Adverse Drug Effects and Medication Errors

Adverse Drug Effects

- The nurse plays a key role in preventing and managing adverse drug effects.
- Adverse Drug Effects
- Undesirable effects
- Potentially harmful
- All drugs have potential for adverse effects.
  - Prescription
  - OTC
  - Herbal
  - Dietary supplements
- Side effects
  - Minor drugs effects
  - Predictable
  - Can occur at therapeutic doses
  - Distinguished from adverse effects by severity
  - Need drug knowledge to predict common side effects.
- Serious drug effects
  - Can result in death, hospitalization, or disability
  - Cause congenital abnormalities
  - Cause life-threatening events
  - Require interventions to prevent serious consequences

Prevention of adverse effects

  - Obtain a thorough medical history
  - Assess patient and diagnostic data
  - Monitor pharmacotherapy carefully
  - Know all drugs taken by the patient
  - Be prepared for unusual drug effects
  - Question unusual orders
  - Teach clients about adverse effects
  - Can be a delayed reaction
- The FDA continues to monitor for new adverse events after a drug is approved and marketed.
- FDA's Adverse Event Reporting System (FAERS)
  - Voluntary program that encourages providers and consumers to report suspected adverse effects directly to the FDA or manufacturer
- If safety concern, FDA may:
  - Conduct additional studies
  - Require changes to labeling information
- If safety concern, FDA may:
  - Require black box warning
  - Restrict use of drug in specific populations
  - Communicate safety information to providers, consumers
  - Recall a product with quality or performance concerns

    - Remove product from market
- Allergic reactions are caused by a hyper-response of the immune system.
- Drug allergies
    - Caused by hyper-response of body defenses
    - Severity not proportional to dose of drug
    - Allergy symptoms unrelated to pharmacologic actions of the drug
    - Anaphylaxis same symptoms for all drugs
    - Previous drug exposure necessary
    - Signs and symptoms variable
        - May be nonspecific
- Drug classes most likely to cause allergic reactions
    - Penicillin and related antibiotics
    - Radiologic contrast media with iodine
    - Insulin
    - NSAIDs
    - Sulfonamides
    - Cancer chemotherapy agents
    - Preservatives
    - Certain antiseizure drugs
    - Adverse Drug Effects

Idiosyncratic reactions are unusual drug responses often caused by genetic differences among patients. Pharmacogenetics can prevent

- Idiosyncratic reactions
    - Unusual or unexpected responses
    - Unrelated to pharmacological action of drug
    - Rare
    - Unpredictable
    - Vary in individual clients

Some drugs have the ability to induce cancer or cause birth defects.

- Risk–benefit ratio
    - Drug benefit outweighs long-term risk.
    - Some cancer-causing drugs approved by FDA
        - Treatment often prolongs life.
- Carcinogenic drugs
    - Drugs known for producing cancer risk
        - Antineoplastics
        - Immunosuppressants
        - Hormone and hormone antagonists
- Teratogens
    - Potential to cause birth defects
    - Only used in pregnancy when benefit clearly outweighs risk
    - Drugs not tested in pregnant women
    - Drug should be identified as safe for use in pregnancy.

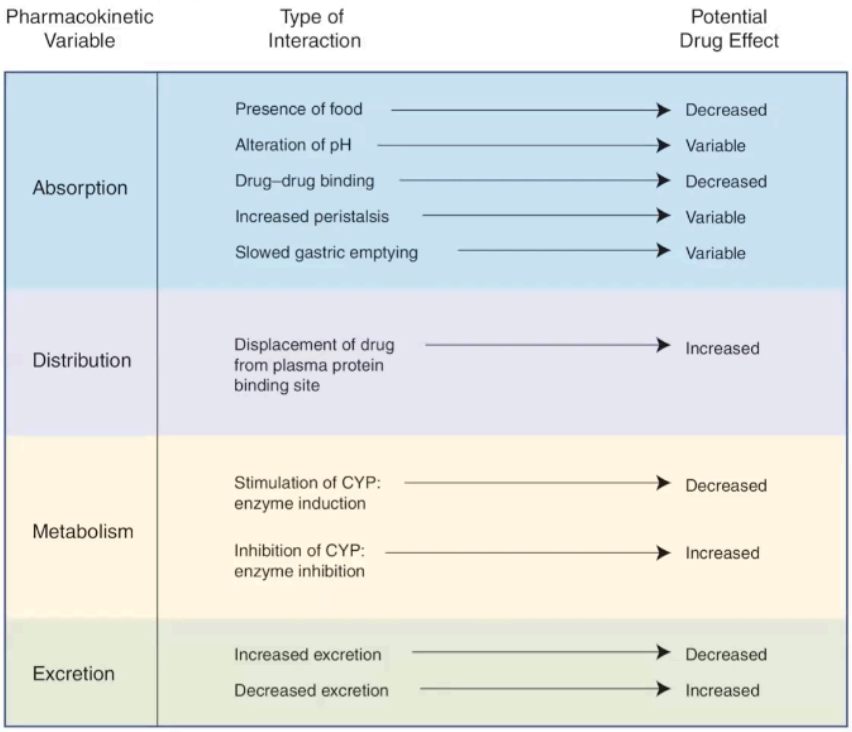
Drug toxicity may be specific to particular organs.

- Bone marrow toxicity
  - Often is serious or life-threatening
  - Pancytopenia
  - Aplastic anemia
  - Agranulocytosis and neutropenia
  - Frequently associated with antineoplastics
- Cardiotoxicity
  - Common class is anthracyclines
    - Antineoplastic medications
  - Prolongation of QT interval on ECG
    - Torsade de pointes
      - Rare type of ventricular tachycardia that can cause sudden cardiac death
- Dermatologic toxicity
  - Skin reactions are common adverse effects.
  - Rash with pruritis common
  - Urticaria may lead to anaphylaxis.
  - Angioedema and SJS are serious reactions and may be fatal.
  - Phototoxicity
- Hepatotoxicity
  - Liver detoxifies majority of drugs.
  - Hepatotoxicity common adverse effect
  - Monitor liver enzyme tests with hepatotoxic drugs.
  - Signs of liver impairment can be vague.
  - Severe liver impairment can cause toxic drug levels.
- Nephrotoxicity
  - Majority of drugs excreted in kidneys.
  - Renal tubules exposed to high drug concentrations.
  - Recognize signs of risk in client
    - Dehydration
    - Abnormal lab values
    - History of renal impairment
- Neurotoxicity
  - Blood–brain barrier controls access of drugs to brain.
  - Brain very sensitive to toxic substances
  - Recognize signs/symptoms of CNS toxicity
  - Safety hazards associated with CNS depressants
- Ototoxicity
  - Hearing impairment that can result from drug-induced damage to eighth cranial nerve
- Skeletal muscle and tendon toxicity
  - Drug-induced skeletal myopathy uncommon
    - Most severe myopathy is rhabdomyolysis
    - Monitor CK levels

Drug Interactions

- Drug interactions may significantly affect pharmacotherapeutic outcomes.
- Types of interactions
  - Drug–drug
  - Drug–food
- Occur continually
- Often go unnoticed
- May or may not be harmful
- Mechanisms
  - Classified by effect on drug action
    - Inhibition
      - Decreases therapeutic action
    - Enhancement
      - Provides greater therapeutic action
    - Change in drug response
- Pharmacokinetic drug interactions include changes in the absorption, distribution, metabolism, or excretion of medications.
- Absorption
  - Speed of substances moving through GI tract
  - Co-administration with resins
  - Administration with food or on empty stomach
  - pH of stomach
- Distribution
  - Drugs travel bound to protein
  - Displacement from protein increases drug level
  - Increased protein binding decreases drug level
  - Plasma pH affects drug ionization and ability to cross membranes

Figure 5.1



Types of pharmacokinetic drug–drug interactions.

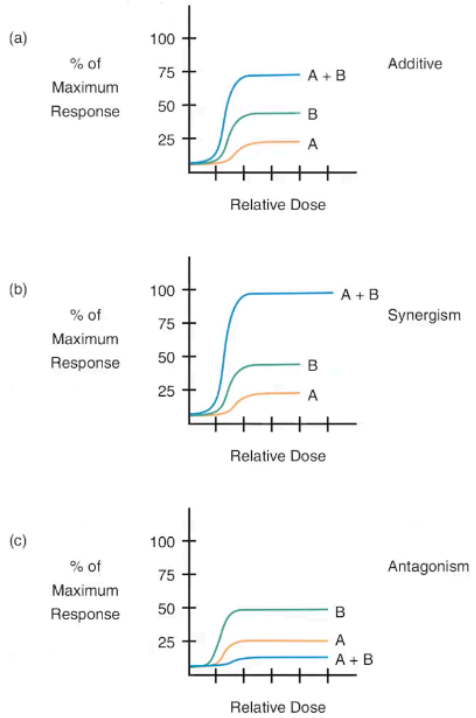
- Metabolism
  - Hepatic enzyme activity
  - Drug inducers
  - Drug inhibitors
  - Prodrugs
    - Activated by metabolism
- PharmFACT

Polycyclic aromatic hydrocarbons (PAHs) found in tobacco smoke are potent inducers of several hepatic microsomal enzymes. Smoking has been shown to interact with antipsychotics, antidepressants, benzodiazepines, oral contraceptives, inhaled corticosteroids, and beta blockers (Lucas & Martin, 2013).

- Excretion
  - Most drugs eliminated through renal excretion
  - Glomerular filtration rate (GFR)
  - Competition for excretion in renal tubules
  - pH changes
  - Biliary drug excretion
- Pharmacodynamic drug interactions include additive, synergistic, or antagonistic effects.
- Pharmacodynamic drug interactions
  - Drug action enhanced or inhibited

  - Interactions can be desirable.
    - Increased therapeutic response
    - Decreased adverse effects
  - Interactions can be undesirable.
    - Decreased therapeutic responses
    - Increased adverse effects
- Pharmacodynamic drug interactions
  - Types
    - Additive effect
      - Combined summation response
    - Synergistic effect
      - Enhanced response from combined drugs
    - Antagonistic effect
      - Diminished response occurs.

Figure 5.2



- Additive, synergistic, and antagonistic drug interactions: (a) additive response; (b) synergistic response; (c) antagonistic response.
- Food, nutrients, and dietary supplements may interact with medications and affect their actions.
- Food–drug interactions
  - Absorption and bioavailability affected
  - Grapefruit juice and CYP3A4 enzyme
  - Avoiding interactions

        - Separating drugs and food
        - Administering some drugs with food
    - Drug–herb interactions

Drug	Interaction
antiplatelet and anticoagulant drugs	Garlic can increase the risk of bleeding.
atovaquone (Malarone)	Fatty food enhances absorption.
azithromycin (Zithromax)	Food reduces absorption.
calcium channel blockers and cyclosporine	Grapefruit juice enhances absorption.
cholestyramine (Questran)	Drug binds iron, folic acid, and vitamin A to decrease their absorption.
CNS depressants	Valerian can increase drowsiness and sedation.
etidronate (Didronel)	Milk, calcium, and iron bind the drug and decrease absorption.
fluoroquinolones	Calcium, iron, and other metal ions bind the drug and decrease absorption.
lovastatin (Mevacor)	Food increases absorption.
MAO inhibitors	Foods containing tyramine can cause hypertensive crisis.

Drug	Interaction
NSAIDs	Food reduces the incidence of side effects.
penicillin G	Food (milk) and metal ions reduce absorption.
selective serotonin reuptake inhibitors (SSRIs)	St. John's wort and grapefruit juice increase risk of adverse effects (serotonin syndrome).
sucralfate (Carafate)	Food protein binds the drug to decrease absorption.
tetracyclines	Dairy products and iron reduce absorption.
warfarin (Coumadin)	Vitamin K antagonizes the action of warfarin; ginkgo, garlic, and St. John's wort may increase risk of bleeding.
zidovudine (AZT)	Food reduces bioavailability.

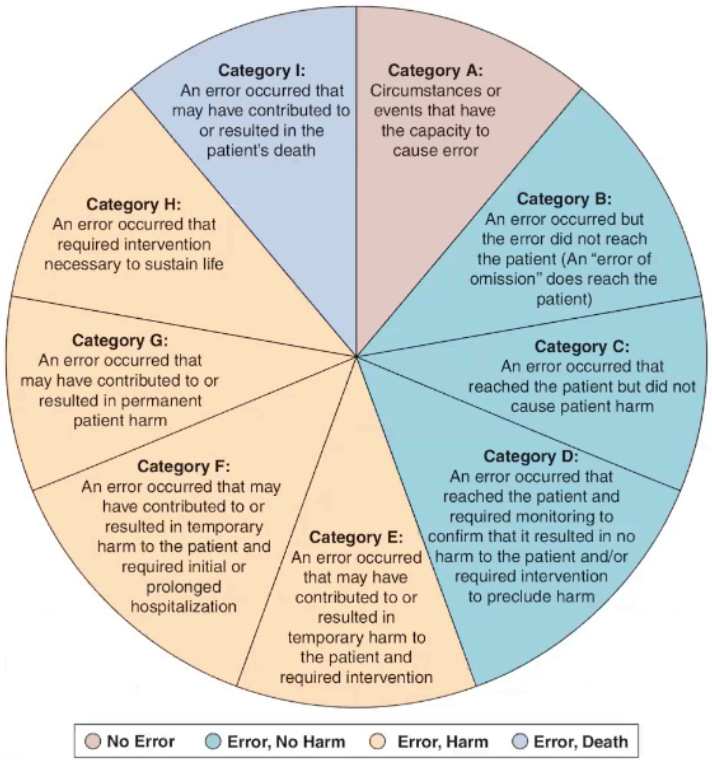
Medication Errors and Risk Reduction

PharmFACT
It is estimated that 10% of all deaths in the United States are associated with medical errors. With medical errors accounting for 250,000 deaths annually, this becomes the third most common cause of death (Johns Hopkins Medicine, 2016).

Factors Contributing to Medication Errors

- Majority stem from human factors
- Most frequent
  - Errors in patient assessment
  - Inaccurate prescribing
  - Errors in administration
- Studying types and causes of errors allows agencies and facilities to design ways to prevent them.
- Institute for Safe Medication Practices (ISMP)
  - Founded in 1994 to help standardize medication error reporting systems
  - List of error-prone abbreviations, symbols, and dose designations

Figure 6.2



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Drug Names and Medication Errors

- Certain drugs have higher rates of medication errors.

Table 6.1 Look-Alike and Sound-Alike Drug Names (1 of 3)

Acetazolamide	acetohexamide
AcipHex	Aricept
Adderall	Inderal
Bupropion	Buspirone
Carboplatin	cisplatin
Celebrex	Cerebyx
Chlorpromazine	chlorpropamide
Cycloserine	cyclosporine
daunorubicin	doxorubicin
dimenhydramine	diphenhydramine
Diprivan	Ditropan
dobutamine	dopamine
ephedrine	epinephrine
Humalog	Humulin
hydromorphone	morphine

Table 6.1 Look-Alike and Sound-Alike Drug Names (2 of 3)

Infliximab	Rituximab
Isotretinoin	Tretinoin
Kaletra	Keppra
Lamisil	Lamictal
lamivudine	lamotrigine
leucovorin	Leukeran
Lexapro	Loxitane
MS Contin	OxyContin
Neulasta	Neumega
oxycodone	OxyContin
paroxetine	fluoxetine
Retrovir	ritonavir
Seroquel	Sinequan
sumatriptan	zolmitriptan
Tiagabine	tizanidine

Table 6.1 Look-Alike and Sound-Alike Drug Names (3 of 3)

TobraDex	Tobrex
Tramadol	trazodone
Trental	tegretol
valacyclovir	valganciclovir
vinblastine	vincristine
Viracept	Viramune
Zantac	Zyrtec
Zestril	Zetia
Zyprexa	Celexa

Strategies for Reducing Medication Errors

- Thorough medication reconciliation is an important means of reducing medication errors.