Medication Challenges in Older Adults

1.0 contact hours: Free

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Course Summary: Describes the prevalence of polypharmacy and its risks in older adults in light of the physiological changes of aging. It discusses Beers criteria for identifying meds inappropriate for older adults, measures to improve medication management and to enhance compliance, and describes polypharmacy related to the risk for falls.

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Criteria for Successful Completion: 80% or higher on the post test, a completed evaluation form, and payment where required. No partial credit will be awarded.

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Target Audience: Occupational Therapists, OTAs
Instructional Level: Introductory
Content Focus:

- Category 1 - Domain of OT, Client Factors
- Category 2 - Occupational Therapy Process, Outcomes

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Instructions

1. Read the course material and then complete the following forms:
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Course Objectives

When you finish this course, you will be able to:

- Define polypharmacy and explain its significance.
- Summarize the risks of multiple medications.
- Explain the Beers criteria for identifying medications inappropriate for older adults.
- Identify the scope of polypharmacy in elders and risk factors for adverse results.
- List ways of improving medication management.
- Relate polypharmacy to the risk for falls.
- Discuss physiologic changes of aging that impact the efficacy of medications and distinguish between pharmacokinetics and pharmacodynamics.
- Discuss measures that can enhance medications compliance in elders.

Background and Significance

Medication management is a challenge in caring for the older adult. More than 90% of those 65 or older use at least one medication per week, 40% take five or more, and 12% use ten or more (Gurwitz, 2004). Home care professionals can tell you that home medication management systems range from the methodical to the inventive. Elders who have difficulty opening medication bottles may utilize the "candy dish" method—dumping multiple medications into one bowl and fishing out the appropriate medication at the scheduled time. Some older adults store medications in shopping bags or shoeboxes while others carefully fill medi-sets weeks in advance. As the number of older adults increase, health professionals will spend more time evaluating medication regimens.

The rate of growth in the number and proportion of older adults is unprecedented in the history of the United States. Two factors—longer life spans and the large cohort of aging baby boomers—will combine to double the population aged 65 and older in the next twenty-five years. By 2030, there will be 71 million older adults accounting for roughly 20% of the U.S. population (CDC, 2007a). Proper use of medications is critical to proper and cost-effective chronic disease management.

Improved medical care and prevention efforts have contributed to dramatic increases in life expectancy in the United States over the past century. These factors have caused a major shift in the leading causes of death from infectious diseases and acute illnesses to chronic diseases and degenerative illnesses. The incidence of chronic disease increases with advancing age, causing Medicare expenditures to rise proportionally. Currently, about 80% of older Americans are living with at least one chronic condition (CDC, 2007a).

The cost of providing healthcare for an older American is 3 to 5 times greater than the cost for someone younger than 65. By 2030 the nation's healthcare spending is projected to increase by 25% (CDC, 2007a). A large portion of medical expenses is attributable to medication-related problems, which cost the United States 200,000 lives and $200 billion a year (Zagaria, 2006). Elders are at risk because of their high rate of medication use. In addition, age-related changes in physiology can render an older adult more sensitive to medications, making polypharmacy a major issue.

Polypharmacy

There is no universal definition of polypharmacy. Some definitions are based on the number of medications taken, while others consider whether each medication is clearly indicated (Fulton & Allen, 2005). Pugh and colleagues (2005) describe polypharmacy as using the wrong drug, the wrong dose, or the wrong duration. For the purposes of this educational activity, **polypharmacy** describes the use of multiple medications at one time, including over-the-counter (OTC) medications, dietary supplements, and herbal remedies. Polypharmacy includes prescribing more medication than is clinically indicated, using inappropriate medications, and using the correct medication for an inappropriate length of time (Lococo & Staplin, 2006; Pugh et al., 2005).

Polypharmacy significantly increases the chance for medication non-adherence, medication errors, and drug-drug, drug-food, and drug-disease interactions. The risk for adverse drug reactions (ADRs) increases as the number of medications increases. The older adult who has cognitive impairment, who is living alone, or who is seeing multiple prescribers, is especially at risk. In addition, normal changes of aging alter the effect of medications, so that medications that are appropriate for younger people may be contraindicated in older adults.

Beers Criteria

In 1991 Beers and colleagues published an expert consensus document that attempted to establish criteria for identifying medications that are inappropriate for use in older adults. The Beers criteria are commonly used to identify "potentially inappropriate medications" for older adults, meaning the risk may outweigh the benefit.

Zhan and colleagues (2001) refined the Beers list of medications by identifying drugs that should:

- Always be avoided (have serious potential effects and alternative medications are available)
- Are rarely appropriate
- Have indications for use in older patients but are frequently misused

Zhan's research showed that 21.3% of older Americans received at least one potentially inappropriate drug and 2.6% received an "always avoid" drug.

A study in seventeen Japanese long-term care facilities used the Beers criteria to assess the prevalence of inappropriate medication use. It concluded that the use of inappropriate medications was similar in Japan to that of other countries. The study noted that the highest prevalence of "inappropriate medication use dependent on the disease or condition" was found in patients with chronic constipation, who were treated with medications such as calcium channel blockers, anticholinergics, and tricyclic antidepressants (Niwata, 2006). The researchers also noted:

- 21.1% of the patients were treated with potentially inappropriate medication independent of disease or condition
- The most commonly inappropriately prescribed medication was ticlopidine (an anti-platelet), which had been prescribed for 6.3% of patients
- 18% of patients were treated with at least one inappropriate medication dependent on the disease or condition (Niwata, 2006)

A number of other studies have identified common medication culprits, including diphenhydramine, amitriptyline, and propoxyphene. Pugh and colleagues (2005) implicated pain relievers, benzodiazepines, antidepressants, and musculoskeletal agents as the cause of 61% of the incidents of inappropriate prescribing. Fick and colleagues (2003) identified two classes of medications considered problematic:

- Medications or medication classes that should generally be avoided in persons 65 years or older because they are either ineffective or they pose unnecessarily high risk for older persons and a safer alternative is available
- Medications that should not be used in older people known to have specific medical conditions (Fick et al., 2003)

Of particular note is that 66 drugs were considered by the panel to have the potential for severe adverse outcomes when used in older adults (see Medications Potentially Inappropriate for Older Adults on following page).

Medications Potentially Inappropriate for Older Adults (Adapted from Fick et al., 2003.)

A	**H**
alprazolam (Xanax)	halazepam (Paxipam)
amiodarone (Cordarone)	hydroxyzine (Vistaril, Atarax)
amitriptyline (Elavil)	hyoscyamine (Levsin, Levsinex)
amphetamines	**I**
anorexic agents	indomethacin (Indocin, Indocin SR)
B	isoxsuprine (Vasodilan)
barbiturates	**K**
belladonna alkaloids (Donnatal)	ketorolac (Toradol)
bisacodyl (Dulcolax)	**L**
C	lorazepam (Ativan)
carisoprodol (Soma)	**M**
cascara sagrada	meperidine (Demerol)
chlordiazepoxide (Librium, Mitran)	meprobamate (Miltown, Equanil)
chlordiazepoxide-amitriptyline (Limbitrol)	mesoridazine (Serentil)
chlorpheniramine (Chlor-Trimeton)	metaxalone (Skelaxin)
chlorpropamide (Diabinese)	methocarbamol (Robaxin)
chlorzoxazone (Paraflex)	methyldopa (Aldomet)
cimetidine (Tagamet)	methyldopa-hydrochlorothiazide (Aldoril)
clidinium-chlordiazepoxide (Librax)	methyltestosterone (Android, Virilon, Testred)
clonidine (Catapres)	mineral oil
clorazepate (Tranxene)	**N**
cyclandelate (Cyclospasmol)	naproxen (Naprosyn, Anaprox, Aleve)
cyclobenzaprine (Flexeril)	Neoloid
cyproheptadine (Periactin)	nifedipine (Procardia, Adalat)
D	nitrofurantoin (Macrodantin)
desiccated thyroid	**O**
dexchlorpheniramine (Polaramine)	orphenadrine (Norflex)
diazepam (Valium)	oxaprozin (Daypro)
dicyclomine (Bentyl)	oxazepam (Serax)
digoxin (Lanoxin)	oxybutynin (Ditropan)
diphenhydramine (Benadryl)	**P**
dipyridamole (Persantine)	pentazocine (Talwin)
disopyramide (Norpace, Norpace CR)	perphenazine-amitriptyline (Triavil)
doxazosin (Cardura)	piroxicam (Feldene)
doxepin (Sinequan)	promethazine (Phenergan)
E	propantheline (Pro-Banthine)
ergot mesyloids (Hydergine)	propoxyphene (Darvon) and combination products
estrogens	**Q**
ethacrynic acid (Edecrin)	quazepam (Doral)
F	**R**
ferrous sulfate (iron)	reserpine (Serpalan, Serpasil)
fluoxetine (Prozac)	**T**
flurazepam (Dalmane)	temazepam (Restoril)
G	thioridazine (Mellaril)
guanadrel (Hylorel)	ticlopidine (Ticlid)
guanethidine (Ismelin)	triazolam (Halcion)
	trimethobenzamide (Tigan)
	tripelennamine

Pugh and colleagues (2005) recommend intervening with the most commonly misused medications to have the greatest impact; however, the extent of Fick's list explains why inappropriate prescribing is so difficult to manage. There are many medications on the questionable list, and research constantly identifies more problematic medications. In addition, deciding when a medication is inappropriate because of medical condition, genetic predisposition, or age is a complex task. Understanding how the scope of the problem highlights the importance of being alert to polypharmacy when caring for older adults.

Scope of Polypharmacy

Elders make up 13% of the American population but receive 34% of all prescriptions and consume 40% of all nonprescription medications (Garcia, 2006). The average person over the age of 65 takes twice as many medications as a younger person. These might be prescription medications, recreational drugs, over-the-counter (OTC) medications, or herbal remedies.

In the United States, nearly 30% of all hospital admissions are older adults who have not taken their medications properly. The classes of drugs most commonly associated with adverse drug reactions in older adults include diuretics, warfarin, nonsteroidal anti-inflammatory drugs (NSAIDs), selective serotonin reuptake inhibitors (SSRIs), beta blockers, and angiotensin-converting enzyme inhibitors (ACEI) (Cresswell, 2007).

In a 12-month cohort study of nearly 28,000 Medicare+Choice enrollees cared for in an ambulatory clinic 1999–2000, researchers found that 75% of the participants received prescriptions for six or more prescription drugs. The list that follows presents specific prescription medication categories and percentages of enrollees receiving prescriptions (Lococo & Staplin, 2006).

- Cardiovascular (53.2%)
- Antibiotics/anti-infectives (44.5%)
- Diuretics (29.5%)
- Opioids (21.9%)
- Anti-hyperlipidemics (21.7%)
- Nonopioid analgesics (19.8%)
    - Gastrointestinal tract (19.0%)
    - Respiratory tract (15.6%)
    - Dermatologic (14.8%)
- Antidepressants (13.2%)
- Sedatives/hypnotics (12.9%)
- Nutrients/supplements (12.3%)
- Hypoglycemics (11.5%)
- Steroids (9.7%)
- Ophthalmics (9.6%)
- Thyroid (9.4%)
- Antihistamines (9.2%)
- Hormones (9.1%)
- Anticoagulants (7.0%)
- Muscle relaxants (5.4%)
- Osteoporotics (5.3%)
- Anti-seizure (3.4%)
- Anti-gout (3.2%)
- Anti-neoplastics (2.8%)
- Anti-platelets (1.3%)
- Anti-psychotics (1.2%)
- Anti-parkinsonians (0.9%)
- Alzheimer disease (0.9%)
- Immunomodulators (0.04%)

Risk Factors

Healthcare providers need to be alert to the potential for polypharmacy and its complications. It is essential to identify risk factors in the patients we treat in order to manage medications appropriately (see table below).

Polypharmacy increases the risk of potentially inappropriate prescriptions, cognitive disorders, falls, hip fractures, depression, and incontinence. Inappropriate medications complicate polypharmacy because many of the drugs classified as potentially inappropriate are associated with ADRs, some offer little or no advantage over other, safer drugs, and some have a long half-life in older patients (Lococo & Staplin, 2006).

Risk Factors for Adverse Effects from Polypharmacy

Category	Characteristic(s) indicating high risk
Age	Over 75 years of age
Living situation	Living alone
Medications	Taking multiple drugs, OTC, social drugs
Medical	• Multiple prescribers, such as physicians, psychiatrists, dentists, podiatrists, or nurse practitioners • Multiple medical problems • Multiple caregivers • Poor communication between older patients and health professionals
Cognition	• Impaired alertness or memory • Psychiatric problems • Inability to take medications as directed
Physical	• Appears weak and with impaired mobility • Needing a walker or cane

Improving Medication Management

Because older adults must manage a plethora of chronic illnesses with medications, it is critical to ensure that each medication is essential and taken as prescribed. When financial resources are stretched, elders may extend medications by creative self-administration strategies.

Elders with low income, those without adequate prescription drug coverage, and those using high-cost medications are likely to stretch out their medication supply by skipping doses or extending the interval between doses. Strategies to decrease the number of tablets needed include taking a smaller dose (splitting tablets or taking one when multiple tablets are prescribed) and substituting an OTC or herbal alternative. Taking a lower-than-prescribed dose is especially prevalent in patients with multiple medical conditions using many medications, those prone to medication side effects, and people who resist prescribed treatment due to personal or cultural beliefs.

Although these activities are not in the realm of polypharmacy per se, they are related, in that appropriate prescribing ensures that older adults purchase only the medications they need. Left to decide which medication to extend, the elder may neglect taking a critical medication, for example an anti-hypertensive, and continue taking a noncritical medication. Hypertension is asymptomatic, so an older adult might favor taking a proton pump inhibitor (PPI) for gastric discomfort and skip doses of the antihypertensive to save money.

A wise health worker may identify the PPI as an expensive medication that might be substituted for a less expensive but effective alternative (in this case, an H2-blocker might work). Identifying problems such as this in a medication regimen could potentially reduce the overall cost of medications for the patient so both the anti-hypertensive and an effective remedy for gastric discomfort can be afforded.

The Gerontological Nursing Interventions Research Center at the University of Iowa has published four recommendations designed to improve medication management in older adults. They are:

- Reduce inappropriate prescribing
- Decrease polypharmacy
- Avoid adverse events
- Maintain functional status (Bergman-Evans, 2004)

Reduce Inappropriate Prescribing

A number of studies have looked at methods to reduce inappropriate prescribing for older adults. Evidence supports the following practice guidelines:

- Incorporate pharmacist recommendations
- Use computerized alerts
- Review patient's medication list regularly
- Utilize patient education (Garcia, 2006)

Prescribers should practice the following measures:

- Discontinue medications found to be in conflict with Beers criteria unless compelling evidence exists for continuance
- Follow treatment guidelines for chronic and acute disorders that affect older adults
- Identify methods for payment other than giving drug samples
- Provide Medicare prescription information
- Consider generic drugs
- Use pre-filled drug boxes and regular reminders to improve adherence
- Work with your patient to design a system for remembering the medication regimen (Bergman-Evans, 2004)

Decrease Polypharmacy

Inappropriate prescribing and polypharmacy are closely linked. Evidence suggests that both can be reduced by up to 25% by utilizing a pharmacist to review the patient's chart and medication list (Garcia, 2006).

Other recommendations to reduce polypharmacy include:

- Use combination drugs or tablets and alternative routes
- Use one-a-day dosing when possible
- Avoid prescribing medications to counteract the effects of other medications
- Monitor lab results more frequently
- Screen for drug interactions (Bergman-Evans, 2004)

Avoid Adverse Effects

An **adverse drug event (ADE)** is defined as "an injury resulting from the use of a drug." Adverse drug events include "expected adverse drug reactions (or side effects) as well as events due to errors." Adverse drug events due to errors are, by definition, preventable (Lococo & Staplin, 2006).

In contrast, an **adverse drug reaction (ADR)** is "any response to a drug which is noxious and unintended, and which occurs at doses normally used in humans for prophylaxis, diagnosis, or therapy of disease, or for the modification of physiological function." This definition implies that there was no error in the use of the drug. Examples of an injury include an event such as a rash or diarrhea caused by an antibiotic/anti-infective agent; gastrointestinal tract events such as nausea, vomiting, diarrhea, constipation, and abdominal pain; anaphylaxis (a serious allergic reaction) to penicillin; a major hemorrhage from a blood-thinning agent; and kidney failure from aminoglycosides (antibiotics often administered into veins or muscle to treat serious bacterial infections) (Lococo & Staplin, 2006).

Adverse events can be categorized as fatal, life-threatening, serious, or significant. Events resulting in permanent disability included stroke, intracranial bleeding events, hemorrhagic injury to the eye, and drug-induced pulmonary injury. Deaths in one study were related to fatal bleeding, peptic ulcers, neutropenia/infection, hypoglycemia, drug toxicity related to lithium or digoxin, anaphylaxis, and complications of antibiotic-associated diarrhea (Lococo & Staplin, 2006).

In the same study, the most common types of preventable adverse drug events were: electrolyte/renal (27%), gastrointestinal tract (21%), hemorrhagic (16%), metabolic/endocrine (14%), and neuropsychiatric (9%). The most common medication categories associated with preventable ADEs were:

- Cardiovascular medications (24.5% of the ADEs)
- Diuretics (22.1% of the ADEs)
- Nonopioid analgesics (15.4% of the ADEs)
- Hypoglycemics (10.9% of the ADEs)
- Anticoagulants (10.2% of the ADEs) (Lococo & Staplin, 2006)

Adverse drug events can result from errors in prescribing or administering medication or patient noncompliance. The percentage of community-dwelling elder Americans who had at least 1 of the 33 drugs considered potentially inappropriate for older adults improved significantly from 21.3% in 1996 to 18.4% in 2002. The percentage of community-dwelling elders who had 1 of 11 drugs that should always be avoided by older adults remained at about 3% over the 6-year time period between 1996 and 2002 (AHRQ, 2005).

An analysis of emergency department visits between 1992 and 2000 of patients 65 and older estimated that inappropriate medications were given in 12.6% of the visits. The top six drugs involved in inappropriate administration (accounting for 70.8% of all cases) were promethazine (22.2%), meperidine (18.0%), propoxyphene (17.2%), hydroxyzine (10.3%), diphenhydramine (7.1%), and diazepam (6.0%) (Zagaria, 2006). Often, any diagnosis indicating an appropriate use of these medications was absent.

In elders, lower initial doses should be used and upward titration done at a slower rate than in younger patients. If there is renal failure, dosages for drugs that are renally excreted should be adjusted (Bergman-Evans, 2004).

Polypharmacy and Risk for Falls

It has been well-established that polypharmacy is a risk factor for falls. In her seminal 1994 study of risk factors associated with falls in elders, Mary Tinetti studied multiple-modifiable risk factors and the effects of multi-factorial interventions on the risk of falling among community-dwelling older adults. Physicians, nurse practitioners, and physical therapists examined these risk factors in a control group and an intervention group:

- Postural hypotension
- Use of sedatives
- Use of at least four prescription medications
- Impairment in arm or leg strength or range of motion
- Balance
- Ability to move safely from bed to chair or to the bathtub or toilet (transfer skills)
- Gait (Tinetti, 1994)

The greatest difference between the control and intervention groups was noted in those with balance and transfer impairments and those taking four or more prescription medications. In the intervention group, there was a reduction in the proportion and incidence of subjects who fell. The subjects in the intervention group also reported fewer injuries and fewer episodes of medical care associated with falls. During the study, several participating physicians reported an increased awareness of the effects of postural hypotension and the relationship of medications to fall risk (Tinetti, 1994). This is of note because 50% of all Medicare beneficiaries are taking five or more medications (Tinetti, 2004).

In a case vignette published in 2003, Tinetti noted that serotonin-reuptake inhibitors (SSRIs), tricyclic antidepressants, neuroleptic agents, benzodiazepines, anti-convulsants, and anti-arrhythmic medications have been shown to have the strongest link to an increased risk of falling. Other have noted that an increased risk of falls is especially associated with the following classes of medications:

- Hypnotics
- Sedatives
- Analgesics
- Psychotropics
- Anti-hypertensives
- Laxatives
- Diuretics (CDC, 2007b)

Less well known is that fall risk can increase significantly in the days following a medication change. In October 2004, researchers at Johns Hopkins University studied the effect of medication changes on the risk of falls among residents of three nursing homes who fell during 2002–2003. The study looked at medication changes that occurred 1 to 9 days before the fall, including the odds ratio of falling after a start, stop, or dose change in medication in the case time period versus the control time period (CDC, 2007b).

The results indicated that the short-term risk of single and recurring falls may triple within two days after a medication change. Study outcomes may be used to develop similar fall risk studies in other clinical settings; to identify high-risk times for falls depending on medication changes; and to develop intensive, short-term interventions for vulnerable residents after medication changes (CDC, 2007b).

In 2005 the National Council on Aging, Center for Healthy Aging, issued the Falls-Free National Action Plan in which they urged healthcare professionals to support policies that increase awareness of polypharmacy and fall risk. The goal of the call to action is to "increase the number of older adults who have annual medication reviews conducted by healthcare providers or pharmacists and ensure this review includes an adequate focus on falls and fall-related injury prevention, with the goal of reducing or eliminating medications that increase fall risk" (CDC, 2007a).

To address this goal, clinicians should regularly review each patient's medications for potential interactions and side effects that may increase fall risk and, where possible, reduce or eliminate medications or select alternatives. Reducing the number and types of medications, particularly tranquilizers, sleeping pills, and anti-anxiety drugs, can be an effective fall prevention strategy when used alone or as part of a multi-component intervention (CDC, 2007a).

Pharmacokinetics and the Aging Process

Pharmacokinetics is the study of the absorption, distribution, metabolism, and excretion (ADME) of drugs. Changes associated with aging affect the pharmacokinetics of medications. Once taken, a medication must obtain therapeutic levels in the bloodstream to exert a clinical action. This section discusses how normal changes of aging and alterations due to age-related conditions affect the body's response to polypharmacy.

Absorption

Drugs are administered orally, parenterally, or topically. Drugs taken orally are absorbed in the gastrointestinal (GI) tract. Drugs administered parenterally are absorbed by the vascular circulation, while topical drugs are absorbed by skin or mucosa. Incomplete absorption of orally administered drugs occurs mainly because of lack of absorption from the gut. If a drug is too *hydrophilic* (easily absorbed by or dissolved in water) it will have trouble crossing the cell's lipid membrane. If a drug is too *lipophilic* (fat-soluble) it will not be soluble enough to cross the water layer surrounding the cell (Katzung, 2007).

Following administration of a drug by any route, some fraction of the unchanged drug will reach the systemic circulation. The amount of drug reaching the systemic circulation after administration is referred to as its **bioavailability**. In general, absorption is unchanged in later adulthood; however, there are some important changes to consider related to aging.

Age-related changes can impede absorption due to decreased blood flow to the tissues and the GI tract and changes in gastric pH (Banning, 2007). In most older adults this normative change of aging has no clinical consequence; however, the use of certain medications can enhance this effect and alter absorption significantly. For example, proton pump inhibitors (PPIs) such as omeprazole lower gastric pH and can inhibit Vitamin B12 absorption (Dharmarahan et al., 2008). Elders should take PPIs for the least time necessary to ameliorate the condition they are meant to treat. An older adult taking a PPI for a prolonged period of time should have periodic monitoring of vitamin B12 or take supplements.

Chronic illness and age-related variations in plasma proteins may also cause significant problems with medications that are highly protein bound, such as phenytoin and levodopa/carbidopa. Blood levels can vary, especially if food intake and dosing are not consistent. For example, if phenytoin is taken with a high-protein meal, less medication is absorbed because phenytoin binds with the protein in the stomach.

Decreased cardiac output in older adults and those with chronic conditions may reduce subcutaneous and intramuscular drug absorption, thus affecting the pharmacokinetics of injectable medications. Transdermal medications are absorbed through subcutaneous fat, which is reduced with aging (Banning, 2007).

Distribution

Once a medication is absorbed into the bloodstream, it is distributed throughout the body and exerts both desired and undesired effects. Distribution dynamics can be affected by body weight and body composition, which changes with age. Distribution of a medication is also affected by impaired absorption, which influences its onset, strength, and duration.

In general, as we age, total body water and muscle mass decrease while percentage of body fat increases. These changes can lead to drugs having a longer duration of action and increased effect.

Protein binding refers to the amount of medication bound to albumin in the blood. It is a theoretical concept that explains variability in pharmacologic distribution. Medications that are highly protein-bound have an affinity for albumin. Bound drug is inactive; unbound drug exerts a pharmacologic effect. Think of the albumin as hands that hold onto drug—the more albumin, the more hands, the less active drug available.

Serum albumin is decreased in older adults, creating unique issues with medications that are highly protein-bound, such as levodopa, warfarin, and phenytoin. Serum albumin is decreased 15% to 20% compared to the levels in healthy younger adults and is perhaps even lower during times of illness (Banning, 2007). If an older adult has low albumin, there are fewer "hands" to hold the drug and render it inactive, leaving more drug free and active. This is one reason older adults need a lower dose of medication than younger adults, especially if the drug is highly protein bound.

Metabolism

Following absorption across the gut wall, drug metabolism occurs almost entirely in the liver. Liver metabolism greatly reduces the bioavailability of medications through a process called **first-pass elimination**, which is the rate at which circulating drugs are metabolized as they traverse the liver before they reach the systemic circulation. First-pass elimination can actually inactivate some drugs, thus requiring alternative routes of administration. The liver can also excrete the drug into the bile. With age and chronic illness, liver size and hepatic blood flow are decreased; therefore, dosing of medications that are significantly metabolized by the liver should be adjusted.

Excretion

Age-related changes in renal function are an important factor in the clearance of drugs from the body. About two-thirds of the population experiences a decline in creatinine clearance with aging. This can lead to a prolonged half-life for many drugs and cause the build-up of toxic levels if the dose and frequency are not adjusted (Katzung, 2007). Renal impairment requires dosage adjustment of medications that are metabolized and excreted by the kidneys. There are two laboratory values commonly used to estimate renal function: creatinine clearance and glomerular filtration rate.

Other Factors

Pharmacodynamics is the effect of the medication on the body (Banning, 2007). Increased drug actions not explained by changes in pharmacokinetics are often listed as pharmacodynamic actions. For example, receptors and receptor sites in elders, or those with long-standing illness, may be reduced or limited in function, having the effect of increasing or decreasing sensitivity to drug action.

Medication is metabolized according to our individual enzyme systems, which are related to our genes and DNA. Some reactions to medications can be predicted genetically. This is referred to as **pharmacogenetics.** Genetic mapping will soon be available as a tool for predicting diseases and drug reactions.

Implications for Healthcare Professionals

Despite risks, medications are often needed to maintain health and well-being. Clinicians can help ensure medication safety by keeping current on medication information, reviewing medications frequently to verify need, and by educating the patient and family about safe administration practices.

Clinicians have a professional responsibility to keep informed about new medications and new research on medications and their use. Often adverse effects of medications are not known until many people use the medications over a period of time. For example, findings from the Women's Health Initiative (WHI) in 2008 revealed that a widely used exogenous estrogen, thought to be safe and beneficial to postmenopausal women, actually increased risk of breast cancer (Heiss et al., 2008). Between 2003 to 2005, the Food and Drug Administration (FDA) issued a series of black-box warnings regarding potential metabolic and cardiovascular adverse effects from atypical antipsychotic medications (Rosack, 2005).

One maxim of geriatric care (care of older adults) is that it is often more effective to remove a medication than to add one. Be aware that herbals and supplements can interact with prescribed drugs. Include questions regarding over-the-counter (OTC) medications and supplements when taking a medication history. Make certain every medication has a current indication.

Instruct the patient or family to keep a current record of medications. This list should be in an easily accessible place in the home or in the person's wallet or purse. When working with an older adult who is cognitively impaired, ask the family to designate one caregiver to manage the medications. This representative should be the only person to communicate with healthcare providers about changes in medications.

Teach the use of a medi-set that will organize the medications by the day of the week and the time of the day they are to be administered. Consider health literacy and language competence when teaching the patient or family. Provide legible instructions in large font. After giving medication instructions, ask the patient or family member to repeat the instructions back to you to ensure comprehension.

Resources

www.ucsfagrc.org
Self-paced modules on geriatric care, including pharmacology—free and available to the public.

www.geronurseonline.org
Information about gerontological nursing. Check out the "Try This" series of assessment tools.

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(Post test begins on next page)

Post Test

Use the Answer Sheet following the test to record your answers.

1. The term polypharmacy describes:
   a. Medications that are synthetic rather than biological.
   b. Use of multiple medications at one time.
   c. Buying prescription drugs at more than one pharmacy.
   d. Getting prescriptions from more than one physician.

2. Risk for adverse drug reactions (ADRs):
   a. Decreases with age and experience.
   b. Increases in women of childbearing age.
   c. Decreases in those who consult multiple specialists.
   d. Increases as the number of medications increases.

3. The Beers criteria are designed to identify:
   a. Medications inappropriate for use in older adults.
   b. Practitioners who write too many prescriptions.
   c. Caregivers who need education in giving medications properly.
   d. Medications with side effects known to be potentially dangerous.

4. Inappropriate prescribing is difficult to manage because:
   a. Names of medications are often similar.
   b. Patients don't follow directions.
   c. There are so many medications that are questionable for older adults.
   d. There are too few drugs from which to choose.

5. In a 12-month study of the scope of polypharmacy, three-quarters of the participants were taking six or more prescribed drugs.
   a. True
   b. False

6. One way to improve medication management is to:
   a. Reduce the total number of medications to no more than five.
   b. Challenge personal or cultural beliefs that interfere.
   c. Ensure that the patient is taking medications as prescribed.
   d. Encourage "creative" self-administration.

(continued on next page)

7. The risk for falls:
   a. Lessens in those relaxed through use of anti-anxiety drugs.
   b. Is generally related to impulsive behavior.
   c. May triple within two days of a medication change.
   d. Is decreased when older adults remain in the home.

8. Age-related changes that impact bioavailability of a medication include:
   a. Decreased blood flow to the digestive tract.
   b. Increased oxygen levels in the blood.
   c. Decreased subcutaneous fat.
   d. Increased absorption in the gut.

9. Pharmacodynamics refers to the:
   a. Interaction of multiple medications.
   b. Way the body metabolizes the medication.
   c. Energy released by a medication.
   d. Effect of the medication on the body.

10. When taking a medication history:
   a. Focus exclusively on prescription drugs.
   b. Make certain every medication has a current indication.
   c. Explain that herbals and supplements are not medications.
   d. Advise against taking over-the-counter drugs.

(Answer Sheet on next page)

Answer Sheet

Polypharmacy in Older Adults

Name (Please print your name): _____

Date: _____

Passing score is 80%

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

(Continued on next page)

Course Evaluation

Please use this scale for your course evaluation. Items with asterisks (*) are required.

- 5 = Strongly agree
- 4 = Agree
- 3 = Neutral
- 2 = Disagree
- 1 = Strongly disagree

*1. Upon completion of the course, I was able to:

a. Define polypharmacy and explain its significance.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

b. Summarize the risks of multiple medications.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

c. Explain the Beers criteria for identifying medications inappropriate for older adults.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

d. Identify the scope of polypharmacy in elders and risk factors for adverse results.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

e. List ways of improving medication management.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

f. Relate polypharmacy to the risk for falls.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

(continued on next page)

g. Discuss physiologic changes of aging that impact the efficacy of medications and distinguish between pharmacokinetics and pharmacodynamics.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

h. Discuss measures that can enhance medications compliance in elders.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

*2. The course was written in a way that facilitated my learning.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

*3. This course was free from commercial bias.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

*4. The course met my continuing education needs.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

*5. The material presented was supported by evidence.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

*6. The author avoided the use of anecdotal information as the main source of material.

❑ 5 ❑ 4 ❑ 3 ❑ 2 ❑ 1

*7. The course was free of product promotion.

❑ Yes ❑ No**

** If you answered no, please answer #8.

8. Was product promotion the sole purpose of the presentation?

❑ Yes ❑ No

(continued on next page)

* 9. It took me 60 minutes per contact hour to complete the course, test, and evaluation.

❑ Yes ❑ No**

** If your answer was no, how long did it take? _____

10. My professional educational level is (check one):

Nursing

❑ Nurse Aide ❑ LVN/LPN ❑ RN (diploma) ❑ RN (AD)

❑ BSN ❑ MSN ❑ Nurse Practitioner / Advanced Practice Nurse

❑ PhD / DNSc

Therapy

❑ OT Aide ❑ COTA ❑ OT ❑ MOT ❑ OTD

❑ PT Aide ❑ PTA ❑ PT ❑ MPT ❑ MSPT ❑ DPT ❑ PhD

Other (please specify): _____

11. I heard about ATrain Education from:

❑ Search engine ❑ Advertisement

❑ Government or Board website ❑ Returning customer

❑ Friend ❑ Publication (Magazine, etc.)

❑ Other _____

12. I found the ATrainCEU.com website easy to use:

❑ Yes ❑ No

13. Comments or suggestions (optional):

_____

_____

_____

(Registration on next page)

Registration Information

Please answer all of the following questions (*required).

* Name: _____

* Address: _____

* City: _____State:_____ Zip: _____

* Phone: _____

* Professional Designation: _____

* License Number and State: _____

Please email my certificate: ❑ Yes ❑ No
Email (required if you want your certificate sent by email): _____
(If you request an email certificate we will **not** send a copy of the certificate by US Mail.)

Payment Options
This course is free of charge until May 1, 2012.
If you want to order a printed certificate, the charge is $5.00.

Credit card information:
Name _____

Address (if different from above): _____

City: _____State:_____ Zip: _____

Card type: ❑ Visa ❑ MC ❑ American Express ❑ Discover

Card number _____ CVS # _____

Expiration date _____

Test Completion and Mailing Instructions

1. Complete all forms:
   - ❑ Answer Sheet
   - ❑ Evaluation Learning Activity
   - ❑ Registration Form (this page)
2. If you order a printed certificate and are not paying by credit card, please prepare a check for $5.00 made out to ATrain Education, Inc. There is no charge for the class if you only want an electronic certificate.
3. Mail the completed forms and your payment to:
   ATrain Education, Inc
   5171 Ridgewood Rd
   Willits, CA 95490

When we receive your forms and payment, we will mail (or email, if you request it) your certificate of completion. If you have any questions or concerns, please call or contact us at Sharon@ATrainCEU.com. And thanks for taking the ATrain!