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The Beers Criteria: Screening for Potentially Inappropriate Medications in the Elderly

Prescribing medications for elderly patients presents many unique challenges. As we age, our bodies undergo physiologic changes that affect how medications are absorbed, distributed, metabolized, and eliminated. These changes often make elderly patients more sensitive to the effects of medications. However, there are criteria that can help practitioners reduce the risk of patient harm by guiding more appropriate drug selection in the elderly commonly known as the Beers Criteria.

Between 1960 and 1994, the number of persons aged 65 and older doubled, and individuals aged 85 years and older increased 274%.¹ Today, people over age 65 account for 15% of the US population but consume more than one-third of all prescription and over-the-counter (OTC) medications.^{2,3} In Pennsylvania, 41% of patients admitted to the hospital are 65 years or older.⁴ It should therefore come as no surprise that patients over age 65 are involved in 41% of the adverse drug reaction reports and almost 60% of the medication-related fall reports submitted to PA-PSRS.

Pharmacodynamics in the Elderly⁵

As a person ages their total body water decreases while their relative percentage of body fat increases. These changes affect how some drugs are distributed in the body. The decrease in total body water can lead to higher blood concentrations of some water-soluble drugs. The relative increase in body fat may increase the total amount of drug stored in the body for lipid-soluble drugs and may result in longer half-lives of those medications. Some drugs bind to albumin in the blood stream, but with age, serum albumin levels decrease. This may enhance a drug's effect by increasing serum concentrations of unbound (active) drug.

Many medications are metabolized by the liver. With age, decreased hepatic mass and hepatic blood flow can slow the rate of hepatic elimination. In addition, hepatic clearance of many drugs, such as diazepam, amitriptyline, and chlordiazepoxide, carried out by the cytochrome P-450 system often diminishes with age. Overall, the clearance of drugs metabolized by the liver is typically decreased 30 to 40% in the elderly.

Renal size and renal blood flow also decrease significantly with age. However, serum creatinine levels

may remain within normal limits because the elderly have less lean body mass and produce less creatinine. These "normal" serum creatinine levels may mislead practitioners to believe that drug adjustments for renally excreted drugs are not necessary. However, this is often not the case, as these physiologic changes to the kidneys decrease renal clearance of drugs necessitating a dose adjustment.

Many drugs produce active metabolites in clinically significant concentrations. Examples include some benzodiazepines (e.g., diazepam, chlordiazepoxide), tertiary amine antidepressants (e.g., amitriptyline, imipramine), antipsychotics (e.g., chlorpromazine, thioridazine, risperidone), and opioid analgesics (e.g., meperidine, propoxyphene). Age-related decreases in renal clearance, particularly in patients with any additional renal disease, can lead to increased accumulation of these metabolites, increasing the risk of toxicity unless maintenance doses are reduced.

Adverse Drug Events and Beers Criteria

Many studies demonstrate the vulnerability of elderly patients to adverse drug events (ADEs) that may be due to the physiologic changes of aging. Problems in this population such as depression, constipation, falls, immobility, confusion, urinary retention, incontinence, anorexia, and hip fractures have been linked to *preventable* ADEs. One study showed that 30% of hospital admissions of elderly patients may be linked to drug-related problems including toxic effects.^{6,7} A 1997 study of ADEs found that 35% of ambulatory older adults experienced an ADE and 29% required health care services (physician, emergency department, or hospitalization) for the ADE.⁶ ADEs also affect drug regimen adherence in the elderly. A study of 20 elderly patients hospitalized due to non-adherence

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The Beers Criteria: Screening for Potentially Inappropriate Medications in the Elderly (Continued)

found that adverse effects were the most common reason (35%).⁸ Data from PA-PSRS show that 62% of medication-related falls that result in a Serious Event affected the elderly.

In 1991, 13 nationally recognized experts in geriatrics reached a consensus on explicit criteria for certain medications that may lead to ADEs and were considered to be inappropriate for use in nursing home patients. These criteria were originally developed by Dr. Mark Beers and are commonly referred to as the “Beers Criteria.” The criteria, most recently updated in 2003,^{9,10} are based on the risk-benefit definition of appropriateness, meaning that the use of a medication is considered to be appropriate if its use has potential benefits that outweigh potential risks.¹¹

The Beers criteria define three categories of drug use or selection that are inappropriate for elderly patients. The categories, along with some examples are:

1. Inappropriate drug choice, i.e., medications generally to be avoided in the elderly population. Examples include:
 - a) Long-acting benzodiazepines, including diazepam (VALIUM), flurazepam (DALMANE), and chlordiazepoxide (LIBRIUM) which have long half-lives. This can lead to accumulation of the drug, leading to excessive sedation and an increase in the risk of falls and fractures.
 - b) Meperidine (DEMEROL), which can cause confusion and its metabolites can lead to seizures.
 - c) Anticholinergics and antihistamines, including diphenhydramine (BENADRYL), chlorpheniramine (CHLORTRIMETON), hydroxyzine (ATARAX, VISTARIL) and promethazine (PHENERGAN). These agents have potent anticholinergic effects and cause confusion and sedation. Diphenhydramine may be used in the lowest effective dose and only for emergency treatment of allergic reactions.
2. Excess dosage, i.e., medications at a dose or duration of therapy not to be exceeded. Examples include:
 - a) Long-term use of stimulant laxatives such as bisacodyl (DULCOLAX) and cascara sagrada, which may be appropriate in the presence of opiate analgesic use, but may exacerbate bowel dysfunction.
 - b) Doses for digoxin (LANOXIN) should not exceed 0.125 mg/day except when treating

atrial arrhythmias. Diminished renal clearance of this medication increases the risk of toxicity.

3. Drug-disease interaction, i.e., medications to be avoided for patients with specific co-morbid conditions. Examples include:
 - a) Patients with cognitive impairment receiving medications such as barbiturates, anticholinergics and muscle relaxants, which can worsen cognitive performance.
 - b) Patients with a history of syncope or falls receiving medications such as short or intermediate-acting benzodiazepines and tricyclic antidepressants (amitriptyline [ELAVIL], doxepin [SINEQUAN], and imipramine [NORPRAMIN]) which may produce ataxia, impair psychomotor function, and increase falls.

The Beers criteria are intended for persons older than 65 years of age, regardless of their level of frailty. The criteria also provide a rating of severity for adverse outcomes (severe vs. less severe) as well as a summary of the prescribing concerns associated with the medication. An abbreviated list of these medications can be found in Table 1. A complete list is available at <http://mqa.dhs.state.tx.us/qmweb/MedSim/MedSimTable1.htm>.

Today, the Beers criteria are the most widely used criteria for identifying drugs that potentially increase the likelihood of ADEs in elderly patients.¹² The criteria were adopted by the Centers for Medicare & Medicaid Services (CMS) in July 1999 for evaluation of medication therapy in nursing home patients.

Numerous studies confirm that contraindicated medication use remains a serious problem for the elderly in a variety of healthcare settings.¹³⁻¹⁵ However, until recently, there was no published evidence demonstrating that the medications listed on the Beers criteria were actually associated with adverse outcomes. In Spring 2005, a study of the association between potentially contraindicated prescribing and hospitalization and death among elderly nursing home residents showed that:¹⁶

- a) The risk of hospitalization was almost 30% higher among residents who, in the preceding month, received potentially contraindicated medications that appear on the Beers criteria, and 33% higher among residents who received these medications for two consecutive months, compared with residents with no exposure.

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Table 1. Abbreviated Beers List of Medications with Increased Risk of Adverse Drug Events in Patients Over 65

Medications	Reason that Use is a Problem
Pain Relievers	
propoxyphene and combination products (Darvon®, Darvocet N-100®)	Used to control pain. Propoxyphene offers little pain-relieving advantage over acetaminophen (Tylenol®), yet has the side effects of other narcotics.
Meperidine (Demerol®)	Used to treat pain. Meperidine is not an effective oral pain reliever and has many disadvantages compared to other narcotics. Avoid using in older persons.
Antidepressants	
amitriptyline (Elavil®) doxepin (Sinequan®)	Used to treat depression. These medications can cause sedation, weakness, blood pressure changes, dry mouth, problems with urination, and can lead to falls and fractures.
Sleeping Pills and Antianxiety Medications	
flurazepam (Dalmane®)	Used to treat insomnia. This medication produces prolonged sedation/sleepiness (often lasting for days and can worsen if taken daily) and can increase the risk of falls and fractures.
alprazolam (Xanax®) 2 mg lorazepam (Ativan®) 3 mg oxazepam (Serax®) 60 mg temazepam (Restoril®) 15 mg triazolam (Halcion®) 0.25mg zolpidem (Ambien®) 5 mg	Used to treat insomnia and anxiety. Older people should be prescribed small doses of these medications. Total daily doses should rarely exceed the suggested maximum doses noted to the left.
chlordiazepoxide (Librium®) diazepam (Valium®)	Used to treat insomnia and anxiety. Chlordiazepoxide and diazepam produce prolonged sedation (often lasting several days and can worsen if taken daily) and can increase the risk of falls and fractures.
Heart Medications	
digoxin (Lanoxin®) [doses above 0.125 mg]	Used to treat abnormal heart rhythms and heart failure. Because of decreased processing of digoxin by the kidney, doses in older persons should rarely exceed 0.125 mg daily, except when treating certain types of abnormal heart rhythms.
dipyridamole (Persantine®)	Used to help stop blood from clotting in people who have experienced strokes, heart attacks, and other conditions. Dipyridamole frequently causes light-headedness upon standing in older persons. Dipyridamole has been proven beneficial only in patients with artificial heart valves. Whenever possible, its use in older persons should be avoided.
methyldopa (Aldomet®) methyldopa/HCTZ (Aldoril®)	Used to treat high blood pressure. Methyldopa may cause a slowed heart beat and worsen depression. Alternate treatments for hypertension are generally preferred.
Diabetes Medications	
chlorpropamide (Diabinese®)	Used to control blood sugar in people with diabetes. Chlorpropamide can cause prolonged and serious low blood sugar.
Stomach and Intestinal Medications	
dicyclomine (Bentyl®) hyoscyamine (Levsin®, Levsinex®) propantheline (Pro-Banthine®) belladonna alkaloids (Donnatal®)	Used to treat stomach and intestinal cramps. These medications can cause sedation, weakness, blood pressure changes, dry mouth, problems with urination, and can lead to falls and fractures. All of these drugs are best avoided in older persons, especially for long term use.
trimethobenzamide (Tigan®)	Used to control nausea. This is one of the least effective medications used to control nausea and vomiting, yet can cause severe side effects, such as stiffness, shuffling gait, difficulty swallowing, and tremor.
Antihistamines	
chlorpheniramine (Chlor-Trimeton®) diphenhydramine (Benadryl®) hydroxyzine (Vistaril®, Atarax®) cycloheptadine (Periactin®) promethazine (Phenergan®)	Used to treat the runny nose of the common cold and allergy symptoms. Most nonprescription and many prescription antihistamines can cause sedation, weakness, blood pressure changes, dry mouth, problems with urination, and can lead to falls and fractures. Many cough and cold preparations are available without antihistamines, and these are safer substitutes in older persons.
diphenhydramine (Benadryl®)	Used to treat allergies and insomnia. Diphenhydramine can cause sedation, weakness, blood pressure changes, dry mouth, problems with urination, and can lead to falls and fractures. When used to treat or prevent allergic reactions, it should be used in the smallest possible dose and with great caution.

Adapted from: <http://www.seniorcarepharmacist.com/inappropriate/>. Used with permission. For a complete list, go to <http://mqa.dhs.state.tx.us/qmweb/MedSim/MedSimTable1.htm>

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- b) The odds of death in any month were 21% higher among residents who had exposure to these medications during the month of death or the preceding month, compared to those with no exposure.

A second study published this year showed a positive association between adverse drug reactions (ADRs) and drug prescribing practices that are contrary to the Beers criteria.¹² Patients who experienced ADRs received a greater number of potentially inappropriate medications. In addition, there was a positive correlation between the number of ADRs and the number of prescribed drugs. The study also found a positive association between potentially inappropriate drug prescribing, as defined by the Beers criteria and ADRs, some of which were *preventable*, among elderly outpatients.

Analysis of PA-PSRS data shows that many reports of ADRs and falls involving the elderly cite a medication that appears on the Beers criteria, such as meperidine (DEMEROL), temazepam (RESTORIL), promethazine (PHENERGAN), and diphenhydramine (BENADRYL). Twenty percent (20%) of those ADR reports in patients over 65 describe patients receiving PHENERGAN (promethazine) and developing mental status changes such as agitation, “jitters,” and restlessness. Also, 58% of all medication-related falls in the elderly involve medications categorized as benzodiazepines or opiates, some of which may be contraindicated according to the Beers criteria.

Conclusion

The use of medications in the elderly population presents many challenges for all healthcare practitioners. Due to metabolic changes, the elderly are more prone to ADEs as well as ADRs. Though Beers' 1991 criteria were developed for elderly nursing home residents and the 1997 criteria for community-dwelling elderly, these criteria can also be used in the acute care setting. The latest studies suggest that many ADRs we attribute to medications in the elderly may actually be due to *preventable* ADEs. If the Beers criteria were followed, these ADRs may not have occurred.

The following practices may help to prevent ADEs and ADRs among the elderly:

- Reviewing the medication profile upon admission and discharge against the Beers criteria. Consider substituting non-drug based treatments. For example, studies have shown that non-pharmacologic sleep protocols for inpatients are an effective means of reducing the use of sedatives and the risks of ADEs.¹⁷
- Placing alerts into pharmacy order entry systems and computerized prescriber order entry systems for those medications on the Beers list that are prescribed for patients over age 65.
- Increasing practitioner awareness of the Beers criteria through educational sessions and distributing laminated lists of the Beers criteria.
- Monitoring elderly patients for ADRs and potential ADEs who are receiving medications that appear on the Beers criteria.
- Identifying medications in your reports to PA-PSRS for those patients involved in falls to help identify those medications that are most problematic to this population.
- Analyzing reports of ADRs, falls, and medication errors in your organization's PA-PSRS reports for patients over age 65 to see if they were receiving medications that may not follow the Beers criteria.
- When it is medically necessary to prescribe a drug to an elderly patient that is on the Beers criteria, consider starting at the lowest possible dose. For example, medications like PHENERGAN (promethazine) could be prescribed at doses as low as 6.25 mg, which may reduce the likelihood of an ADE.

By paying special attention to elderly patients who are receiving medications that appear on the Beers list we may be able to *prevent* ADEs and ADRs in this vulnerable population.

Notes

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