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Medication Safety in the Pediatric Patient

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Learning Objectives

Determine pediatric characteristics or challenges that increase the risk of medication errors

Recognize high alert medications that may result in errors in the pediatric population

Discuss common medication errors that occur in pediatric populations

Describe strategies to decrease the risk related to pediatric errors

Definitions

Medication error

- most common type of MEDICAL error
- most preventable event that may cause or lead to inappropriate prescribing, dispensing, or administering of a medication

Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err Is Human: Building a Safer Health System*. 2000.

Definitions

Adverse drug event

- injury resulting from medical intervention related to a drug, which can be attributable to preventable and non-preventable causes

Kohn LT, Corrigan JM, Donaldson MS, eds. *To Err Is Human: Building a Safer Health System*. 2000.

Institute of Medicine Reports

2000: *To Err is Human*

- 44,000-98,000 medical error deaths each year

2006: *Preventing Medication Errors*

- ~1.5 million individuals harmed with medical errors each year
- 380,000-450,000 preventable hospital adverse effects each year

Kohn LT, et al. *To Err Is Human: Building a Safer Health System*. 2000.
Committee on Identifying and Preventing Medication Errors; Aspden P et al., eds. *Preventing Medication Errors*. 2006.

Pediatric Studies

Inpatient: 4.5-5.7 errors per 100 medication orders

Outpatients: 3x more at risk of adverse drug reactions

Kaushal R, et al. *JAMA* 2001;285(16): 2114-20.
Horen B, et al. *Br J Clin Pharmacol* 2002;54(6):665-70.

Pediatric Studies

2008: Takata GS, et al.

- **960 randomly selected charts at 12 children's hospitals**
  - **22% of adverse drug events were preventable**
  - **17.8% possible earlier identification**
  - **97% resulted in mild temporary harm**
  - **51% of adverse events associated with opioids/analgesics**

Takata, GS, et al. *Pediatrics*, 2008, 121:e927-3935.

Sentinel Event Alert

- **April 2008: Sentinel Event Alert issued by the Joint Commission**
  - **initiated by reports of serious medication errors in pediatric institutions**
    - **neonatal heparin overdoses; both blue: dark and light blue**
      - **10,000 units/ml heparin instead of 10 units/ml heparin flush**

www.jointcommission.org/sentinel_event_alert_issue_39_preventing_pediatric_medication_errors/

Sentinel Event Alert

- **Improve safety of pediatric medication delivery**
- **Reevaluate medication preparation, administration, and monitoring**

www.jointcommission.org/sentinel_event_alert_issue_39_preventing_pediatric_medication_errors/

Increased Risks of Pediatric Errors

- Age <2 years
- Settings
  - emergency settings
  - surgical settings
  - intensive care units (neonatal, pediatric)
- Chemotherapy medication
- Unfamiliarity with pediatric patients

Pediatric High Alert/Hazard Medications

Antimicrobial Agents	Narcotics*	Fluid and Electrolytes	Other Medications
•Vancomycin •Ceftriaxone •Gentamicin	•Morphine •Fentanyl	•Potassium chloride •Total parenteral nutrition	•Albuterol •Dopamine •Heparin •Insulin*

*Frequently associated with errors and harm

Hicks, R, et al., J Ped Nurs 2006, 21 (4): 290-298.

Morphine

Miscalculation with different doses and different routes – intravenous (IV), intramuscular (IM), oral, patient/nurse controlled analgesia

Dosing for infants (>6 months) and children <50 kg

- oral: 0.2-0.5 mg/kg/dose every 3-4 hours as needed
- IM, IV, subcutaneously (subQ): 0.1-0.2 mg/kg/dose every 2-4 hours as needed

Morphine

Pharmacokinetics – half-life

- preterm: 10-20 hours
- neonates: 7.6 hours
- infants 1-3 months: 6.2 hours
- infants (6 months)-children 2.5 years: 2.9 hours
- adults: 2-4 hours

Pediatric Characteristics and Challenges Increased Risk of Errors

- Developmental pharmacokinetics: neonate-adolescent
- Lack of published studies
- Doses: no standard dosing
  - calculation of doses
  - weight or body surface area based dosing
  - different routes
  - off-label prescribing

Pediatric Characteristics and Challenges Increased Risk of Errors

- Drug formulation
  - extemporaneous formulations
  - neonate: dilutions
  - adult drugs

Pediatric Characteristics and Challenges Increased Risk of Errors

Administration devices

- dispensed as cc or ml
- measurement markings
- teaspoon
- medicine cup, dropper, or spoon
- oral syringe

Parent understanding

Neonate Dosing Challenges

AMPICILLIN – MENINGITIS

Lexicomp®	Pediatric – Lexicomp®
Infants and Children: 300-400 mg/kg/day divided every 4-6 hours	PNA <7 days: 200-300 mg/kg/day divided every 8 hours PNA ≥7 days: 300 mg/kg/day divided every 6 hours

Differences in dose and interval

Lexi-Drugs™.; crlonline.com
Pediatric and Neonatal Lexi-Drugs™; crlonline.com

Calculations

Weight	Decimal points	Doses	Intravenous medications

• kilograms vs pounds	• 0.3
	• 3.0
		• mL/kg/day
		• mg/kg/dose
		• mcg/kg/dose
		• mg/kg/day
		• mcg/kg/day
		• units/kg/day
		• mg/m2/day
		• mg/kg/day divide doses
		• mg/kg/dose every __ hours
			• Different drip rates
			  • mcg/kg/min
			  • mcg/kg/hr
			  • mg/kg/min

Calculation Errors

Acetaminophen

- single dose divided by frequency
  - 10 mg/kg/dose every 6 hours
    - example: 10 kg patient
      - correct: 100 mg every 6 hours
      - incorrect: 100 mg daily divided every 6 hours = 25 mg every 6 hours

Drug Formulations

- Lack of manufactured pediatric formulations
- Adult vs. pediatric formulations
  - different concentrations and volumes
    - ibuprofen: infants 40 mg/mL vs. children 20 mg/mL
- Formulations with preservatives

Drug Formulations

- Extemporaneous formulations
  - concentrations and stability
    - multiple strengths

Most Common Pediatric Errors

Procedure or protocol not followed

Lack of communication or miscommunication

Inadequate or lack of monitoring

Improper use of pumps

Errors: calculation, computer, or documentation

Deficit

Knowledge & Performance Deficit

Resources

- Lexicomp® – Pediatric Dosage Handbook
  - charts: compatibility, drip calculations, therapeutic drug monitoring
- Micromedex
- NeoFax®
- *Pediatric Injectable Drugs: The Teddy Bear Book*

Knowledge & Performance Deficit

Up to date news

- **Medscape – Nurses: Pediatrics/Neonatal**

Medication Use Process

Medication incident – occurs at one of the four stages of the medication use processes

Prescribe → Dispense → Administer → Monitor

Administration Errors

Improper quantity of medication
Administration technique
Wrong time
Improper use of pumps
Documentation errors

Medication Use Process

Look-alike and/or sound-alike (LASA) errors

Node	N	%
Procurement	119	0.5
Prescribing	2060	8.1
Transcribing/documenting	2544	10
Dispensing	16314	64.4
Administering	4251	16.8
Monitoring	61	0.2
Total	25349	100 %

http://www.ismp.org/tools/default.asp
usp.org/pdf/EN/medmarx/2008MEDMARXReport.pdf

2015 Updated
Look-Alike/Sound-Alike Drugs

Drug Name	Confused Drug Name
acetaminophen	acetaZOLAMIDE
cefuroxime	sulfaSALAzine
desmopressin	vasopressin
HYDROmorphone	buprenorphine
hydrOXYzine	hydroCHLOROthiazide
methylPREDNISolone	methylTESTOSTERone
polyethylene glycol	propylene glycol
predisposing: extended release, same class	

www.ismp.org/tools/confuseddrugnames.pdf

Risk Reduction Strategies

Continuing education/training

- staff education and competency
- LASA medications
- high alert meds

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Risk Reduction Strategies

Readily available resources

- dosage
  - double-check doses
  - avoid trailing zeros
- know medication indication, interactions, and adverse effects

Risk Reduction Strategies

Standardize dose strengths and concentrations

- preprinted order forms
- formulations
- drug shortages
- drug preparation verification
- packaging and labeling clarity

Risk Reduction Strategies

- Weight admission requirement
  - g/kg
- Patient/parent education
  - appropriate administration devices

Risk Reduction Strategies

- Administration
  - avoid during unit or patient crisis
  - reduce stimuli
  - checklist for medication administration
  - two-check system with high alert meds
  - obtain adequate patient information

Risk Reduction Strategies

Administration

- use technology safeguards – barcoding, use drug libraries, limit overrides
- monitor response of patient
- documentation

Risk Reduction Strategies

Communication

- eliminate barriers and verify drug information
  - SBAR (situation, background, assessment, and recommendations)
- communicating difficult situations with patients
  - prior issues/errors communicated during shift changes

Risk Reduction Strategies

Environmental – medication zone or no interruption zones

- in adequate lightening
- cluttered work environments
- distractions during drug preparation or administration
- reduce workloads

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Considerations Before Administering Any Medication to a Child

Minimize distractions and interruptions

Inattentiveness or rushing

Communicate with parents and families/healthcare providers

Two-provider check process for high-alert medications

Summary: Be Proactive

Keep up-to-date on new information

Use judgment and investigate any concerns

Last barrier to prevent errors

Advocate for the patient

Phone a pharmacist

Resources

The Joint Commission

- www.jointcommission.org

The Institute for Safe Medication Practices

- www.ismp.org

U.S. Food and Drug Administration MedWatch

- www.fda.gov/medwatch

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