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Pharmacology

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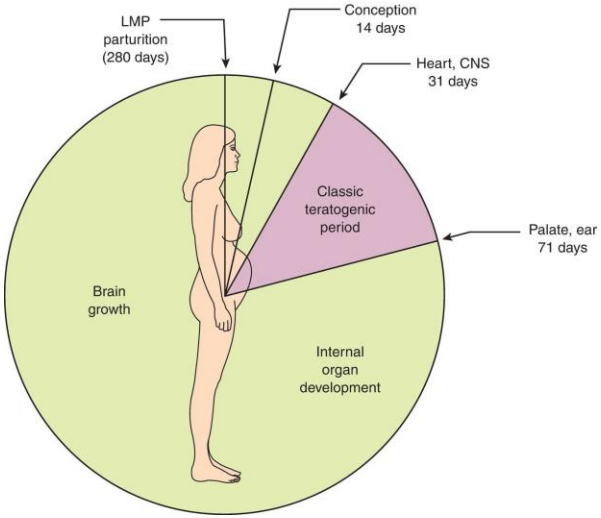
Drug Therapy Throughout the Lifespan

- ❑ Drug therapy during pregnancy and breast feeding.
- ❑ Drug therapy for pediatric patients.
- ❑ Drug therapy for Geriatric patients



❑ Drug therapy during pregnancy and breast feeding

During pregnancy, mother and fetus undergo **physiologic changes** that influence drug effects. In pregnant women, physiologic changes alter drug pharmacokinetics .In general, drug effects are less predictable because plasma volume expansion

- **decreases plasma drug concentrations**, and
- **increased metabolism** by the liver and
- **increased elimination** by the kidneys
- **shorten the duration of drug actions and effects**

Principles of Drug Therapy in Pregnancy

Before administering a drug to a pregnant woman, it is the responsibility and requirement of all health care providers, including; **nurses,** to conduct a risk benefit assessment a comprehensive analytic comparison of the benefits to the mother and the risks to the fetus. Inclusion of family in a decision regarding drug exposure during pregnancy and lactation to obtain informed consent is critical. Ideally, the risk to the fetus should be small compared with the potential maternal benefit. It is necessary to consider the consequences with and without drug therapy. **Important factors** are **gestational age**; **drug route**, **dosage**, and **concentration**; and **duration of exposure.**

Fetal Therapeutics

Although the major fear about drugs ingested during pregnancy is **adverse effects on the fetus**, a few drugs are given to the mother for therapeutic effects on the fetus. These include **digoxin** for fetal tachycardia or heart failure ,**levothyroxine** for hypothyroidism, **penicillin** for exposure to maternal syphilis and group B *Streptococcus* (GBS), and **prenatal betamethasone** to promote surfactant production, thus improving fetal lung function and decreasing respiratory distress syndrome in preterm infants. Also, pregnant women who are rhesus factor (Rh) negative receive **Rh immune globulin** (RhoGAM) for antenatal and postpartal prevention of sensitization to the Rh factor and hemolytic disease of the newborn.

Maternal Therapeutics

The main importance on drug use during pregnancy has related to actual or potential **adverse effects on the fetus**. Despite the general principle that drug use should be avoided whenever possible, pregnant women may require drug therapy for;

- **immunizations**,
- **various illnesses**,
- **increased nutritional needs**,
- **pregnancy-associated problems**,
- **chronic disease processes**,
- **treatment of preterm labor**,
- **induction of labor**,
- **pain management during labor**, and
- **prevention of postpartum hemorrhage**

Lactation

Lactation Induction

Metoclopramide stimulates the hormone prolactin after delivery, thus inducing lactation. The galactagogue, or lactation inducing, effect of this drug is considered an off-label use of metoclopramide. The recommended dose is 10 to 15 mg two to three times a day for 7 to 14 days. Higher doses of the drug in the postpartum period have been associated with depression, and use in women with a history of depression warrants caution. The herbs fenugreek, goat's rue, milk thistle, blessed thistle, and fennel seeds are just some herbal **galactagogues** thought to induce lactation or stimulate the production of breast milk in postpartum women.

Drug Use During Lactation

Antidepressants such as selective serotonin reuptake inhibitors (SSRIs) and serotonin and norepinephrine reuptake inhibitors (SNRIs) disturb the serotonin balance and are **first-line choices** for pharmacologic management of depression in lactating women. Although antidepressants have been detected in human milk, the amount is very low to undetectable. For mothers with severe depression, the benefits often outweigh the risks, and pharmacologic treatment is recommended.

fluoxetine.
citalopram.
sertraline.
paroxetine.
escitalopram.
fluvoxamine.
vilazodone

❑ Drug therapy for pediatric patients

Pediatrics includes the evaluation and management of all children—patients from birth to age 18. This group is further divided into five subgroups

Group	Age
Premature infant	<38 wk gestational age
Neonate	From full-term newborn 0 to 4 wk of age
Infant	From >4 wk to 1 y of age
Child	From >1 to 12 y of age
Adolescent	13–18 y of age

It is essential that nurses and other health care professionals understand the many ways children differ from adults because this presents a challenge in **medication dosing**, **administration**, and **management**. For example, physiologic changes throughout development influence both the pharmacodynamic and pharmacokinetic actions of medications.

Calculating Drug Dosages

The basis of pediatric drug dosing is **weight**, and determining drug dosages is highly dependent on the growth and development changes that occur across the lifespan. The prescriber uses weight alone to calculate pediatric dosages in an expression such as gentamicin 5 mg/kg/24 h or **determines the body surface area (BSA**), the surface of a human body expressed in **square meters**, using the **child's weight**. Then the prescriber calculates the dose based on a known adult dose by using the following equation

pediatric dose = BSA/1.73 × adult dose.

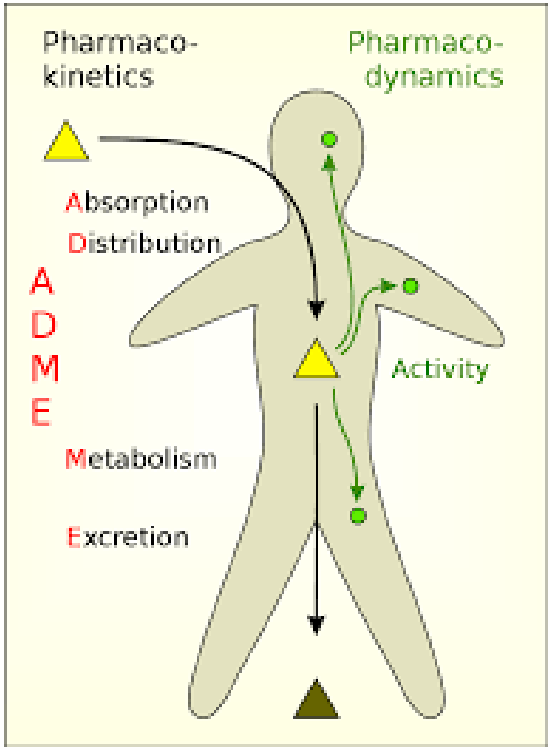
Body Surface Area *

Age	Average BSA (m^2)
Neonate (newborn)	0.25
Child, 2 y	0.50
Child, 9 y	1.07
Child, 10 y	1.14
Child, 12–13 y	1.33
Man (older than 18 y)	1.90
Woman (older than 18 y)	1.60

*The following formula is used to calculate BSA:

$$\text{BSA } (m^2) = \sqrt{\frac{\text{body weight (kg)} - \text{body height (cm)}}{3600}}$$

- **pharmacodynamic** variables in pediatric patients are related to differences in **target cell sites** and changing numbers of protein receptors. Immature systems and changing body compositions mean that drugs affect children differently. Causes of pharmacodynamic variability across the lifespan include differences in **body composition**, **immature organ systems**, and **genetics**. **Total body water** , **fat stores**, and **protein levels** change throughout childhood and greatly influence the effectiveness of drugs in the pediatric population



Pharmacokinetics ; refers to the processes of drug **absorption**, **distribution, metabolism**, and **elimination** . The organ systems in pediatric patients vary widely in their growth and maturation compared with adult patients

- **Drug absorption** in pediatrics is affected by the **age of the child**, **gastric emptying**, **intestinal motility**, **routes of administration**, and **skin permeability**.
- **Distribution of drugs** in pediatric patients is dependent on **percentage of body water**, **liver function**, **degree of protein binding**, and the **development of the blood–brain barrier** .
- **Metabolism** The enzyme cytochrome P450 (CYP450) in the liver metabolizes most drugs. In neonates, the ability to metabolize drugs is very low because of the immaturity of the liver and the resultant inability to break down drugs.
- **Elimination** of most drugs occurs via the kidneys, and elimination in the urine follows. Young children have immature kidneys, a reduced glomerular filtration rate, and slower renal clearance.

❑ Drug therapy for Geriatric patients

Aging is a natural process that begins at birth. The most significant age-related changes begin in the adult years (19–64 years of age). These physiologic events, which can affect drug responses, are due to increasing age. Most commonly, they occur in middle age and are related to heart disease, pulmonary insufficiency, cancer, arthritis, diabetes mellitus, obesity, substance abuse, and depression.

Older adults , people who are 65 years of age or older, are the largest consumers of health care.

Pharmacodynamics in older adults

Pharmacodynamics involves **drug actions** on target cells and the resulting alterations in cellular biochemical reactions and functions. In older adults, physiologic changes such as a **reduced number of receptor sites** for medications or **affinity to receptors** alter the medication's ability to produce the desired effect. Older adults are prone to adverse drug reactions because of a **decrease in the number of receptors** needed for drug distribution. Beta-adrenergic agonists are less effective as a result of the **decreased function** of the beta-receptor system.

Nurses must be aware of other **physiologic changes** associated with increased age. The volume of distribution of drugs may be **increased** based on the older adult's **increase in body fat** relative to the percentage of the skeletal muscle. The **decline in renal function** inhibits the adequate clearance of a drug .In addition, drug storage **reservoirs increase with age**. This physiologic change **prolongs a drug's half-life**, increasing the plasma drug concentrations

Cardiovascular disease is the number one cause of death in adults, including older adults. In patients with **hypertension**, the control of blood pressure is key to the prevention of cardiovascular disease and **stroke**. Hypertension affects 70% to 80% of older adults.

Older adults who require antihypertensive medication should initially be prescribed a **low-dose** thiazide type diuretic, angiotensin-converting enzyme inhibitor, angiotensin II receptor blocker, or long-acting calcium channel blocker. Beta-blockers should **not** be used as a primary treatment for **systolic hypertension** in the older adult population.

The use of digoxin (Lanoxin) in heart disease should **not** exceed 0.125 mg/day except when treating atrial fibrillation or supraventricular tachy dysrhythmia. In atrial fibrillation, the maximum dose is 1.5 mg over 24hours. In supraventricular tachy dysrhythmia, the digitalizing dose is 0.75 to 1.5 mg, with a daily maintenance dose of 0.125 to 0.5 mg once daily. Digoxin has a **low therapeutic index**, placing patients at risk for adverse effects..

Pharmacokinetics in older adults

Aging results in physiologic changes that affect the absorption, distribution ,metabolism , and excretion of medications. The most relevant physiologic change is the decreased function of vital organs needed for the pharmacokinetic processes.

Absorption

In older adults, changes in the gastrointestinal (GI) tract include

- **decreased gastric acidity**,
- **increase in the gastric pH**, and
- **delayed absorption** or lack of absorption of medications
- **decreased blood flow** and
- **decreased surface area** to support absorption.
- **Diminished gastric emptying**. This factor increases the risk of developing nausea and vomiting, thus causing elimination of the medication in emesis and promoting fluid volume deficit.

Distribution

In older adults, physiologic factors that contribute to alterations in distribution of medications include

- **diminished cardiac output**,
- **increased body fat**,
- **Decreased body mass** and **body fluid**, and
- **decreased serum albumin**.

Lipid-soluble drugs such as the anesthetic agents stay in the fat tissue for a longer period of time. This places older adults at risk for respiratory depression following surgery

The amount of body fluid decreases in proportion to total body weight .**Water-soluble drugs** such as antibiotics are distributed in smaller volumes due to the decrease in total body fluid volume. This increases the risk of toxicity because drug concentrations are greater

Many medications require **serum albumin to bind**, transport, and distribute the medication to the target organ. Medications are not distributed adequately due to the **decreased circulation** and diminished cardiac output

Metabolism

Age-related physiologic changes of the **liver affect the metabolism** of medications. At approximately 60 years of age, the liver begins to **decrease in size** and **mass**. There is also a **decrease in the hepatic circulation**, **lowering the rate of metabolism**. The **hepatic enzymes** of the liver are decreased, altering the ability to **remove metabolic by-products**. so, medications with a long half life will remain in the body for a greater amount of time.

Excretion

The elimination of medications is vital in the **prevention of adverse drug reactions.** In older adults, physiologic changes associated with alterations in medication excretion include **diminished renal blood flow**, **number of functioning nephrons**, **glomerular filtration rate**, and **tubular secretion**.


Thank You