CHAPTER 12

SPECIAL POPULATION CARE

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Abstract

Special population care addresses unique medication challenges in physiologically distinct patient groups requiring specialized knowledge, modified approaches, and heightened vigilance throughout the medication use process. Pediatric pharmacotherapy navigates developmental pharmacokinetics, weight-based dosing strategies, appropriate formulation selection, and age-specific monitoring parameters from neonates through adolescents with particular attention to medication safety and growth considerations. Geriatric medication management addresses pharmacokinetic alterations, pharmacodynamic sensitivity changes, polypharmacy challenges, and geriatric syndrome considerations through deprescribing methodologies, inappropriate medication avoidance, and simplified regimen development. Pregnancy and lactation pharmacotherapy balances maternal benefit against fetal or infant risk through teratogenicity assessment, placental transfer evaluation, lactation compatibility determination, and alternative therapeutic approaches when standard medications pose unacceptable risks. Renal impairment adaptations implement appropriate dosage adjustment methodologies, nephrotoxicity avoidance, dialysis considerations, and electrolyte management strategies based on kidney function assessment and medication clearance mechanisms. Hepatic dysfunction approaches address altered metabolism, protein binding changes, and encephalopathy risk through appropriate medication selection, dosage modification, and monitoring parameter adjustment based on liver disease severity classification. These specialized approaches ensure safe, effective medication use in populations with unique physiological considerations requiring modified pharmacotherapeutic strategies.

Keywords: *Developmental Pharmacokinetics, Altered Drug Disposition, Physiologic Adaptation, Vulnerable Populations, Organ Dysfunction*

Learning Objectives

After completion of the chapter, the learners should be able to:

- Apply pediatric-specific pharmacotherapy principles including weight-based dosing, appropriate formulation selection, and developmental considerations across pediatric age groups.
- Implement geriatric medication management strategies including deprescribing, falls risk reduction, and potentially inappropriate medication avoidance.
- Evaluate medication safety during pregnancy and lactation by assessing teratogenic potential, placental transfer, and breast milk excretion to optimize maternal-fetal outcomes.
- Adjust medication regimens appropriately for patients with renal impairment using established dosing algorithms, monitoring parameters, and nephrotoxicity prevention strategies.
- Modify drug therapy for patients with hepatic dysfunction based on liver disease severity, medication hepatic clearance mechanisms, and encephalopathy risk.
- Develop personalized therapeutic approaches addressing physiological alterations, pharmacokinetic changes, and specific monitoring requirements across special populations.

PEDIATRICS

Absorption variations include age-dependent gastric pH (relatively neutral in neonates, gradually acidifying to adult values by age 2), altered gastric emptying times, variable intestinal transit, and differences in transporter expression affecting drug uptake particularly for medications requiring active transport processes. Distribution changes include higher total body water percentage (80-85% in neonates versus 55-60% in adults), lower body fat proportion, reduced plasma protein concentrations affecting drug binding, and variable blood-brain barrier permeability allowing greater central nervous system penetration of many medications in neonates and young infants. Metabolism differences reflect immature hepatic enzyme systems in neonates with gradually developing activity, reaching adult capacity at variable ages depending on specific pathways (CYP3A4 approaches adult activity by 1 year, while CYP1A2 and CYP2D6 develop more slowly).

Dosing Strategies

Weight-based dosing calculates medication quantities based on total body weight (mg/kg), typically used for most pediatric medications but requiring consideration of maximum doses for larger children approaching or exceeding adult size to prevent excessive dosing. Body surface area approaches (mg/m²) better approximate metabolic activity for selected medications, particularly chemotherapeutic agents and medications with significant pharmacokinetic differences between children and adults, generally calculated using the Mosteller formula (BSA = √[(height × weight)/3600]). Age-based dosing employs specific recommendations for different age categories, particularly for neonates and young infants where developmental pharmacology considerations significantly impact dosing requirements, sometimes using "step" approaches with distinct dosing for neonates, infants, children, and adolescents.

Table 12.1: Pediatric Pharmacotherapy Considerations

Age Group	Physiological Considerations	Dosing Approaches	Administration Challenges
Neonates (0-28 days)	Immature renal/hepatic systems, altered body composition, BBB permeability	Weight-based dosing, reduced clearance consideration, extended intervals	Limited IV access, small fluid volumes, accurate measurement challenges
Infants (1-12 months)	Developing enzyme systems, rapid growth, variable absorption	mg/kg dosing, developmental adjustments, organ maturation consideration	Taste considerations, liquid formulation needs, feeding coordination
Toddlers (1-3 years)	Increased clearance rates, activity levels, first-pass metabolism	BSA calculations, weight verification, frequent reassessment	Cooperation challenges, taste sensitivity, dosage form limitations
Children (4-11 years)	Approaching adult metabolism, growth variability, formulation needs	Weight or BSA-based, max dose considerations, growth monitoring	Swallowing ability development, school administration needs, taste importance
Adolescents (12-18 years)	Hormonal influences, adult-approaching clearance, compliance issues	Adult dose transitions, weight checks, adherence strategies	Autonomy development, privacy concerns, peer influence considerations

Medication Formulation Selection

Liquid formulation assessment evaluates concentration appropriateness, measuring device accuracy, taste characteristics, and excipient safety for young children unable to swallow solid dosage forms, with particular attention to potentially harmful preservatives including alcohol, propylene glycol, or benzyl alcohol in neonates and young infants. Extemporaneous compounding provides appropriate formulations when commercial liquid options are unavailable, including stability assessment, beyond-use dating, and palatability considerations with specific attention to appropriate vehicles, compatible flavoring agents, and physical stability throughout the intended use period. Alternative delivery systems include orally disintegrating tablets, chewable formulations, transdermal preparations, and intranasal options that may overcome administration challenges in specific pediatric populations.

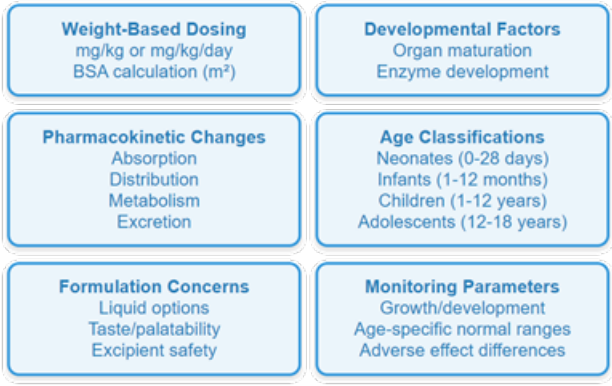

Figure 12.1: Pediatric Medication Dosing Considerations

Neonatal Intensive Care

Gestational age-based dosing adjusts medication selection and quantities based on developmental status, with significant differences between extremely premature (<28 weeks), moderately premature (28-34 weeks), late preterm (34-37 weeks), and term neonates (>37 weeks) reflecting varying degrees of organ system maturity affecting drug disposition. Parenteral nutrition design addresses the specialized nutritional needs of neonates with precise electrolyte, protein, and micronutrient requirements that differ substantially from older children, requiring careful calcium:phosphorus ratios, appropriate protein provision (2-4 g/kg/day depending on gestational age), and specific trace

element considerations. Medication dilution protocols ensure appropriate concentration and volume for accurate administration of small doses while maintaining compatibility with limited fluid allowances.

Pediatric Infectious Disease Management

Empiric therapy selection matches antimicrobial coverage to age-specific pathogens and resistance patterns for common pediatric infections including otitis media, pharyngitis, pneumonia, and urinary tract infections, recognizing different pathogen distributions across age groups from neonates through adolescents. Antimicrobial dosing optimization ensures adequate drug exposure for common pediatric pathogens while accounting for developmental pharmacokinetic differences, often requiring weight-based dosing with careful maximum dose considerations and age-appropriate adjustments. Formulation palatability significantly impacts adherence for oral antimicrobials, requiring consideration of taste, texture, and administration volume alongside clinical efficacy, particularly important for longer treatment courses or younger children with limited cooperation capability.

Medication Safety Systems

Dose range checking implements automated or manual verification processes comparing calculated doses against age-appropriate reference ranges before dispensing or administration, flagging potential errors for additional verification before reaching patients. Weight-based double-checks verify both the weight measurement accuracy and the mathematical calculation of weight-based doses, employing independent calculations by different healthcare providers to identify potential errors before administration. Standardized concentrations establish consistent medication preparations across care areas, reducing the complexity that contributes to preparation errors, particularly important for high-risk medications including opioids, sedatives, anticonvulsants, and inotropes.

Chronic Disease Management

Growth and development monitoring tracks height, weight, and developmental milestones during chronic therapy, particularly for medications with potential growth effects including stimulants (possible growth velocity reduction) and corticosteroids (growth suppression with long-term systemic use), ensuring early detection and intervention for concerning trends. School-based medication administration coordinates treatment schedules with educational environments, addressing timing, administration supervision, and emergency

medication access during school hours, particularly important for conditions requiring midday dosing including attention deficit hyperactivity disorder, diabetes, seizure disorders, and asthma. Transition planning prepares adolescents for eventual transfer to adult care services through gradually increasing medication self-management responsibility, knowledge development, and engagement in treatment decisions.

Pharmacogenomic Considerations

Developmental gene expression patterns show age-dependent activity for many pharmacogenetically relevant genes, with some polymorphisms having more significant effects during specific developmental periods, creating complex interactions between ontogeny and genetics requiring nuanced interpretation beyond adult pharmacogenomic models. Testing considerations include appropriate timing, interpretation differences across developmental stages, and ethical considerations regarding testing for adult-onset conditions, balancing immediate therapeutic decision needs against broader implications of genetic information. Medication selection incorporates available genetic information alongside developmental pharmacology principles, recognizing that genetic factors may alter expected developmental patterns of drug disposition and response.

GERIATRICS

Absorption changes include increased gastric pH, reduced gastrointestinal blood flow, decreased absorptive surface area, and delayed gastric emptying, collectively affecting drug dissolution and uptake particularly for medications requiring acidic environments for dissolution or exhibiting narrow absorption windows in specific intestinal segments. Distribution alterations include increased body fat percentage (affecting lipophilic drug distribution), decreased total body water (affecting hydrophilic drug concentration), reduced serum albumin affecting protein binding, and changes in tissue perfusion altering drug delivery to effect sites, collectively requiring consideration for initial dosing and volume of distribution estimates. Metabolism changes include reduced hepatic mass (approximately 1% reduction annually after age 40), decreased hepatic blood flow (reducing first-pass metabolism and clearance of flow-limited drugs), and altered activity of specific cytochrome P450 enzymes with variable age-related changes.

Table 12.2: Geriatric Medication Management

Geriatric Challenge	Assessment Tools	Intervention Strategies	Monitoring Approaches
Polypharmacy	Medication appropriateness index, STOPP/START criteria, medication count	Deprescribing protocols, therapeutic duplication elimination, prioritization frameworks	Medication count tracking, functional improvement, symptom resolution monitoring
Potentially Inappropriate Medications	Beers Criteria, STOPP/START, country-specific criteria	Alternative agent selection, dose reduction, risk mitigation strategies	Adverse effect resolution, functional improvement, symptom monitoring
Altered Pharmacokinetics	Cockcroft-Gault with ideal body weight, hepatic function tests, drug levels	Reduced initial doses, extended titration schedules, therapeutic drug monitoring	Concentration monitoring, response assessment, adverse effect vigilance
Altered Pharmacodynamics	Functional assessments, symptom reports, sensitivity indicators	Dose reduction, alternative selections, enhanced monitoring	Response magnitude, side effect emergence, cognitive impact assessment
Adherence Challenges	Pill counts, refill analysis, cognitive assessment, caregiver reports	Regimen simplification, adherence aids, caregiver integration	Adherence rate improvement, therapeutic outcome achievement, caregiver feedback
Falls Risk	Medication fall risk assessment, Timed Up and Go, fall history	High-risk medication reduction, dosage adjustment, non-pharmacologic alternatives	Fall incidence reduction, mobility improvement, fear of falling assessment