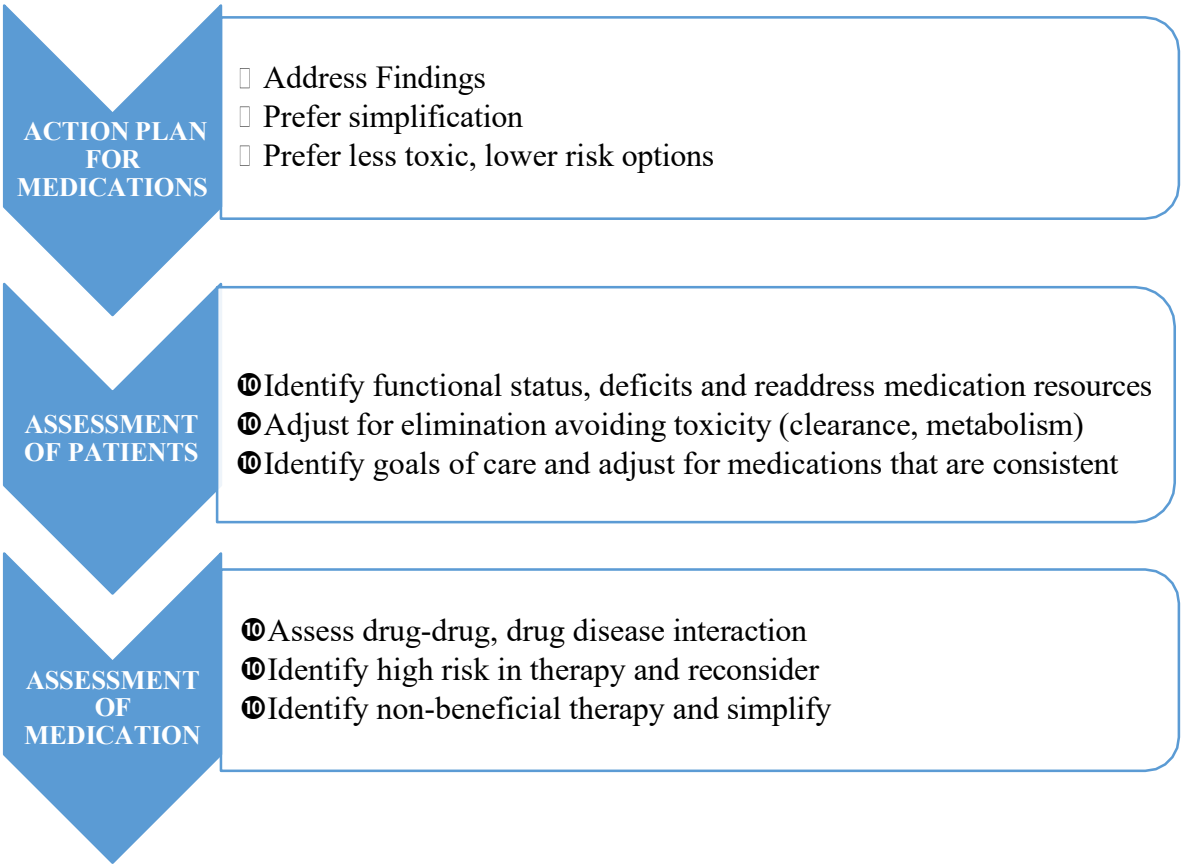


Figure 1: Consultation and therapeutic measures in case of polypharmacy

1.5. Process to Identify Drug Therapy Problems in Cases of Polypharmacy

PROBLEMS/ ISSUES	REASONS EXAMPLES	PROBLEMS /RISKS TO BE FOUND	ACTIONS TO BE TAKEN/ SIMPLIFY IF POSSIBLE
Medication reconciliation: an accurate medication list	Know what patient actually takes - Discover unexpected or unfilled prescriptions	Discontinued medications Missing medications Taking incorrectly	Stop, modify or initiate appropriate therapy - Patient education
Adherence assessment: Identify missed doses using tools such as Morisky, review pill box and bottles, fill dates	Adherence barriers: complex therapy burden: 3-times- daily, 4-times-daily doses, missing inhalers (cost), missing bottles, duplicate bottles.	Too many doses of medications daily Unfilled or perpetuated prescriptions Unaffordability of medications and Presence of side effects	Simplify regimen burden, use cost effective alternatives; eliminate agent(s) with adverse side effects
Identify drug -drug interactions using interaction databases	Interactions risk: QT prolongation, anticoagulant and bleed risk medications: NSAIDs, anticoagulants; serotonin syndrome	Monitor the risk, eliminate when risk outweighs benefit	Select noninteracting agents; choose alternatives with lower risk
Drug - disease interaction screen	NSAIDs in CHF, CKD, hypertension; sulfonylureas in CKD	High-risk therapy that exacerbates heart failure, hypoglycaemia	Select alternate therapy; monitor for high-risk events
Overtreatment: accumulating therapy	Identify duplicate or concomitant therapy that results in	Duplicates, medications with additive side effects resulting in toxicity	Adjust doses, taper therapy; monitor results

	orthostasis, hypoglycaemia		
Identify high risk drugs in older adults: Beer's criteria, STOPP/START	Sedative/hypnotics, opioids, anticholinergics, benzodiazepines, anxiolytics, hypoglycaemics	Monitoring of high-risk therapy is necessary; survey risk before it begins to outweigh benefit	Reduce or eliminate risk; educate patients about OTC anticholinergic avoidance
Undertreated indications or missed therapy. START criteria	Overlooked treatment: CAD without a statin, antiplatelet agent after coronary stenting	In complex regimen, sometimes an indicated medication has fallen unnoticed	Initiate medications that decrease risk for the patient within goals of care
Medication monitoring for efficacy and patient safety	Insulin without glucose monitoring, TSH, warfarin: INR	Medication is fulfilling its purpose/ indication; safety monitoring for each medication	Routine labs (TSH), drug levels; assess kidney, liver function
Evaluate supplements, herbal supplements, multiple vitamins in older American adults.	Contribute to medication burden, cost, side effects, interactions: iron, multivitamin/trace elements.	Except for recommended supplements such as vitamin D, many supplements are noncontribution.	Discuss, simplify, educate patients.

Table 1: Lists out the problems, reasons and measures to be taken in polypharmacy cases.[3,4,5]

1.6. MULTIMORBIDITY

1.6.1. DEFINITION

Multimorbidity also known as **MULTIPLE LONG-TERM CONDITIONS** and it referred as the existence of two or more chronic disease conditions.[6]

1.6.2. Approach to Managing Multimorbid Patients:

Adapted from the American Geriatrics Society's Guiding Principles — a practical 5-step approach is set in cases of multimorbid conditions

Step 1: Get the Patients Preferences

Who should decide: the doctor, the patient, or family?

Which is more important to the patient: longevity, comfortor independence?

Step 2: Consider Evidence-Based Treatments

Does the treatment have sufficient proof behind it? Does this patient meet the criteria?

What are the possible drawbacks and expected advantages? For what length of time does the treatment start to work?

Step 3: Determine the outcome

Evaluating the prognosis aids in determining the right level of treatment intensity: To calculate the 4-year mortality risk or life expectancy, use validated programs like (ePrognosis.org.) Align treatment schedules with the prognosis of the patient. Example: if a patient has less than a year to live, starting long-term preventive treatment with bisphosphonates might not be helpful.

Step 4: Determine Clinical Feasibility

Check the patient's ability to follow the prescribed course of treatment. Examine: Complexity of medication

Budgetary limitations Support for caregivers Awareness of health

When possible, include non-pharmacological methods (e.g.: physiotherapy, nutrition)

Step 5: Prioritize the Care Plan

Integrating insights from the previous steps allows clinicians to create a prioritized, personalized care plan:

Select treatments that reflect the patient's preferences and prognosis.[7,8]

1.6.3. FACTORS AFFECTING MULTIMORBIDITY:

1.6.3.1. Patient related factors:

Age: Due to a natural decline in physiological function and heightened vulnerability to chronic diseases, elderly patients are more likely to develop multimorbidity.
Sex: Multimorbidity tends to be more common in women compared to men.
Genetics: The likelihood of acquiring specific chronic illnesses can be influenced by an individual's genetic predispositions.
Comorbidities: Having one chronic illness can make others more likely to occur.

1.6.3.2. Behavioural Elements:

Way of life: Multimorbidity is largely caused by unhealthy lifestyle choices, including smoking, binge drinking, eating poorly, and not exercising.
Stress: Both acute and chronic stress can have a detrimental effect on one's health and raise the chance of developing a number of illnesses.
Sleep: Poor sleep quality and insufficient sleep duration are linked to higher risk.

1.6.3.3. Social and Economic Aspects:

Socioeconomic Status: Low socioeconomic status restricts access to secure environments, nutritious food options and healthcare, it is frequently associated with higher rates of multimorbidity.
Employment: Unemployment and job-related stress can negatively impact health and contribute to multimorbidity.

1.6.3.4. Environmental Aspects:

Access to Healthcare: Poorer health outcomes and higher rates of multimorbidity might result from limited access to healthcare services, such as chronic disease management and preventive care.
Social Support: Isolation and a lack of social support can have a detrimental effect on one's health and raise the likelihood of multimorbidity. [9]

2. LITERATURE REVIEW

1) ***Georgie B Lee et al., (2021)*** This review examines potentially suboptimal medicine regimens in older adults, focusing on polypharmacy, under prescribing, and inappropriate prescribing. Research from 1990–2021 was sourced using MEDLINE and relevant keywords. It highlights the prevalence, risk factors, and outcomes of these prescribing issues. Evidence on the longitudinal patterns of polypharmacy is also summarized. Gaps in the literature are discussed, with future research directions proposed.
2) ***Stewart et al., (2017)*** This review addresses the shortcomings of single-disease guidelines in managing multimorbidities, leading to inappropriate polypharmacy. The SIMPATHY project supports innovative, evidence-based polypharmacy management across the EU. A systematic review examined current policies and guidelines for older adults. Scotland's approach, guided by Kotter's change model, is discussed as a case study. Effective solutions must be patient-centered, multidisciplinary, and tailored to healthcare systems.
3) ***Pritti Aggarwal et al., (2020)*** Multi-morbidity and polypharmacy are common in older people and challenge health systems globally. They are complex, interrelated, and require early detection and shared decision-making. Comprehensive geriatric assessment (CGA) by a multidisciplinary team is essential. Care plans must be personalized, responsive, and support patient independence. This review explores the recognition and management of these issues in older adults.
4) ***Andrew whitmann et al.,(2021)*** The care of older cancer patients is increasingly complex due to comorbidities, transitions of care, and medication management challenges. Polypharmacy commonly defined as the use of five or more medications and inappropriate medication use can result in adverse outcomes. These include falls, cognitive decline, chemotherapy toxicity, hospital readmissions, and increased mortality. Barriers to safe medication management include limited time, lack of reimbursement, poor communication, and unclear deprescribing responsibility. This narrative

review summarizes studies from the past decade on medication management and provider roles in addressing polypharmacy across cancer care settings.

5) ***Gabriel Majewski et al., (2024)*** stated that Polypharmacy is a growing public health concern, especially among the elderly with multimorbidity like dementia and stroke, due to complex treatment needs. A review of seven studies (2018–2023) found that countries with higher per capita spending on health and education had lower polypharmacy prevalence. Polypharmacy negatively affects patients' quality of life and adherence, especially when there is limited understanding of their conditions and medications. Improving patient education, leveraging technology, and increasing healthcare and education investment may help mitigate inappropriate polypharmacy

6) ***Anne D Halley- Teirney et al., (2019)*** Polypharmacy, often defined as the regular use of five or more medications, is common among older adults and at-risk populations, increasing the risk of adverse outcomes. Risk factors include multiple chronic conditions, mental health issues, involvement of multiple providers, and systemic issues like outdated records and automated refills. Tools such as Beers Criteria, STOPP/START, and the Medication Appropriateness Index help identify inappropriate medication use, though no single tool is clearly superior. Deprescribing unnecessary medications can reduce pill burden, adverse drug events, and financial stress, and should be approached as a therapeutic intervention. Patient and caregiver goals, preferences, and understanding should guide deprescribing, aided by point-of-care tools to support informed decisions.

7) ***Joseph O Shea et al., (2022)*** Conventional medicines optimization in people with multimorbidity and polypharmacy is complex and limited. A holistic, integrated approach is needed, with pharmacogenetics showing potential in optimisation strategies. This systematic review included studies on multi-medicine pharmacogenetics in adults with multimorbidity or polypharmacy. Fifteen diverse studies were reviewed narratively due to heterogeneity, limiting meta-analysis feasibility. One small randomized study showed pharmacist-led pharmacogenetic interventions may benefit patients and systems. However, general conclusions are limited; more robust, real-world studies are needed to confirm outcomes.

8) ***Kartyn Nicholson et al., (2024)*** Multimorbidity and polypharmacy are increasingly common, especially among older adults. This systematic review examined their prevalence in adults (≥18) and older adults (≥65) across clinical and community settings. A total of 87 studies from six databases were included, mostly focusing on population-based older adult samples. Despite varying definitions, most studies used consistent thresholds: ≥2 conditions for multimorbidity and ≥5 medications for polypharmacy. Prevalence varied widely, highlighting the need for standardized reporting of conditions and medications.

9) ***Soren T Skou et al., (2022)*** Multimorbidity, defined as two or more coexisting conditions, is a growing global challenge impacting individuals, careers, and society. It occurs earlier in socioeconomically deprived groups and is linked to premature death, poor function, and higher healthcare use. Its development is complex, involving ageing, biological mechanisms, and social determinants like deprivation. Prevention is not well understood, but psychosocial, behavioural, and structural population-level interventions may help. Current healthcare systems and guidelines focus on single diseases, often resulting in inadequate or harmful care. Multimorbidity requires coordinated, person-centered care and greater research, training, and system reconfiguration.

10) Emma Wellace et al., (2015) Multimorbidity, defined as two or more chronic conditions, is linked to reduced quality of life and increased healthcare use. Higher numbers of conditions are associated with more emergency admissions and functional decline. Drug management in multimorbidity is complex, often leading to polypharmacy and its associated risks. Patients face a high treatment burden, including complex regimens and multiple appointments. Qualitative studies describe the constant struggle patient's face in managing their conditions. Psychological distress is common, with depression rates increasing alongside the number of chronic conditions.

11) Isumi Sato et al., (2013) Polypharmacy is increasingly common among elderly hypertensive patients in Japan due to treatment guidelines and rising multimorbidity. This study examined the association between polypharmacy (≥5 medications) and risk of adverse drug reactions (ADRs) in

this population. A retrospective cohort of 61,661 patients aged 65+ was analyzed from a national antihypertensive medication database. Patients were grouped by monotherapy, co-medication (≤4 drugs), and polypharmacy (≥5 drugs) to assess ADR incidence. ADR rates increased with more medications: 2.0 (monotherapy), 5.1 (co-medication), and 8.6 (polypharmacy) per 10,000 person-days. Polypharmacy significantly raised ADR risk (RR 4.3), highlighting the need for regular medication reviews.

12) ***Bianca Papotti et al., (2021)*** Chronic kidney disease (CKD) often coexists with comorbidities like cardiovascular disease and diabetes, leading to frequent polypharmacy. Polypharmacy in CKD patients increases the risk of adverse drug reactions (ADRs), primarily through drug-drug interactions (DDIs). Renal impairment alters pharmacokinetics and pharmacodynamics, further elevating ADR risk. DDI prevalence in CKD patients ranges from 56.9% to 89.1%, contributing to higher healthcare costs and poorer outcomes. Despite this, limited literature exists on DDIs in CKD patients receiving multiple therapies. This review summarizes common DDIs in CKD and discusses their underlying mechanisms and clinical relevance.

13) ***Al Meslamani AZ et al., (2025)*** This review explores the impact of AI technologies—such as chatbots, mobile apps, clinical decision support systems (CDSS), and machine learning (ML) algorithms—on evidence-based deprescribing for older adults. A comprehensive search of electronic databases up to November 2024 identified studies focusing on AI applications in this area. Findings suggest that AI aids in predicting adverse drug events, detecting potentially inappropriate medications, and supporting medication management.

14) ***Mihir Adhikary et al., (2014)*** A study using nationally representative LASI data analysed the prevalence, patterns, and predictors of multimorbidity in India through bivariate and multivariate methods. Findings show that ~25% of older adults in each age group have multimorbidity, with slightly higher rates in females. Kerala recorded the highest prevalence and Nagaland the lowest. Hypertension was most common, followed by arthritis and diabetes. Key determinants included age, sex, marital status, education, wealth, physical activity, and living arrangement, with prevalence rising with age. The study offers important national- level insights to guide policy and healthcare strategies for India's aging population.

3. EPIDEMIOLOGY OF MULTIMORBIDITY AND POLYPHARMACY IN ELDERLY

PREVALENCE OF MULTIMORBIDITY

Globally, more than 60-70% of adults aged above 65 years have two or more chronic diseases. Common chronic conditions include:

1. Hypertension
2. Osteoarthritis
3. Cardiovascular disease
4. Diabetes
5. Chronic kidney diseases
6. Depression and Dementia

PREVALENCE OF POLYPHARMACY

40-60% of older adults takes more than 5 medications and 12-20% may be exposed to excessive polypharmacy (more than 10 medications)

Higher in nursing homes and long-term care settings.

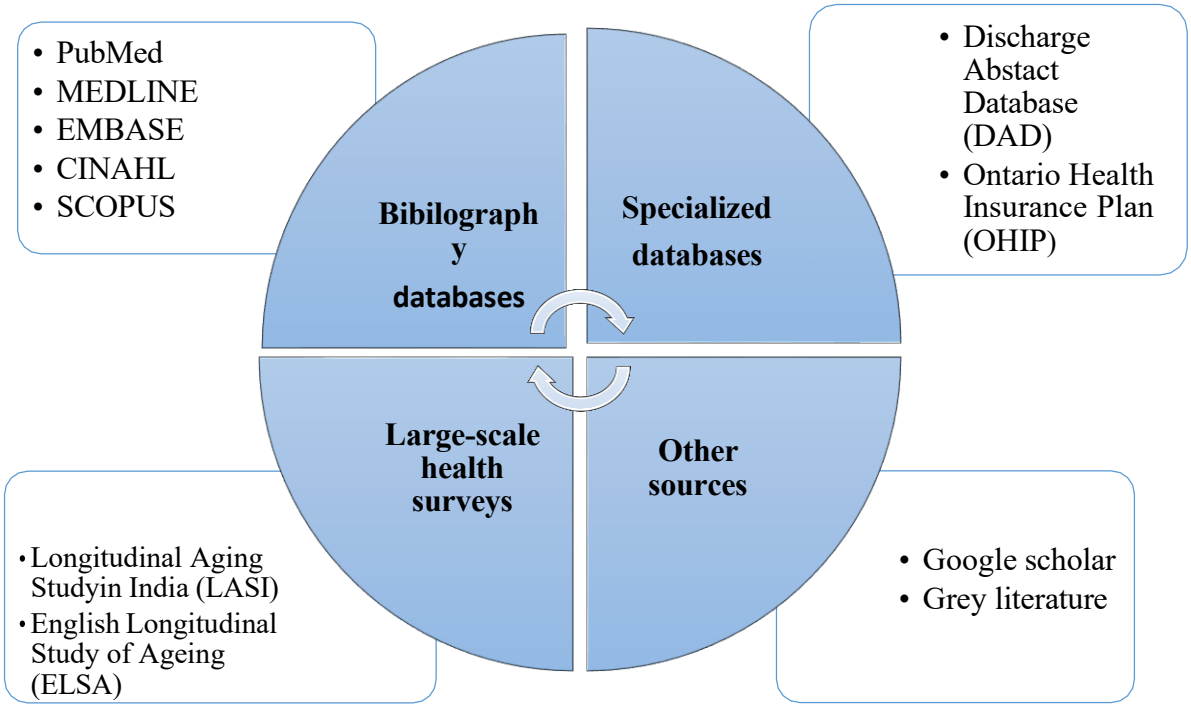


Figure 2: Methods of data collections on Prevelance using various databases[10,11]

4. INTERELATION BETWEEN MULTIMORBIDITY AND POLYPHARMACY

The Pharmacological management of multimorbidity often requires polypharmacy, which is defined as the use of multiple medications concurrently for the treatment of one to several medical conditions, and high dosage frequency.

Dosage frequency was divided into two groups:

✓ <3 doses per day (lower dosage frequency)

✓ ≥3 doses per day (higher dosage frequency)

Hospitalization, poor adherence, and high rates of adverse drug reactions are linked to both polypharmacy and high dosage frequency.

Furthermore, treatment burden which is characterized as the "work" of being a patient and its impact on the patient's quality of life is brought on by polypharmacy and high dosage frequency.

4.1. MULTIMORBIDITY AND ITS IMPACT ON POLYPHARMACY:

Increased medication needs (Directly Proportional):

As People who have multiple chronic conditions frequently need a greater variety of medications to treat each one, leading to polypharmacy.

Example: A patient with diabetes, hypertension, and arthritis may be prescribed: Anti-diabetics (e.g., metformin, insulin)

Antihypertensive (e.g., ACE inhibitors, beta blockers) Pain relievers or anti-inflammatories

Clustering and interactions of diseases:

Chronic illnesses frequently coexist and interact with one another, which may make each condition worse and require further medicine.

Example: The metabolic syndrome, characterized by conditions like insulin resistance, hypertension, and high cholesterol, exemplifies this, where the interaction of these conditions can lead to cardiovascular disease and the need for multiple medications.

Fragmented Healthcare Delivery:

Patients with multimorbidity often consult multiple specialists, each prescribing drugs based on their specialty. This can lead to overlapping or unnecessary medications, increasing polypharmacy risk.

4.2. Consequences of Multimorbidity-Induced Polypharmacy:

4.2.1. Increased risk of adverse drug reactions (ADR

Hypnotics, diuretics, NSAIDs, antihypertensives, psychotropics, and digoxin: Commonly cause problems in the elderly due to age-related changes in drug metabolism and excretion.
ACE inhibitors: Can cause a persistent cough in some individuals.

4.2.2 Higher likelihood of drug-drug interactions: Heart failure and COPD:

Corticosteroids prescribed for COPD exacerbations can worsen heart failure.
Diabetes and COPD:
The combination of corticosteroids and diabetes can increase the risk of diabetes- related hospitalizations.

4.2.3 Medication non-adherence

Consider an elderly individual with diabetes, hypertension, and arthritis. They are prescribed metformin for diabetes, lisinopril for hypertension, and ibuprofen for arthritis. Due to the complexity of managing three different medications, the individual might:
Non-initiation:
Not fill the prescription for lisinopril due to the cost or perceived lack of benefit.
Suboptimal implementation:
Only take ibuprofen occasionally when experiencing pain, rather than regularly as prescribed. They might also skip doses of metformin due to forgetfulness or feeling well.
Early discontinuation:
Stop taking metformin altogether because they experience side effects like stomach upset, even though its crucial for managing their blood sugar.
This non-adherence can lead to uncontrolled blood sugar levels, increased blood pressure, and potentially worsening arthritis pain and inflammation. The individual might then require more frequent doctor visits, emergency room visits, or even hospitalization, increasing healthcare utilization and costs.

4.2.4 Higher healthcare utilization and costs

Consider a patient with type 2 diabetes, hypertension, and arthritis. This individual is likely to: See their primary care doctor more frequently:
For diabetes management, blood pressure monitoring, and arthritis pain management.
Need specialist visits:
Such as an endocrinologist for diabetes care and a rheumatologist for arthritis.
Require more medications:
Including oral medications for diabetes and hypertension, and potentially pain relievers or anti-inflammatory drugs for arthritis.

Undergo more diagnostic tests:
Such as blood glucose monitoring, blood pressure checks, and potentially X-rays or other imaging for arthritis.
Be more prone to hospitalizations:
For example, if they experience a diabetic complication or a severe arthritis flare-up.

4.2.5 Reduced quality of life

Consider an elderly individual with diabetes, arthritis, and hypertension. This individual might experience:

Physical limitations:
Difficulty walking due to arthritis and high blood pressure, requiring assistance with daily tasks.

Psychological distress:
Worry about managing multiple medications, fear of complications, and potential depression from the chronic conditions and limitations.

Social isolation:
Reduced participation in social activities due to physical limitations and pain, leading to feelings of isolation and loneliness.
This combination of physical, psychological, and social challenges significantly reduces the individual's overall quality of life, making it harder to enjoy daily life and participate in activities they once did.

4.3. POLYPHARMACY AND ITS IMPACT ON MULTIMORBIDITY:

Increased Risk of Adverse Drug Reactions (ADRs):
Polypharmacy raises the likelihood of ADRs, which can trigger or worsen chronic conditions
Example: Long-term NSAID use can lead to peptic ulcer disease or kidney dysfunction.
Antipsychotics or steroids may cause diabetes or hypertension Drug-
Induced Comorbidities:
Some medications can induce new diseases, mimicking or adding to existing multimorbidity conditions.
Example: Use of corticosteroids can result in osteoporosis or glaucoma. Statins may cause muscle pain, limiting mobility and increasing risk of frailty.
Decreased Treatment Effectiveness:
Interactions between drugs can reduce therapeutic benefits. E.g.,
Antacids reducing absorption of iron or antibiotics.
Diuretics may worsen gout or renal issues.
This may lead to disease progression or the need for more medications, creating a cycle.
Psychological Burden and Depression:
Managing many medications can increase stress, anxiety, and treatment fatigue, particularly in older adults.

This mental health burden may worsen conditions like diabetes, hypertension, and cardiac diseases.
Poor Adherence → Disease Complications:
Complex regimens make it harder for patients to take medications correctly.
Missed doses or incorrect usage can lead to poor disease control, further contributing to multimorbidity progression.

4.4. OVERALL IMPACT:

- Impact on Quality of Life:

The combined effects of multimorbidity and polypharmacy can negatively impact quality of life, functional status, and cognitive function.

- Hospitalization and Mortality:

Polypharmacy and multimorbidity are associated with increased rates of hospitalization and, in some cases, mortality.[12,13,14]

5. COMPREHENSIVE GERIATRIC ASSESSMENT

"A Multidimensional interdisciplinary diagnostic process focused on determining a frail older person's medical, psychological and functional capability in order to develop a coordinated and integrated plan for treatment and long term follow up.

5.1 MAJOR COMPONENTS - Core components of comprehensive geriatric assessment (CGA) that should be evaluated during the assessment process are as follows:

- Functional capacity

- Fall risk
- Cognition
- Mood
- Polypharmacy
- Social support
- Financial concerns
- Goals of care
- Advance care preference

Additional components:
- Nutrition/weight Change
- Urinary continence
- Sexual function
- Vision/hearing
- Dentition
- Living situation
- Spirituality

5.2 Key Components of CGA

5.2.1. Medical Assessment
- Review of current illnesses, comorbidities, medications
- Detection of geriatric syndromes (e.g., falls, incontinence, frailty)
- Nutritional status and sensory impairments

5.2.2. Functional Assessment
- Activities of Daily Living (ADL): Bathing, dressing, feeding, etc.
- Instrumental Activities of Daily Living (IADL): Managing finances, medication, transportation.

5.2.3. Psychological Assessment
- Cognitive screening (e.g., MMSE, MoCA)
- Evaluation of mood (e.g., Geriatric Depression Scale)

5.2.4. Social Assessment
- Financial resources
- Access to transportation and community services

5.2.5. Environmental Assessment
- Risk factors for falls or isolation and Home safety evaluation

5.3 Benefits of CGA :
- Improves diagnostic accuracy and detection of treatable conditions
- Reduces hospital admissions and readmissions
- Enhances functional status and independence
- Improves medication management (polypharmacy reduction)
- Supports informed decision-making for long-term care
- Improves quality of life and patient satisfaction
- Decreased nursing facility admission
- Decreased medication use
- Decreased mortality
- Decreased annual medical care costs [15-19]

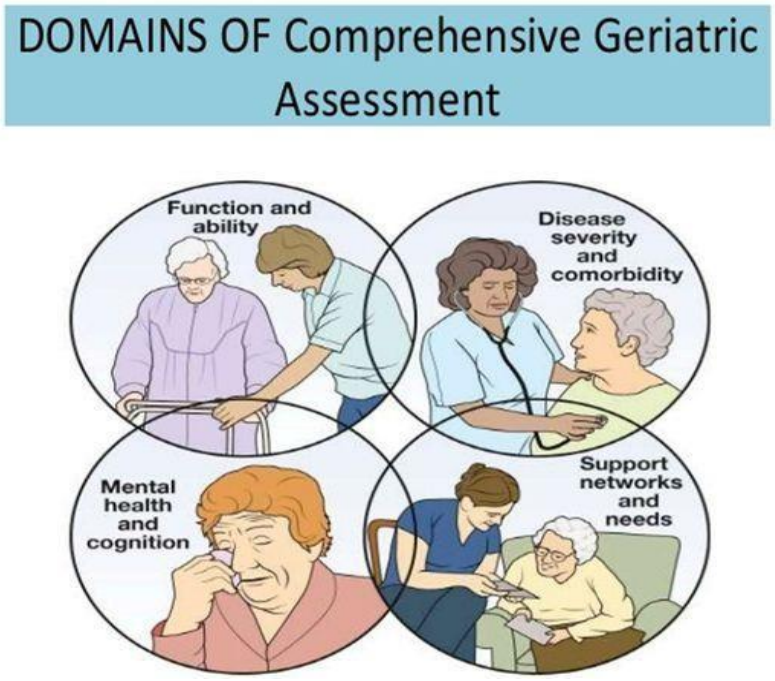


Figure 3: Domains of comprehensive assessment

6. MANAGEMENT STRATEGIES IN PATIENTS WITH MULTIMORBIDITY

6.1. Comprehensive Geriatric/Chronic Disease Assessment

A detailed assessment of medical, psychological, functional, and social domains.
Prioritize patient goals over strict disease targets (e.g., HbA1c in diabetes).
Evaluate life expectancy, comorbidity burden, frailty, and cognitive function.

6.2. Systematic Medication Review Regularly scheduled reviews help:

- Identify drug–drug and drug–disease interactions.
- Remove duplicate therapies or those with minimal benefit.
- Adjust medications for renal/hepatic impairment.

Tools used:

- STOPP/START criteria
- Beers Criteria (especially in elderly)
- Medication Appropriateness Index (MAI)

6.3. Deprescribing Framework

Deprescribing is the practice of methodically stopping prescription drugs that are no longer required or suitable, especially in older persons who could react differently to drugs physiologically. It is divided into categories based on the kinds of medications, their hazards, deprescribing methods, and recommendations

1. NSAIDs

- **Examples**: Indomethacin, naproxen, ibuprofen.
- **Risks**: Worsen kidney clearance, hypertension, heart failure, gastrointestinal ulcers/bleeding.
- **Deprescribe Methods**: Avoid in older adults or use for short periods with proper monitoring.

2. Sulfonylureas

- **Examples**: Glyburide, glipizide.
- **Risks**: Hypoglycemia, especially in individuals with chronic kidney disease (CKD).
- **Deprescribe Methods**: Taper and substitute with safer agents like metformin or GLP-1

agonists.[20 - 23]

Tools for Identifying Medication Risk and for Deprescribing in Older Adults:

Beers Criteria, American Geriatric Society:

Identifies potentially inappropriate medications that add risks; to be avoided in older adults.

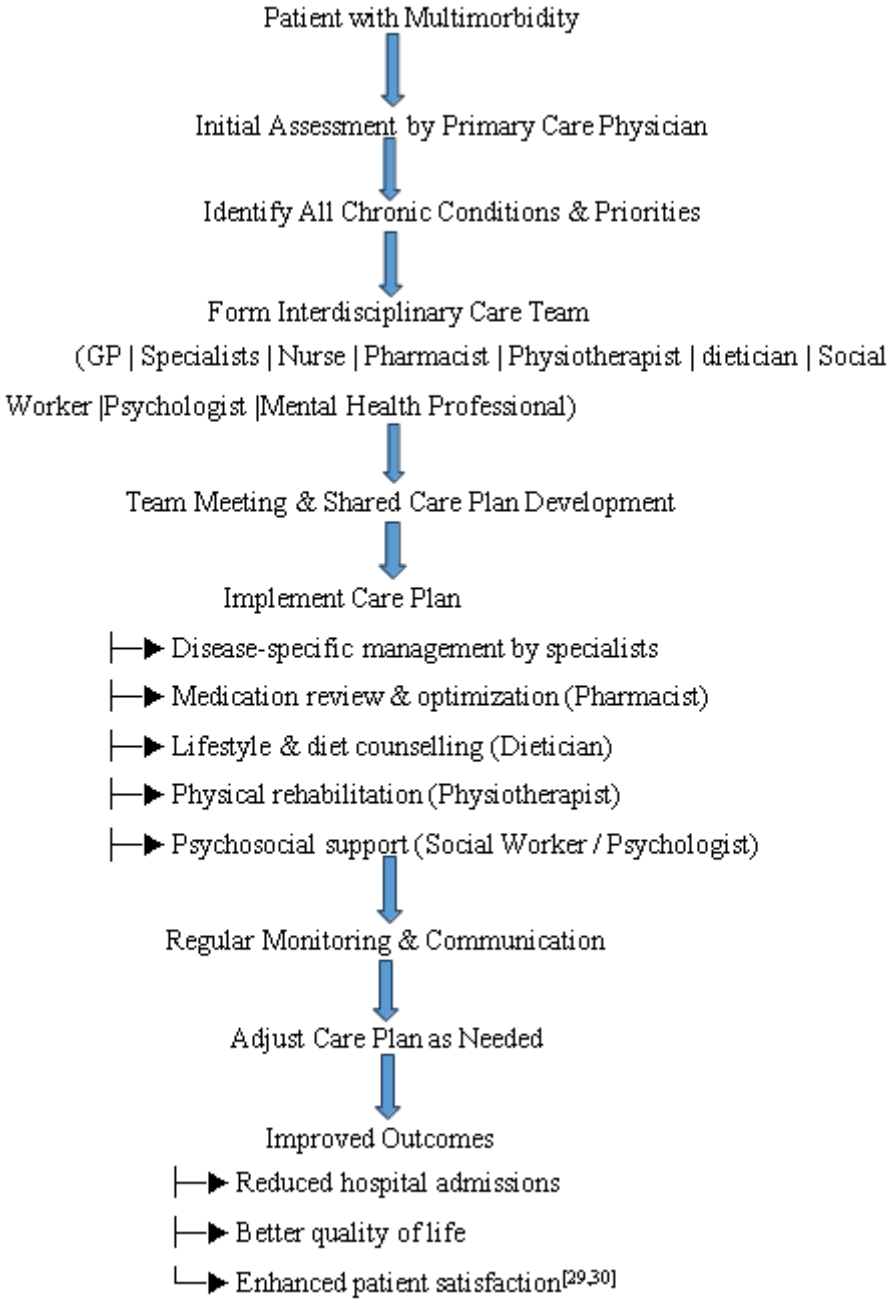
STOPP/START Criteria:

Identify potentially inappropriate medications (PIMs) and potential prescribing omissions (PPOs) in older adults.)

EMPOWER (Effectively Managing Polypharmacy to Optimize Well-being, Engagement, Sand Recovery): Study focuses on deprescribing benzodiazepines in older adults:

Considerations for patients about successful benzodiazepine reductions.[24-28]

7. INTERDISIPLINARY CARE IMPLEMENTATION



8. ROLE OF AI IN MULTIMORBIDITY AND POLYPHARMACY

1. By evaluating electronic health records (EHRs), forecasting risks, and improving treatment strategies, artificial intelligence (AI) has the potential to revolutionize these issues through machine learning and natural language processing.
2. **Risk Stratification Using Predictive modelling** to determine which patients are more likely to experience complications, readmissions to the hospital, or the advancement of their disease. **Random Forests, Support Vector Machines (SVMs), and XGBoost** are employed. This aids in resource prioritization and follow-up care customization for patients with several chronic conditions.
3. Tailored and Preventive Intervention Techniques AI makes it possible to create customized care plans by combining various patient data, such as lab results, clinical notes, and demographic information.
4. **CDSS, or clinical decision support systems** by offering real-time alerts and recommendations during patient care, these systems help with medication reviews, dosage modifications, and preventing drug duplications, all of which improve patient safety.
5. Using NLP to Extract Insights Traditional analysis frequently ignores the important insights that

Natural Language Processing (NLP) techniques can glean from unstructured clinical texts in **electronic health records (EHRs),** such as discharge summaries or physician notes which makes it possible to comprehend the patient's history and treatment.[31,32]

6. Drug Interaction Prediction: AI algorithms can analyze vast drug databases to identify potential harmful drug–drug interactions before prescribing.This helps clinicians choose safer medication combinations for patients with multiple diseases. Machine learning models improve prediction accuracy over time by learning from reported adverse events.Thus, AI minimizes medication errors and enhances overall patient safety.
7. Remote Patient Monitoring and Early Intervention: AI-powered wearable devices and mobile apps continuously track patients' vital signs and medication adherence.These systems detect early warning signs of complications and alert healthcare providers in real time. It enables timely medical intervention, reducing hospital admissions and emergency visits.

9. DISCUSSION

The interrelationship between polypharmacy and multimorbidity presents one of the most pressing challenges in modern geriatric medicine. As life expectancy increases, the prevalence of multiple chronic conditions among older adults continues to rise, making the concurrent use of multiple medications often unavoidable. However, the resulting therapeutic complexity can undermine the very goals of treatment. The evidence consistently shows that polypharmacy is associated with adverse drug events, functional decline, hospitalization, and increased mortality. When multimorbidity is present, these risks are magnified due to the intricate interactions among diseases, medications, and the psychosocial context of aging.

A critical point emerging from this review is that polypharmacy and multimorbidity do not operate as independent phenomena; rather, they form a self-perpetuating cycle. Chronic diseases necessitate multiple therapies, yet the accumulation of medications may precipitate new health problems or exacerbate existing ones. This cycle can lead to a cascade of prescribing, where new drugs are introduced to manage side effects of previous ones. Consequently, the burden on patients and caregivers grows—not only physically and financially, but also psychologically, as treatment regimens become increasingly difficult to manage.

Breaking this cycle requires a paradigm shift from a disease-centered to a person-centered model of care. Comprehensive Geriatric Assessment (CGA) has proven to be an effective framework for addressing this complexity, as it evaluates not just medical conditions but also functional ability, cognition, mental health, and social support. Incorporating systematic medication reviews and deprescribing protocols is essential to ensuring that treatments align with patient goals and clinical appropriateness. Deprescribing, when approached as an active and evidence-based process, enhances safety, reduces adverse events, and can improve overall quality of life.

Equally important is the role of interdisciplinary collaboration. Managing multimorbidity and polypharmacy effectively requires input from physicians, pharmacists, nurses, dieticians, physiotherapists, and social workers. Such collaborative care models foster communication, reduce fragmented interventions, and promote holistic, patient-centered decision-making. Shared decision-making further empowers patients and families, ensuring that care plans respect individual preferences and balance longevity, comfort, and independence.

Finally, the integration of artificial intelligence (AI) into healthcare offers a transformative opportunity. AI-driven tools can analyze large-scale health data to identify high-risk patients, optimize medication regimens, and predict potential drug interactions or disease trajectories. Nevertheless, the adoption of AI should be viewed as a complement to, not a replacement for, clinical judgment. When ethically implemented and guided by human oversight, AI can enhance precision, efficiency, and personalization in the management of complex elderly patients**.**

10. CONCLUSION

One of the biggest problems facing contemporary healthcare is the rising incidence of polypharmacy and multimorbidity among the elderly. The complexity of medical care rises with life expectancy because older persons frequently have several chronic illnesses that need constant care. Although polypharmacy can occasionally be inevitable, there are significant hazards associated with it, including poor adherence, unpleasant drug reactions, interactions between drugs and diseases, and a lower quality of life. When there is multimorbidity, these problems are exacerbated since overlapping illnesses and fragmented care can make well-meaning therapies harmful.

This review emphasizes the profound interdependence rather than merely additive interaction between polypharmacy and multimorbidity. Numerous ailments make taking pharmaceuticals more necessary, and taking a lot of pills can cause chronic disorders to develop or worsen. The cycle frequently results in more medical expenses, more people using healthcare, and more mental and physical strain on both patients and caregivers.

A change from a disease-centered to a person-centered approach is necessary to break this cycle. Comprehensive Geriatric Assessment (CGA) offers an organized strategy to evaluate medical, functional, psychological, and social aspects together, ensuring that treatment decisions reflect the individual's priorities, prognosis, and capacity for self-management. Systematic medication review and deprescribing are equally vital; eliminating unnecessary medications is not a withdrawal of care but rather an active, therapeutic decision to enhance safety and quality of life.

Working together is essential to managing these difficulties effectively. Combining doctors, pharmacists, nurses, dieticians, physiotherapists, and social workers into interdisciplinary care teams puts them in a better position to maximize treatment outcomes, avoid problems, and provide patients with comprehensive support. When trade-offs between independence, comfort, and lifespan must be taken into account, shared decision-making—in which patients and their families actively participate in care planning—ensures that treatment is in line with individual values and practical health objectives.

Artificial intelligence in particular gives this endeavour a fascinating new dimension. AI can anticipate risks, improve drug regimens, find patterns of disease co-occurrence, and offer real-time decision support by evaluating massive datasets from electronic health records. When carefully incorporated, these techniques can supplement a clinician's judgment rather than take its place, allowing for more accurate, customized treatment of complex patients.

BIBILIOGRAPHY

1. Varghese D, Ishida C, Patel P, Haseer Koya H. Polypharmacy [Internet]. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2025 Jan–(Updated 2024 Feb 12)
2 . Pan Jia (Becky), Chen Xinxin (Zora). Factors affecting medication adherence in older person with polypharmacy: a literature review [Bachelor thesis]. Lishui (China): Lishui University, Faculty of Health and Occupational Studies, Department of Caring Sciences; 2024.

3. Barnsteiner JH. Medication reconciliation. In: Hughes RG, editor. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Rockville (MD): Agency for Healthcare Research and Quality (US); 2008 Apr. Chapter: Medication reconciliation.
4. Holbrook A, Schulman S, Witt DM, et al. Evidence-based management of anticoagulant therapy: Antithrombotic Therapy and Prevention of Thrombosis (9th ed.). Chest. 2012;141(2 Suppl):e152S– e184S (warfarin/INR monitoring guidance).
5. National Institutes of Health, Office of Dietary Supplements. Dietary Supplement Fact Sheets for Health Professionals (vitamins, herbs, interactions, regulation). sBethesda (MD): NIH ODS; [updated regularly].
6. Skou ST, Mair FS, Fortin M, Guthrie B, Nunes BP, Miranda JJ, Boyd CM, Pati S, Mtenga S, Smith SM. Multimorbidity. Nat Rev Dis Primers. 2022 Jul 14;8(1):48. Doi:10.1038/s41572-022- 00376-4
7. Lu J, Wang Y, Hou L, Zuo Z, Zhang N, Wei A. Multimorbidity patterns in old adults and their associated multi-layered factors: a cross-sectional study. BMC Geriatr. 2021;21:372. Doi:10.1186/s12877-021-02292-w.
8. Boyd CM, McNabney MK, Brandt N, Correa-de-Araujo R, Daniel M, Epplin J, Fried TR, Goldstein MK, Holmes HM, Ritchie CS, Shega JW, American Geriatrics Society Expert Panel on the Care of Older Adults with Multimorbidity. Guiding principles for the care of older adults with multimorbidity: an approach for clinicians. J Am Geriatr Soc. 2012 Oct;60(10):E1-E25. Doi:10.1111/j.1532-5415.2012.04188.x. PMID: 22994865; PMCID: PMC4450364.
9) Melo LA, Braga LC, Leite FPP, Bittar BF, Oséas JM, Lima KC. Factors associated with multimorbidity in the elderly: an integrative literature review. Rev Bras Geriatr Gerontol. 2019;22(1). Doi:10.1590/1981-22562019022.180154.
10. Nicholson K, Liu W, Fitzpatrick D, Hardacre KA, Roberts S, Salerno J, et al. Prevalence of multimorbidity and polypharmacy among adults and older adults: a systematic review. Lancet Healthy Longev. 2024;5(4):e287–e296. Doi:10.1016/S2666-7568(24)00007-2.
11. Nguyen H, Manolova G, Daskalopoulou C, Vitoratou S, Prince M, Prina AM. Prevalence of multimorbidity in community settings: a systematic review and meta-analysis of observational studies. J Comorbidity. 2019;9:2235042X19870934. Doi:10.1177/2235042X19870934.
12 .Aoki T, Yamamoto Y, Ikenoue T, Onishi Y, Fukuhara S; for the Scientific Reports Multimorbidity Study Group. Multimorbidity patterns in relation to polypharmacy and dosage frequency: a nationwide, cross-sectional study in a Japanese population. Sci Rep. 2018;8:3806. Doi:10.1038/s41598-018-21917-6.
13 .Aggarwal P, Woolford SJ, Patel HP. Multi-morbidity and polypharmacy in older people: challenges and opportunities for clinical practice. Geriatrics. 2020;5(4):85. Doi:10.3390/geriatrics5040085
14 .Molokhia M, Majeed A. Current and future perspectives on the management of polypharmacy. BMC Fam Pract. 2017;18(1):70. Doi: 10.1186/s12875-017-0642-0.
15. Garrard JW, Cox NJ, Dodds RM, Roberts HC, Sayer AA. Comprehensive geriatric assessment in primary care: a systematic review. Aging Clin Exp Res. 2020;32(2):197–205. doi:10.1007/s40520- 019-01183-w
16 .Stefanacci RG. Comprehensive geriatric assessment. In: Wasserman MR, reviewer. MSD Manual Professional Version [Internet]. Merck & Co., Inc.; reviewed and revised April 2024
17. Beck J, Sequeira E. PubMed Central (PMC): an archive for literature from life sciences journals. In: McEntyre J, editor. The NCBI handbook [Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2002 Oct.
18. Devons CAJ. Comprehensive geriatric assessment: making the most of the aging years. Curr Opin Clin Nutr Metab Care. 2002 Jan;5(1):19–24. Doi: 10.1097/00075197-200201000-00004.
19. SG, McCue P, Phelps K, McCleod A, Arora S, Nockels K, et al. What is comprehensive geriatric assessment (CGA)? An umbrella review. Age Ageing. 2018;47(1):149-55. Doi:10.1093/ageing/afx166.
20. Saxena A, Singh S, Sharma S, et al. Multimorbidity management: A scoping review of

interventions and models. J Multimorbidity Health. 2025
21. Forslund T, Carlsson AC, Ljunggren G, Ärnlöv J, Wachtler C. Patterns of multimorbidity and pharmacotherapy: a total population cross-sectional study. Fam Pract. 2021;38(1):132-9. Doi:10.1093/fampra/cmaa101.
22. Pearson-Stuttard J, Ezzati M, Gregg EW. Multimorbidity—a defining challenge for health systems. Lancet Public Health. 2019;4(12):e599-e600. Doi:10.1016/S2468-2667(19)30250-0.
23. Molokhia M, Majeed A. Current and future perspectives on the management of polypharmacy. BMC Fam Pract. 2017;18(1):70. Doi: 10.1186/s12875-017-0642-0.
24. American Geriatrics Society. American Geriatrics Society 2023 updated AGS Beers Criteria® for potentially inappropriate medication use in older adults. J Am Geriatr Soc. 2023;71(7):2052-2081. Doi:10.1111/jgs.18372.
25. O'Mahony D, Cherubini A, Guiteras AR, et al. STOPP/START criteria for potentially inappropriate prescribing in older people: version 3. Eur Geriatr Med. 2023;14(4):625-632. Doi:10.1007/s41999-023-00777-y.
26. Tannenbaum C, Martin P, Tamblyn R, Benedetti A, Ahmed S. Reduction of inappropriate benzodiazepine prescriptions among older adults through direct patient education: the EMPOWER cluster randomized trial. JAMA Intern Med. 2014;174(6):890-898. Doi:10.1001/jamainternmed.2014.949.
27. Lown Institute. Medication Overload: America's Other Drug Problem. Brookline, MA: Lown Institute; 2019.
28. Morisky Medication Adherence Scale (MMAS-8) Morisky DE, Ang A, Krousel-Wood M, Ward HJ. Predictive validity of a medication adherence measure in an outpatient setting. J Clin Hypertens (Greenwich). 2008;10(5):348-354. Doi:10.1111/j.1751-7176.2008.07572.x.
29 Li M, Tang H, Liu X. Primary care team and its association with quality of care for people with multimorbidity: a systematic review. BMC Primary Care. 2023;24:20
30. Sampalli R, Wong ST, Zwarenstein M, Ryan T. Scaling up patient-centered interdisciplinary care for multimorbidity: a pragmatic randomized controlled trial in family medicine groups. Ann Fam Med. 2021;19(2):126-134.
31 .Akyon SH, Akyon FC, Yılmaz TE. Artificial intelligence-supported web application design and development for reducing polypharmacy side effects and supporting rational drug use in geriatric patients. Front Med (Lausanne). 2023 Mar 8;10:1029198. Doi: 10.3389/fmed.2023.1029198.
32 .Cadogan CA, Ryan C, Hughes CM. Appropriate polypharmacy and medicine safety: when many is not too many. Drug Saf. 2016 Feb;39(2):109–16. Doi: 10.1007/s40264-015-0378-5.