

GENERAL PRESCRIBING GUIDELINES FOR GERIATRICS

Presented by
Dr. Ayesha Fatima
Assistant Professor
Dept of Pharmacy Practice

Geriatrics :- It is the branch of medicine that focuses on the health and care of elderly individuals, particularly those aged 65 and older. It encompasses the prevention, diagnosis, treatment, and management of medical conditions and age-related issues specific to older adults.

Classification of Geriatrics

The World Health Organization (WHO) classifies geriatrics according to age as follows:

1. **Young-old:** Typically refers to individuals aged 65 to 74 years old.
2. **Middle-old:** Refers to individuals aged 75 to 84 years old.
3. **Old-old:** Encompasses individuals aged 85 to 99 years old.
4. **Oldest-old or Elite-old:** Denotes individuals aged 100 years and older

This classification help in understanding the diverse healthcare needs and challenges encountered by older adults across different age groups within the geriatric population.

Introduction to Geriatric Population

1. There has been a steady rise in the elderly population (people over 65 years) since the early twentieth century.
2. Globally, more than 760 million people are aged 65 years and above, and this number is expected to reach nearly 1.6 billion by 2050.
3. In India, more than 104 million people are aged 60 years and above, accounting for about 8.6% of the population.
4. Elderly individuals often suffer from multiple chronic diseases and therefore are major consumers of medications, accounting for 25–40% of drug expenditure in developed countries.
5. Institutionalized elderly patients usually take more medications than those living in the community.

6. Pharmacotherapy in older adults helps in curing or controlling diseases and improving health-related quality of life (HRQOL).
7. HRQOL includes improvements in physical functioning, psychological well-being, social functioning, and overall health status.
8. However, age-related physiological and pathological changes can significantly alter drug absorption, distribution, metabolism, and excretion, increasing the risk of adverse drug reactions and polypharmacy.
9. Drug-related problems may compromise the quality of life in older adults.
10. Therefore, healthcare professionals must understand age-specific pharmacotherapeutic considerations to ensure safe, effective, and rational drug therapy in the elderly population.

AGE RELATED PHYSIOLOGICAL CHANGES

- Age-associated physiological changes may result in reduced functional reserve capacity and a decreased ability to maintain homeostasis, making older adults more susceptible to decompensation during stressful situations.
- **Homeostatic mechanisms that may become impaired include postural and gait stability, orthostatic blood pressure responses, thermoregulation, cognitive reserve, and bowel and bladder function.**
- An event causing functional impairment may involve an insult for which the body cannot adequately compensate, and even relatively small stresses can lead to major morbidity and mortality.
- The clinical response to medications in older adults is the result of complex interactions between pharmacokinetic and pharmacodynamic processes.
- Age-related physiological changes can alter drug absorption, distribution, metabolism, and excretion, thereby affecting drug response.
- Concurrent medications, comorbidities, and frailty also play important roles in determining therapeutic outcomes in the elderly population.

Physiologic changes with age

Organ System	Manifestations of Aging
Balance and Gait	↓ Stride length and slower gait; ↓ Arm swing; ↑ Body sway when standing
Body Composition	↓ Total body water; ↓ Lean body mass; ↑ Body fat; ↔ or ↓ Serum albumin; ↑ α 1-acid glycoprotein (may increase further with disease states)
Cardiovascular	↓ Cardiovascular response to stress; ↓ Baroreceptor activity leading to ↑ orthostatic hypotension; ↓ Cardiac output; ↑ Systemic vascular resistance due to loss of arterial elasticity and impaired autonomic tone; ↓ Resting and maximal heart rate
Central Nervous System	↓ Size of the hippocampus and frontal/temporal lobes; ↓ Number of receptors and ↑ sensitivity of remaining receptors; ↓ Short-term memory, information encoding and retrieval, and executive function; Altered sleep patterns
Endocrine	↓ Estrogen, testosterone, TSH, and DHEA-S levels; Altered insulin signaling

Organ System	Manifestations of Aging
Gastrointestinal	↓ Motility of the large intestine; ↓ Vitamin absorption via active transport mechanisms; ↓ Splanchnic blood flow; ↓ Bowel surface area
Genitourinary	Vaginal atrophy due to decreased estrogen; Prostatic hypertrophy due to androgenic hormonal changes; Detrusor hyperactivity predisposing to incontinence
Hepatic	↓ Hepatic size; ↓ Hepatic blood flow; ↓ Phase I (oxidation, reduction, hydrolysis) metabolism
Immune	↓ Antibody production in response to antigens; ↑ Autoimmunity
Oral	Altered dentition; ↓ Ability to taste salt, bitter, sweet, and sour
Pulmonary	↓ Respiratory muscle strength; ↓ Chest wall compliance; ↓ Arterial oxygenation with impaired CO ₂ elimination; ↓ Vital capacity; ↓ Maximal breathing capacity; ↑ Residual volume

Organ System	Manifestations of Aging
Renal	↓ Glomerular filtration rate (GFR); ↓ Renal blood flow; ↓ Filtration fraction; ↓ Tubular secretory function; ↓ Renal mass
Sensory	Presbyopia (reduced ability to focus on near objects); ↓ Night vision; Presbycusis (high-pitch, high-frequency hearing loss); ↓ Sense of smell and taste
Skeletal	↓ Skeletal bone mass (osteopenia); Joint stiffening due to reduced water content in tendons, ligaments, and cartilage
Skin/Hair	Thinning of stratum corneum; ↓ Langerhans cells, melanocytes, and mast cells; ↓ Depth and extent of subcutaneous fat layer; Hair thinning and graying due to more hairs in resting phase and fewer melanocytes in hair follicles

Human Aging And Changes In Drug PK & PD Parameters

Aging results in several physiological changes that can affect the pharmacokinetics and pharmacodynamics of drugs.

These changes may influence drug absorption, first-pass metabolism, protein binding, distribution, and elimination.

Age-related changes in the gastrointestinal tract, liver, and kidneys include:

Gastrointestinal Changes	Hepatic Changes	Renal Changes
1. Reduced gastric acid secretion 2. Decreased gastrointestinal motility 3. Reduced total surface area for absorption 4. Reduced splanchnic blood flow	1. Reduced liver size 2. Reduced liver blood flow	1. Reduced glomerular filtration rate 2. Reduced renal tubular function

These physiological alterations can modify drug response and increase the risk of adverse drug reactions in older adults.

ALTERED PHARMACOKINETICS

Pharmacokinetic Phase	Age-Related Changes in Pharmacokinetics
Gastrointestinal Absorption	Unchanged passive diffusion and no significant change in bioavailability for most drugs
	↓ Active transport and ↓ bioavailability for some drugs
	↓ First-pass metabolism leading to ↑ bioavailability for some drugs and ↓ bioavailability for some prodrugs
Distribution	↓ Volume of distribution and ↑ plasma concentration of water-soluble drugs
	↑ Volume of distribution and ↑ terminal disposition half-life ($t_{1/2}$) for lipid-soluble drugs
Hepatic Metabolism	↓ Clearance and ↑ $t_{1/2}$ for some drugs with poor hepatic extraction (capacity-limited metabolism); Phase I metabolism affected more than Phase II
	↓ Clearance and ↑ $t_{1/2}$ for drugs with high hepatic extraction ratios (flow-limited metabolism)
Renal Excretion	↓ Clearance and ↑ $t_{1/2}$ for renally eliminated drugs and active metabolites

ABSORPTION

1. Aging causes a delay in gastric emptying.
2. Gastric acid secretion is reduced in elderly individuals.
3. Splanchnic blood flow decreases with age.
4. These changes generally do not significantly affect the absorption of most drugs.
5. Some drugs, such as digoxin, may show slower absorption.
6. However, the overall extent of absorption remains similar to that in younger adults.

FIRST PASS METABOLISM

1. After absorption, drugs pass through the portal circulation to the liver.
2. Many lipid-soluble drugs undergo extensive first-pass metabolism in the liver.
3. First-pass metabolism normally reduces systemic bioavailability.
4. In the elderly, even a minor reduction in first-pass metabolism can markedly increase drug bioavailability.
5. Impaired first-pass metabolism has been observed with drugs such as:

Clomethiazole, Labetalol, Nifedipine, Nitrates, Propranolol, Verapamil

1. Increased bioavailability may enhance drug effects and toxicity.
2. Example: the hypotensive effect of nifedipine may become more pronounced in elderly patients.
3. Frail hospitalized elderly patients with chronic debilitating diseases may show an even greater reduction in presystemic elimination.

DISTRIBUTION

Age-Related Change	Effect on Drug Distribution	Examples
↑ Body fat	↑ Vd of lipid-soluble drugs	Diazepam, Thiopental
↓ Total body water	↓ Vd of water-soluble drugs	Digoxin, Ethanol
↓ Serum albumin	↑ Free fraction of acidic drugs	Warfarin, Furosemide
↔/↑ α1-acid glycoprotein	Slight ↓ free fraction of basic drugs	Lidocaine
↓ Lean body mass	Alters drug distribution and tissue uptake	Various drugs

Elderly patients generally exhibit **increased distribution of lipophilic drugs, decreased distribution of hydrophilic drugs, and increased free concentrations of albumin-bound acidic drugs**, necessitating careful dose selection and monitoring.

The age-related physiological changes which may affect drug distribution are

1. Changes in body composition

- a. reduced lean body mass
- b. reduced total body water
- c. increased total body fat
- d. lower serum albumin level
- e. α_1 -acid glycoprotein level unchanged or slightly raised.

2. Effect on Volume of Distribution (Vd)

A. Fat-Soluble (Lipid-Soluble) Drugs : Increased body fat increases the **volume of distribution (Vd)** of lipophilic drugs.

These drugs may have: Longer half-life ,
Prolonged duration of action, Greater drug accumulation

Examples: Clomethiazole, Diazepam, Desmethyldiazepam, Thiopental

B. Water-Soluble Drugs: Reduction in total body water decreases the **volume of distribution (Vd)** of hydrophilic drugs.

This may lead to: Higher plasma drug concentrations, Increased risk of toxicity

Examples: Cimetidine , Digoxin, Ethanol

3. Effect on Plasma Protein Binding

A. Albumin Binding

1. **Acidic drugs** primarily bind to **plasma albumin**.
2. Serum albumin levels decrease with age.
3. Reduced albumin leads to:
 - a. Increased free (unbound) drug concentration
 - b. Enhanced pharmacological and toxic effects

Examples of acidic drugs affected: Cimetidine, Furosemide, Warfarin

B. α 1-Acid Glycoprotein Binding

1. **Basic drugs** primarily bind to **α 1-acid glycoprotein**.
2. Levels remain unchanged or increase slightly with aging.
3. This may cause:
 - a. Slight reduction in free drug concentration
 - b. Usually minimal clinical significance

Example: Lidocaine

METABOLISM & ELIMINATION

Age-Related Changes in Drug Metabolism and Elimination: Renal and Hepatic Clearance

I. Hepatic Clearance in Older Adults

1. Hepatic clearance depends on: Hepatic blood flow (Q), Hepatic extraction ratio (E) Relationship:

$$Cl_H = Q \times \frac{C_a - C_v}{C_a} = Q \times E$$

$$Cl_H = Q \times E$$

Where: **Cl_H** = Hepatic clearance, **Q** = Hepatic blood flow. **E** = Hepatic extraction ratio

1. Factors Affecting Hepatic Extraction

2. Liver size
2. Hepatic blood flow
3. Uptake into hepatocytes
4. Affinity of hepatic enzymes
5. Activity of hepatic enzymes

1. Age-Related Changes in the Liver

1. Reduction in Liver Size: With aging:

Liver mass decreases progressively.

Approximately **20–40% reduction** occurs between the 3rd and 10th decades of life.

2. Reduction in Hepatic Blood Flow

Hepatic blood flow decreases proportionally with liver size.

Reduced blood flow decreases hepatic drug clearance.

Effect of Aging on Hepatic Drug Elimination

Age-related reductions in:

- Liver mass
- Hepatic blood flow

result in:

- Reduced clearance of many hepatically metabolized drugs
- Increased plasma drug concentrations
- Prolonged half-life
- Greater risk of adverse effects

Causes of Impaired Hepatic Clearance

Primary Cause

Morphological changes

- Reduced liver size
- Reduced hepatic blood flow

These are more important than enzyme changes in healthy older adults.

Secondary Cause

Reduced enzyme activity

Usually not significant in healthy elderly individuals.

However, in frail or debilitated elderly patients:

- Plasma esterase activity may decrease.
- Hepatic glucuronyltransferase activity may decrease.

This can further impair drug metabolism.

Types of Hepatic Drug Clearance

A. Flow-Limited Clearance (High Extraction Drugs)

Characteristics:

- High extraction ratio (E)
- Rapid metabolism by the liver
- Clearance depends mainly on hepatic blood flow

Rate-limiting step: Hepatic blood flow

Examples: Lidocaine, Propranolol, Morphine

Effect of Aging: Reduced hepatic blood flow causes reduced drug clearance.

B. Capacity-Limited Clearance (Low Extraction Drugs)

Characteristics:

- Low extraction ratio (E)
- Clearance depends on:
 - Hepatic uptake
 - Enzyme activity
 - Enzyme affinity

Relatively independent of hepatic blood flow

Examples: Warfarin, Phenytoin, Theophylline

II. Renal Clearance in Older Adults

1. Age-Related Changes in Renal Function : These changes can reduce the elimination of many drugs and their metabolites.

1. ↓ Glomerular Filtration Rate (GFR)
 2. ↓ Effective Renal Plasma Flow
 3. ↓ Renal Tubular Function
- Healthy older adults consuming a high-protein diet may maintain GFR values similar to younger adults.
 - Declines in renal function may be more related to: Hypertension, Heart disease , Other comorbid illness
 - Because renal function varies greatly among older adults:
 1. Drug doses should be individualized.
 2. Renally excreted drugs may accumulate and cause toxicity.
 3. Careful monitoring is required, especially for drugs with a narrow therapeutic index.

1. **Drugs Requiring Dose Reduction**

A. Drugs with a Narrow Therapeutic Index

Dose reduction is often necessary because even small increases in concentration can cause toxicity.

Examples: Digoxin Aminoglycosides (Gentamicin, Amikacin)

B. Drugs with a Wide Therapeutic Index

Dose adjustment may not always be required.

Example: Penicillins

1. **Drugs to Avoid in Severe Renal Impairment:** Increased risk of drug accumulation and toxicity.

Avoid if Creatinine Clearance < 30 mL/min: Colchicine, Cotrimoxazole, Glyburide, Nitrofurantoin, Probenecid, Spironolactone, Triamterene

1. **Drugs Requiring Dose Adjustment in Renal Impairment**

The following medications require dosage reduction in older adults with reduced renal function: Acyclovir, Amantadine, Ciprofloxacin, Gabapentin, Memantine, Ranitidine, Valacyclovir

1. **Active Metabolites that Accumulate with Reduced Renal Function :** Some drugs undergo hepatic metabolism but produce active metabolites that are primarily eliminated by the kidneys.

Reduced renal function leads to accumulation of these metabolites.

May result in: Prolonged drug action, Increased adverse effects, Drug toxicity

Example : Procainamide → N-acetylprocainamide (NAPA)

II. Estimation of Renal Function

1. Creatinine Clearance (CrCl)

1. Creatinine clearance is commonly used to estimate renal function.
2. It serves as a practical guide for drug dosage adjustments.
3. Although not perfectly accurate, it remains the standard method used in clinical practice.

2. Cockcroft–Gault Equation

The Cockcroft–Gault equation is the most commonly used method for estimating creatinine clearance in adults with stable renal function.

Formula

$$\text{Creatinine clearance} = \frac{(140 - \text{Age}) (\text{Actual body weight})}{72 (\text{Serum creatinine concentration})}$$

For women:

- Multiply the calculated value by **0.85**

Units: mL/min

- Current dosing guidelines for renally eliminated drugs continue to rely on Cockcroft–Gault estimated creatinine clearance.
- It remains the recommended method for renal drug dosing in older adults.

ALTERED PHARMACODYNAMICS

Older adults generally exhibit: Altered drug responses, Increased drug sensitivity, Greater susceptibility to adverse drug reactions

I. Mechanisms of Altered Pharmacodynamic Response

A. Changes in Drug Concentration at the Receptor Site

- Different amounts of drug may reach receptor sites.
- This can alter the intensity of the drug response.

B. Changes in Receptor Numbers

- Aging may increase or decrease the number of receptors available for drug binding.
- This alters tissue responsiveness to drugs.

C. Changes in Receptor Affinity

- Receptors may bind drugs more or less strongly.
- This can enhance or reduce drug effects.

D. Post-Receptor Alterations

- Changes may occur in intracellular signaling pathways after receptor activation.
- Drug responses may be amplified or diminished despite normal receptor binding.

E. Impairment of Homeostatic Mechanisms

- Aging reduces the body's ability to maintain physiological balance.
- Older adults are less able to compensate for drug-induced changes.

3. Reasons for Different Drug Responses in Older Adults

Differences in pharmacodynamic responses may result from:

A. Altered Sensitivity

- Greater drug effect for a given drug concentration.
- The same dose may produce a larger response than in younger adults.

B. Differences in Baseline Performance

- Physiological reserve declines with age.
- Drug effects become more pronounced because baseline function is reduced.

C. Differences in Drug Concentration at the Site of Action

- Drug concentrations reaching receptors may differ between young and older individuals.

Increased Sensitivity of the Central Nervous System (CNS)

Older adults are particularly sensitive to the CNS effects of medications.

I. Age-Related CNS Changes

1. **Structural Changes** : Decrease in brain size , Decrease in brain weight
2. **Neurotransmitter Changes** : Alterations in several neurotransmitter systems occur with aging.
3. **Increased CNS Drug Penetration** : Some drugs may cross the blood-brain barrier more readily in older adults.

II. Age-Related Changes in the Dopaminergic System

Several changes occur in dopamine pathways with aging:

- ↓ Dopamine transporter levels
- ↓ Number of dopaminergic neurons
- ↓ Density of dopamine receptors

These changes contribute to:

1. Increased sensitivity to antipsychotic drugs
2. Greater risk of extrapyramidal symptoms
3. Increased risk of sedation and cognitive impairment

Age-Related Cardiovascular Changes

Aging causes multiple structural and functional changes in the cardiovascular system:

1. Reduced baroreceptor sensitivity
2. Reduced cardiac reserve
3. Increased arterial stiffness
4. Reduced autonomic responsiveness

These changes predispose older adults to altered responses to cardiovascular drugs.

Orthostatic Hypotension : A sudden drop in blood pressure upon standing.

Why It Occurs More Frequently Due to: Impaired autonomic responses , Reduced baroreceptor reflexes, Decreased cardiovascular reserve

Clinical Consequences: Dizziness, Falls, Syncope, Fractures

Drug/Class	Age-Related Pharmacodynamic Change	Clinical Consequence
Benzodiazepines	Increased sensitivity	Sedation, falls
Opioids	Increased sensitivity	Respiratory depression, delirium
Antipsychotics	Increased sensitivity	Extrapyramidal effects, sedation
Anticholinergics	Increased sensitivity	Cognitive impairment, delirium
Lithium	Increased sensitivity	Neurotoxicity
Calcium channel blockers	Increased hypotensive and bradycardic effects	Dizziness, syncope
β -Blockers	Reduced BP response	Reduced effectiveness
Diuretics	Reduced effectiveness	Less predictable response
Warfarin	Increased sensitivity	Increased bleeding risk

TABLE e7-3 The *Is* of Geriatrics: Common Problems in Older Adults³

Immobility	Instability
Isolation	Intellectual impairment
Incontinence	Impotence
Infection	Immunodeficiency
Inanition (malnutrition)	Insomnia
Impaction	Iatrogenesis
Impaired senses	

TABLE e7-4 Atypical Disease Presentation in Older Adults^{37,38}

Disease	Presentation
Acute myocardial infarction	Only ~50% present with chest pain. In general, older adults present with weakness, confusion, syncope, and abdominal pain; however, electrocardiographic findings are similar to those in younger patients.
Congestive heart failure	Instead of dyspnea, older patients may present with hypoxic symptoms, lethargy, restlessness, and confusion.
Gastrointestinal bleed	Although the mortality rate is ~10%, presenting symptoms are nonspecific, ranging from altered mental status to syncope with hemodynamic collapse. Abdominal pain often is absent.
Upper respiratory infection	Older patients typically present with lethargy, confusion, anorexia, and decompensation of a preexisting medical condition. Fever, chills, and a productive cough may or may not be present.
Urinary tract infection	Dysuria, fever, and flank pain may be absent. More commonly, older adults present with incontinence, confusion, abdominal pain, nausea or vomiting, and azotemia.

Drug-Related Problems in Older Adults

- Medications play an important role in improving the **Health-Related Quality of Life (HRQOL)** of older adults.
- However, drug therapy can also lead to significant negative outcomes.
- Many drug-related problems in older adults are **preventable** through careful prescribing, monitoring, and medication review.

Major Drug-Related Problems in Older Adults

Three important and potentially preventable negative outcomes are:

1. Adverse Drug Withdrawal Events (ADWEs)
2. Therapeutic Failure
3. Adverse Drug Reactions (ADRs)

Why Older Adults Are Particularly Vulnerable

Older adults often have:

1. Multiple chronic diseases
2. Polypharmacy
3. Reduced renal and hepatic function
4. Altered pharmacodynamics
5. Cognitive impairment
6. Increased susceptibility to medication errors

These factors increase the likelihood of drug-related problems.

Drug-Related Problem	Definition	Example
Adverse Drug Withdrawal Event (ADWE)	Symptoms occurring after stopping a drug	Rebound hypertension after stopping β -blockers
Therapeutic Failure	Failure of drug therapy to achieve desired outcome	Uncontrolled hypertension due to inadequate treatment
Adverse Drug Reaction (ADR)	Harmful and unintended effect at normal doses	Bleeding with warfarin

Feature	Adverse Drug Withdrawal Events (ADWEs)	Therapeutic Failure	Adverse Drug Reactions (ADRs)
Definition	Problems that occur when a drug is suddenly stopped or reduced.	Drug therapy fails to achieve the desired effect.	Harmful and unintended effects of a drug at normal doses.
Main Causes	• Sudden drug withdrawal • Rapid dose reduction • No proper tapering	• Wrong drug • Low dose • Poor adherence • Drug interactions	• Polypharmacy • Multiple diseases • Age-related changes in the body
Examples	• Benzodiazepine withdrawal • Rebound hypertension • Rebound angina • Opioid withdrawal	• Uncontrolled hypertension • Failure to prescribe anticoagulants • Antibiotic treatment failure	• Warfarin-induced bleeding • Hypoglycemia • Falls due to sedatives • Delirium
Consequences	• Return of symptoms • Discomfort • Hospitalization	• Disease progression • Increased illness • Hospitalization	• Functional decline • Hospitalization • Increased mortality
Prevention	• Taper drugs gradually • Monitor during withdrawal	• Review medications regularly • Use correct drug and dose	• Start low, go slow • Monitor for side effects • Regular medication review

Risk Factors for Drug-Related Problems in Older Adults

Older adults are at increased risk of drug-related problems because of multiple diseases, age-related physiological changes, and the frequent use of medications. The major risk factors include:

1. Polypharmacy

The concomitant use of multiple medications.

OR

The use of more medications than are clinically indicated.

- Polypharmacy is common and increasing among older adults.
- Community-based surveys show that older adults take an average of: 2–10 prescription and nonprescription medications daily.
- Use of dietary supplements further contributes to polypharmacy: Herbal products, Vitamins, Minerals
- **Consequences of Polypharmacy : Adverse Drug Reactions (ADRs), Geriatric Syndromes - Falls, Cognitive impairment, Delirium, Frailty, Medication Nonadherence, Functional Decline, Increased Healthcare Costs**

2. Inappropriate Prescribing

Prescribing medications outside accepted medical standards.

OR

Prescribing drugs whose risks outweigh their potential benefits.

Common Forms of Inappropriate Prescribing

1. Incorrect Dose
2. Excessive Duration
3. Therapeutic Duplication
4. Drug Interactions
5. High-Risk Medications

3. Underuse of Medications

Underuse is:

Failure to prescribe medications that are indicated for treatment or prevention of disease.

This represents an important but often overlooked drug-related problem.

Consequences of Underuse

1. Disease progression
2. Increased morbidity
3. Poor clinical outcomes
4. Increased hospitalization

Examples of Underuse

- Failure to prescribe anticoagulants in atrial fibrillation
- Failure to prescribe ACE inhibitors in heart failure
- Failure to prescribe bisphosphonates in osteoporosis

4. Medication Nonadherence

The extent to which a person's behavior does not correspond with agreed recommendations from a healthcare provider.

Factors Contributing to Nonadherence

- A. Patient-Related Factors
- B. Condition-Related Factors
- C. Therapy-Related Factors
- D. Health-System and Social Factors

Consequences of Nonadherence

Therapeutic failure
Disease progression
Increased hospital admissions
Increased healthcare costs
Reduced quality of life

Why Older Adults Become Nonadherent

1. Older patients may fail to follow prescribed regimens because of:
2. Fear of adverse effects
3. Complex medication schedules
4. Difficulty understanding medication instructions
5. Cognitive decline
6. Physical limitations (e.g., poor vision, arthritis)
7. Cost of medications

Assessment Tools

STOPP Criteria

Screening Tool of Older Persons' Potentially Inappropriate Prescriptions (STOPP)

Used to identify:

- Potentially inappropriate medications
- Drug interactions
- Therapeutic duplication
- Excessive treatment duration

START Criteria

Screening Tool to Alert Doctors to Right Treatment (START)

Focuses on identifying omissions of beneficial medications.

Particularly useful for diseases involving: Cardiovascular system, Respiratory system, Endocrine system

ACOVE Criteria

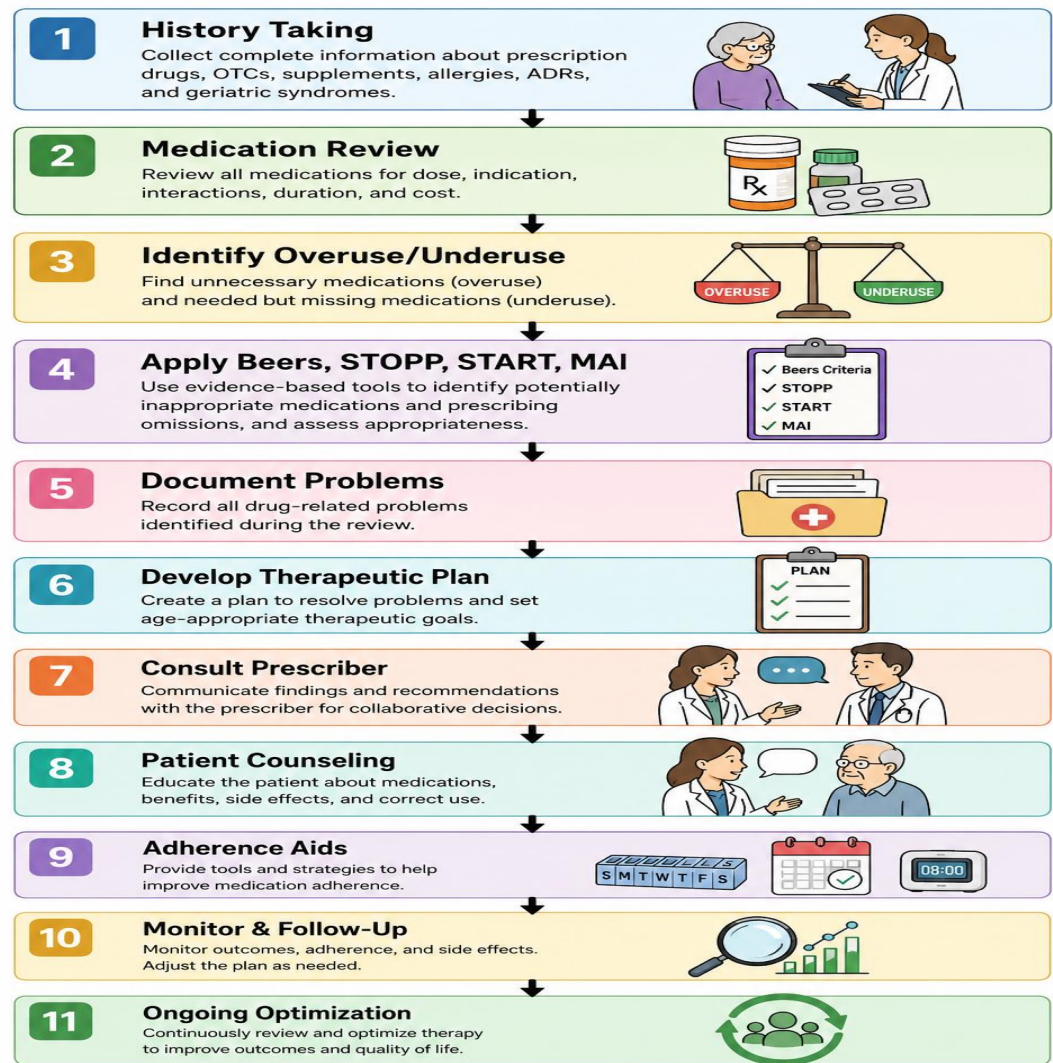
Assessing the Care of Vulnerable Elders (ACOVE)

Identifies underuse of important therapies such as:

- Bisphosphonates
- Anticoagulants
- Antiplatelet agents
- ACE inhibitors
- β -blockers

Provision of Comprehensive Geriatric Assessment (CGA)

Comprehensive Geriatric Assessment (CGA) is a systematic approach used to identify, prevent, and manage drug-related problems in older adults and optimize medication use.



MEDICATION APPROPRIATENESS INDEX (MAI)

An implicit, judgment-based tool to assess the appropriateness of medication prescribing, especially in older adults.



1. DEFINITION

The Medication Appropriateness Index (MAI) is an implicit, judgment-based tool used to evaluate the appropriateness of each medication prescribed to a patient. It assesses multiple aspects of prescribing, including indication, effectiveness, dosage, interactions, duration and cost.



2. HISTORY

- 1992 – Developed by Joseph T. Hanlon and colleagues as a tool to assess prescribing quality in older patients with polypharmacy.
- 1994 – Modified by Samsa et al. by introducing a weighted scoring system to generate a single numerical score for each medication.
- Since then, MAI has been widely used in research and clinical practice to evaluate medication use and the impact of pharmacist/clinical interventions.



3. PURPOSE / USES

- Evaluate prescribing quality.
- Detect potentially inappropriate prescribing.
- Assess polypharmacy.
- Monitor the effect of medication review or intervention.
- Support medication therapy management in older adults.

8. EXAMPLE OF SCORING FOR ONE MEDICATION

Criterion	Rating (A/B/C)	If Inappropriate (Score)	Score Obtained
1. Indication	B	3	1.5
2. Effectiveness	A	3	0
3. Dosage	C	2	2
4. Correct Directions	B	2	1
5. Practical Directions	A	1	0
6. Drug–Drug Interactions	C	2	2
7. Drug–Disease Interactions	A	2	0
8. Duplication	A	1	0
9. Duration	B	1	0.5
10. Cost	C	1	1

Total MAI Score for this medication

8 (out of 18)

4. THE TEN MAI CRITERIA

No.	Criterion	Question
1	Indication	Is there an indication for the drug?
2	Effectiveness	Is the medication effective for the condition?
3	Dosage	Is the dosage correct?
4	Directions	Are the directions correct?
5	Practical Directions	Are the directions practical?
6	Drug–Drug Interactions	Are significant interactions absent?
7	Drug–Disease Interactions	Are significant interactions absent?
8	Duplication	Is unnecessary duplication avoided?
9	Duration	Is the duration of therapy acceptable?
10	Cost	Is the medication the least expensive effective alternative?

5. RATING SYSTEM

For each criterion, the evaluator assigns one of the following ratings based on clinical judgment.

A	Appropriate
B	Marginally Appropriate
C	Inappropriate



7. INTERPRETATION

- Minimum score = 0 (completely appropriate)
- Maximum score = 18 per medication (highly inappropriate)
- Total patient MAI score = Sum of scores for all medications.

Lower score = Better prescribing quality

Higher score = More inappropriate prescribing

6. SCORING SYSTEM

Criterion	Weight (Score if Inappropriate)
1. Indication	3
2. Effectiveness	3
3. Dosage	2
4. Correct Directions	2
5. Practical Directions	1
6. Drug–Drug Interactions	2
7. Drug–Disease Interactions	2
8. Duplication	1
9. Duration	1
10. Cost	1



9. ADVANTAGES

- ✓ Evaluates multiple dimensions of prescribing.
- ✓ Applicable to any medication (prescription, OTC, PRN, etc.).
- ✓ Considers effectiveness, dosage, duration, interactions, and cost.
- ✓ More patient-specific than explicit tools.
- ✓ Helpful in monitoring outcomes of medication interventions.
- ✓ Demonstrates good reliability, validity, and responsiveness.



10. LIMITATIONS

- Time-consuming to perform.
- Requires trained and experienced clinicians.
- Relies on evaluator's clinical judgment.
- Does not directly assess:
 - Underprescribing
 - Polypharmacy burden
 - Medication adherence
 - Drug allergies
- Different evaluators may give slightly different scores.



11. MAI vs BEERS CRITERIA

Feature	MAI	Beers Criteria
Type of tool	Implicit	Explicit
Approach	Clinical judgment	Predefined list
Patient-specific	Yes	Limited
Evaluates effectiveness	Yes	No
Evaluates dosage	Yes	Limited
Evaluates cost	Yes	No
Considers interactions	Yes	Yes (limited)
Time required	High	Low
Ease of use	Moderate–Difficult	Easy
Primary use	Detailed medication review	Screening for PIMs



12. CLINICAL SIGNIFICANCE

Higher MAI scores are associated with adverse drug events, drug-related hospitalizations, and poorer health outcomes. Using MAI helps improve prescribing quality, reduce medication-related problems, and optimize therapy in older adults.

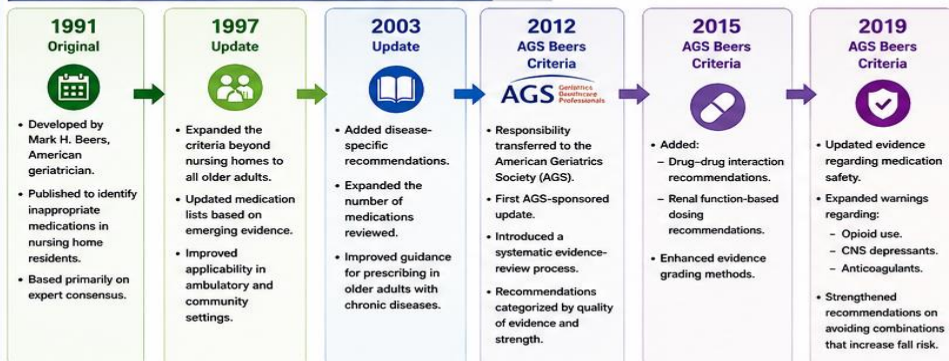


KEY POINT

The Medication Appropriateness Index (MAI) is a patient-centered, implicit tool developed by Hanlon et al. in 1992 that evaluates the appropriateness of each medication using 10 criteria and a weighted score ranging from 0–18, with lower scores indicating better prescribing quality.

AGS BEERS CRITERIA® : HISTORY, EVOLUTION AND OVERVIEW

1. HISTORY OF BEERS CRITERIA (IN SERIAL ORDER)



5. MAJOR CATEGORIES IN CURRENT BEERS CRITERIA

1. MEDICATIONS TO AVOID IN MOST OLDER ADULTS



These drugs generally have a higher risk than benefit.

Examples

- First-generation antihistamines
- Anticholinergics in delirium
- Long-acting benzodiazepines
- Certain skeletal muscle relaxants
- Certain antispasmodics

2. MEDICATIONS TO AVOID IN SPECIFIC DISEASES OR SYNDROMES



These drugs may worsen particular conditions.

Examples

- Benzodiazepines in dementia
- Anticholinergics in delirium
- NSAIDs in heart failure
- Certain drugs in patients with history of falls

3. MEDICATIONS TO USE WITH CAUTION



These medications may be appropriate in some situations but require careful monitoring.

Examples

- Diuretics
- Aspirin for primary prevention
- Certain antidepressants

4. CLINICALLY IMPORTANT DRUG-DRUG INTERACTIONS



Certain medication combinations increase the risk of serious adverse events.

Examples

- Opioids + benzodiazepines
- Opioids + gabapentinoids
- Multiple CNS-active medications

5. MEDICATIONS REQUIRING RENAL DOSE ADJUSTMENT



Certain medications require dosage modification in patients with reduced kidney function.

Examples

- Direct oral anticoagulants (DOACs)
- Certain antidiabetic drugs
- H₂ receptor antagonists

2. EVOLUTION AT A GLANCE

Year	Major Development
1991	Original criteria for nursing home residents
1997	Expanded to all older adults
2003	Added disease-specific recommendations
2012	First AGS update; evidence-based methodology introduced
2015	Added drug interactions and renal dosing recommendations
2019	Expanded opioid and CNS depressant warnings
2023	Updated evidence, renal dosing, and deprescribing recommendations

3. DEFINITION



Beers Criteria is a list of medications that may pose more risk than benefit in older adults and should generally be avoided or used cautiously unless clinically justified.

4. OBJECTIVES



- Improve medication safety.
- Reduce adverse drug reactions (ADRs).
- Reduce polypharmacy.
- Prevent medication-related hospitalizations.
- Improve quality of life in older adults.
- Assist healthcare professionals in rational prescribing.

6. COMMON POTENTIALLY INAPPROPRIATE MEDICATIONS

Drug/Class	Major Concern
Diphenhydramine and other first-generation antihistamines	Confusion, sedation, falls
Benzodiazepines	Cognitive impairment, delirium, falls
Long-acting sulfonylureas	Severe prolonged hypoglycemia
NSAIDs (chronic use)	GI bleeding, renal impairment
Skeletal muscle relaxants	Sedation, fracture risk
Anticholinergic drugs	Cognitive decline and confusion

7. COMPARISON OF RECENT AGS BEERS CRITERIA EDITIONS

Feature	2012	2015	2019	2023
Medications to avoid in older adults	✓	✓	✓	✓
Disease-specific recommendations	✓	✓	✓	✓
Use with caution category	✓	✓	✓	✓
Drug-drug interactions	—	✓	✓	✓
Renal dosing recommendations	—	✓	✓	✓
Deprescribing emphasis	Limited	Moderate	Moderate	Extensive
Updated opioid recommendations	Limited	Moderate	Expanded	Expanded
Updated evidence review	✓	✓	✓	✓

8. CLINICAL SIGNIFICANCE



- Helps identify potentially inappropriate medications.
- Reduces adverse drug events.
- Minimizes falls and fractures.
- Prevents delirium and cognitive decline.
- Reduces hospital admissions.
- Improves medication review and deprescribing practices.

9. LIMITATIONS



- It is a screening tool, not an absolute rule.
- Some medications listed may still be appropriate in selected patients.
- Clinical judgment should always guide therapy.
- Does not replace individualized patient assessment.



10. KEY TAKEAWAY

The Beers Criteria, first developed by Mark H. Beers in 1991, has evolved through multiple updates into the most widely used evidence-based guideline for identifying potentially inappropriate medications in older adults. The current 2023 AGS Beers Criteria provides comprehensive recommendations regarding medication avoidance, disease-specific prescribing, drug interactions, renal dosing, and deprescribing to promote safe and effective pharmacotherapy in geriatric patients.

References :-

- Pharmacotherapy, A Pathologic Approach by J.Dipiro
- Clinical Pharmacy and Therapeutics by Roger Walker