Medication Errors
Learning Outcomes

• List 11 different types of medication errors
• Identify factors that contribute to medication errors
• List 5 “high alert” medications
• Describe methods of preventing medication errors
• List examples of common medication errors
• Describe possible consequences of medication errors
• Explain steps to be taken when an error identified
• Explain role of quality assurance monitoring of medication errors
Key Terms

• Compliance error
• Deteriorated drug error
• Failure mode & effects analysis (FMEA)
• High alert medications
• Improper dose error
• Medication error
• Medication misadventure
• Monitoring error
Key Terms

• Omission error
• Root cause analysis (RCA)
• Unauthorized drug error
• Wrong administration technique error
• Wrong dosage form error
• Wrong time error
Types of Medication Errors

- Prescribing Errors
- Omission Errors
- Wrong Time Errors
- Unauthorized Drug Errors
- Improper Dose Errors
- Wrong Dosage Form Errors
- Wrong Drug Preparation Errors
- Wrong Administration Technique Errors
- Deteriorated Drug Errors
- Monitoring Errors
- Compliance Errors
Prescribing Errors

• Occurs when prescriber orders drug for specific patient
  – drug
  – dose
  – dosage form
  – route of administration
  – length of therapy
  – number of doses
  – administration
  – drug concentration
  – inadequate or incorrect instructions for use
  – illegible handwriting
Omission Errors

• Failure to administer an ordered dose (not late dose)
• Omitted dose is not an error when
  – cannot take anything by mouth (NPO)
  – providers are waiting for drug level results
  – patient refuses
Wrong Time Errors

- Standardized administration times
- Acceptable interval surrounding scheduled time
- Medications administered outside this window
  - considered wrong time errors
- Occasionally unavoidable
  - patient is away care area for test
  - medication is not available at time it is due
Unauthorized Drug Errors

• Administration of medication to patient without proper authorization by prescriber
• Administration of medication outside established guidelines
• Medication for patient given to another patient
• Nurse gives medication without prescriber order
• Patients “share” prescriptions
• Refilling prescription that has no refills remaining

Protocols may allow flexibility - not unauthorized
Improper Dose Errors

• Dose that is greater or less than prescribed dose

• Can occur when additional dose is administered
  – delay in documenting dose
  – absence of documentation

• Inaccurate measurement of oral liquid
  – Exclusions from this error type
    • topical applications
    • variances that occur from apothecary to metric conversions
Wrong Dosage Form Errors

• Doses administered as different form than ordered
• Depends on state laws & facility guidelines
  – dosage form changes may be acceptable
  – accommodate particular patient needs
    • often acceptable
Wrong Drug Preparation Errors

• Reconstituting oral suspension with incorrect volume
• Using bacteriostatic saline instead of sterile water to reconstitute lyophilized powder for injection
• Not activating an ADD-Vantage® IV admixture bag
Wrong Admin Technique Errors

• Examples:
  – subcutaneous injection that is given too deep
  – intravenous (IV) drug is allowed to infuse via gravity instead of using an IV pump
  – instilling eye drops in wrong eye
Deteriorated Drug Errors

• Monitoring expiration dates is very important
• Drugs used past their expiration date
  – may have lost potency
  – may be less effective or ineffective
• Refrigerated drugs stored at room temperature may decompose & lose efficacy
Monitoring Errors

• Inadequate drug therapy review

• Examples:
  – ordering serum drug levels but not reviewing them
  – not responding to level outside of therapeutic range
  – not ordering drug levels when required
  – prescribing antihypertensive agent & then failing to check blood pressure
Compliance Errors

- Failure to adhere to prescribed drug regimen
- Detected when refill requests not on time
- Example:
  - patient does not complete antibiotics therapy—saves a few doses
Other Errors

• Errors that cannot be placed into category
• Examples:
  – medication dispensed without adequate patient education
Incidence

- Difficult to determine
  - few studies provide complete evaluation of errors
  - different methods used to detect errors
  - various definitions of errors

- Large volumes of medications dispensed
  - small percentage of errors can result in large number of medication errors:
    - annual # of prescriptions ~ 3.54 billion
    - small % of 3.54 billion is still large number
Medication Error Rates

• Studying medication errors is complex
• Harvard medical practice study
  – analyzed incidence of adverse events in hospitalized patients
  – found 19% of adverse events in hospitalized patients related to drug complications
Medication Errors

• Physician prescribing error rates
  – 0.3 to 1.9%
  – almost 1/3 (28.3%) prescribing errors were potentially harmful if not followed up by pharmacist
  – majority of potentially serious prescribing errors were made because of
    • performance lapses (knowing right thing to do, but accidentally doing something else)
    • failure to adhere to established procedures
Medication Errors

• Errors occurring earlier in medication use process more likely to be detected & corrected than those occurring later in process.
• Many studies varying results:
  – error rates outpatient pharmacies reported ~12%
  – in hospitals ~1 error per patient per day
  – hospitals & skilled nursing facilities:
    • 19% of all doses were not administered correctly
    • 43% of errors were due to wrong time of administration
Institute of Medicine

• ~1.5 million people are harmed by medications each year
• Up to 400,000 of adverse events considered preventable
• Medication error studies report different error rates
  – how studies were performed
  – various techniques & definitions used
  – scope of study
• Errors which are corrected before medications reach patient might not be accounted for
Medication Error Reporting

• Medication error rates based on incident reports

• Errors not always reported:
  – lack of knowledge to identify errors
  – lack of time to document errors
  – afraid of negative consequences
Impact of Medication Errors

• Outcomes
  – range from no effect to long-term disability or death

• Significance
  – type of medication error
  – health status of patient
  – pharmacologic classification of drug involved
  – route of drug administration,
  – timing of drug administration
  – cost to health care system
Impact on Patient

• Factors:
  – health status of patients
  – magnitude of overdose
  – damage as result of omission

• Financial Implications
  – prolong hospital stays & increase health care expenses
  – estimated to cost billions of dollars annually
    • additional medical management
    • legal fees & out-of-court settlements

Never Events can typically not be Medicaid reimbursed.
Loss of Trust

• Loss of faith in medical community
  – from either experience or knowledge of event
  – may choose to
  • switch pharmacies or physicians
  • hesitate to seek medical help
  • seek nonconventional treatments from outside medical community
Causes of Medication Errors

- Calculation errors
- Improper use of zeros & decimal points
- Inappropriate use of abbreviations
- Careless prescribing
- Illegible handwriting
- Missing information
- Drug product characteristics
- Compounding /drug preparation errors
- Prescription labeling
- Work environment & personnel issues
- Deficiencies in medication use systems
Calculation Errors

• Made by
  – prescribers
  – pharmacists
  – technicians
  – nurses

• Pediatric population at risk
  – adult formulations be diluted/manipulated for peds

• Personnel with multiple years of experience are just as likely to make mathematical errors
Calculation Errors

• Double-check work
• Have pharmacist or another technician double-check
• Look up conversions
• “Does the answer seem reasonable?”
Decimal Points & Zeros

• Decimal point errors cause significant consequences

• Decimal point errors occur
  – result of miscalculation
  – when writing orders or instructions
  – result of artifact on faxed order

• Always write leading zero in front of number < 1

• Never write trailing zeros
Dangerous Abbreviations

• “AZT” for zidovudine (Retrovir)
  – could be azathioprine (Imuran)
• “U” HAS been mistaken for “zero”
  – 10 U insulin order & patient received 100 insulin units
• “QD” has been read as “QID” or “OD”
• DO NOT USE Lists
  – The Joint Commission
  – Institute for Safe Medication Practices (ISMP
High Alert Medications

- High risk of causing serious harm to patients when given in error
  1. heparin
  2. narcotics and opiates
  3. potassium chloride injection
  4. insulin
  5. chemotherapeutic agents
  6. neuromuscular blocking agents
High Alert Med Strategies

• Strategies might include
  – limiting number of strengths or vial sizes of medications
  – special auxiliary labeling
  – storage locations
  – double-checks
  – standardized or preprinted orders
Prescribing Issues

- Verbal orders
- Confusion regarding concentration of product
- Illegible handwriting
- Missing information
- Use of apothecary system
- Writing doses based on course of therapy as opposed to daily dose
Verbal and Telephone Orders

• Oral orders
  – may be heard incorrectly
  – may be transcribed to writing or entered into a computer incorrectly

• Use of cellular phones/poor quality connections

• Never use oral orders in chemotherapy prescribing

• Telephone order should be
  – immediately written down
Drug Concentration

• Failure to include concentration in prescription can result in wrong dose being dispensed
  – amoxicillin suspension 1/2 tsp (2.5 mL) TID
  – Concentration?

• “1 amp,” “1 vial,” “1 cap” unclear
  – multiple strengths, doses, or vial sizes

• Order for one “vial” of magnesium sulfate?
  – 2 mL vial (8 mEq)
  – 20 mL vial (16 mEq)
Illegible Handwriting

• Handwriting of physicians is subject of jokes
  – no laughing matter
• Unclear orders should be clarified
• Use standardized, preprinted order forms
• Computer generated & typewritten labels
• Use of upper- and lowercase lettering
  (TALLman)
Missing Information

• Lack of medical information about patient may cause error
  – age
  – weight
  – height
  – allergies
  – diagnosis
  – indication & severity of condition
Access to Medical Information

• Thorough & complete medication profiles
  – current prescription & nonprescription medications
  – allergies
  – age
  – height
  – weight
  – previous medication use
Apothecary System

• Outdated system – use should be discouraged
• Unfamiliar to many health care personnel
• Must be converted to metric system
• “1 gr” (grain) may be interpreted as 60 mg or 65 mg
• 1 gr may be misread as “1 gm”
• Apothecary conversion charts should be readily available
Course Dose vs. Daily Dose

• Chemotherapy medication regimens are commonly prescribed on per course or cycle of treatment basis as opposed to per dose basis
• Increases risk of medication errors
• Example of a chemotherapy course dose is:
  • *Fluorouracil 4 g/m2 IV days one, two, three, and four*
• order could be misinterpreted as 4 g/m2 of fluorouracil daily for four days—a total of 16
Drug Product Characteristics

• Hundreds of drug names either sound or look alike
• ISMP maintains list of “confused” medication names
• Look & sound alike AND may be used to treat common condition
• nelfinavir (Viracept) & nevirapine (Viramune)
  – two antiretroviral agents
  – used in treatment of HIV infection
  – brand & generic names are similar, increasing risk
Look-alike, Sound-alike

- Sloppy handwriting/misspelling → confusion
- Interferon 1 mL was confused for Imferon 1 mL
- Lanoxin (digoxin) & Levoxine (levothyroxine)
  - Levoxine changed name to Levoxyl
- Quinine & quinidine
Product Labeling

• Labels may emphasize manufacturer’s name or logo instead of drug name & dose

• Same labeling scheme, including letter size, print, background color, to associate the product with manufacturer
  – makes all labels look alike

• Different vial sizes of injections may be similarly labeled with concentration (mg/mL),

• Potassium chloride (KCl) & normal saline

• Potassium chloride injection- **black vial caps** -overseals with warning “must be diluted”
Other Problems

• Color Coding-relying on color of product packaging is not safe practice
  – daunorubicin 20 mg & doxorubicin 10 mg are packaged in vials shaped similarly & have dark blue vial caps
  – both are lyophilized powders that turn red upon reconstitution
Advertising

- Zyrtec oral products
  - contain active ingredient cetirizine
- Zyrtec Itchy Eye Drops
  - contain active ingredient ketotifen
- Claritin oral products
  - contain loratadine as active ingredient
- Claritin Eye
  - contains ketotifen
- Pepcid
  - Pepcid contains active ingredient famotidine
- Pepcid Complete
  - contains famotidine, calcium, magnesium hydroxide
Drug Preparation Errors

- Read product labels carefully
- Process one prescription at a time
- Label prescriptions properly
- Store drugs properly
- Maintain safe work environment
- Keep up with changes in medical profession
Work Environment

- Inadequate lighting
- Poorly designed work spaces
- Inefficient workflow
- Cluttered work spaces & stock areas
- Distractions & interruptions
- Improper maintenance of equipment
Personnel Issues

• Scheduling of staff members
• Frequency of rotating shifts
• Staffing levels
• Amount of supervision
• Untrained, inadequately trained, or inexperienced personnel
• Relying on memory instead of checking references
• Performing complicated calculations without doublecheck
Deficiencies in Drug Use Systems

• Errors frequently due to defective/inadequate systems
• Stocking dangerous drugs in patient care areas
• Floor stock mixups
  – heparin injection & normal saline flush
• Potassium chloride & furosemide injections
• Premixed Lidocaine in D5W500mL & D5W500mL plain bags
• Automation/technology reduce medication errors
Prevention of Medication Errors

- Systems /methods to help prevent medication errors
  - failure mode & effects analysis (FEMA)
  - systems designed to prevent medication errors
  - legal requirements
  - policies & procedures
  - multiple check systems
  - standardized order forms
  - education & training
  - computerization & automation
Failure Mode & Effects Analysis

• Systematic evaluation of process
• Predicts opportunity for errors at steps in process
• Evaluates “how” & “why” instead of “who”
  – each step in process
  – opportunities for failure at each stage
  – effects of failures on process
  – root causes described
  – severity, likelihood of occurrence, probability of actually identifying failure are estimated
Criticality Index

- Multiply
  - severity
  - likelihood of occurrence
  - probability of actually identifying failure

- Address first those steps with highest criticality index
  - greatest potential for reducing risk for error

- After making changes to process
  - perform FMEA again to determine effectiveness of changes
Systems & Medication Errors

• Institutions help minimize medication errors
  – foster well-trained & knowledgeable staff
  – maintain favorable work environment
  – institute effective policies & procedures

• Patient Counseling
  – plays important role in reducing medication errors
  – increases likelihood of compliance
Systems

• Legal Requirements
  – designed to protect public
  – ensure knowledgeable individual involved in process
  – help prevent medication errors

• Policies & Procedures
  – establish systems to prevent medication errors
  – approximately 33% of errors due to noncompliance with policies & procedures
Systems

• Multiple Check Systems might include:
  – pharmacist reviewing physician order
  – pharmacy technician preparing medication
  – nurse inspecting dose from pharmacy
  – patient asking questions & examining medication before taking it
Standardized Order Forms

• Medication orders easier for
  – prescriber to read
  – pharmacist & nurse to interpret

• Chemotherapeutic agents designated as high alert
  – ideal drugs to be included on standardized order form

• Use for complicated drug therapies/high-risk drugs

• Preprinted forms legible
Education & Training

• Education & training: reduce medication errors

• Training
  – pharmacy calculations
  – compounding techniques
  – pharmacy abbreviations
  – preparation of IV medications
  – computer operation skills
  – classes of medications
  – generic & trade names
Computerization & Automation

- Bar coding
- Automated dispensing cabinets (ADCs)
- Robots
- Pharmacy-generated MARs & labels
- Computerized physician order entry (CPOE)
- Decrease # of personnel involved in ordering process
- Decrease medication errors in transcription process
NCC MERP Index for Categorizing Medication Errors

Category I:
An error occurred that may have contributed to or resulted in the patient’s death

Category H:
An error occurred that required intervention necessary to sustain life

Category G:
An error occurred that may have contributed to or resulted in permanent patient harm

Category F:
An error occurred that may have contributed to or resulted in temporary harm to the

Category A:
Circumstances or events that have the capacity to cause error

Category B:
An error occurred but the error did not reach the patient (An “error of omission” does reach the patient)

Category C:
An error occurred that reached the patient but did not cause patient harm

Category D:
An error occurred that reached the patient and required monitoring to confirm that it resulted in no harm to the patient
When an Error Occurs...

• Inform pharmacist about any known details
• Pharmacist investigates error & contacts physician
• Course of action depends on details of error
• Inform patient about error
• Policies & procedures
• Documentation
  – medication error reporting form
• Quality assurance review
Root Cause Analysis

• Examine contributing factors
• Root cause analysis consists of 5 steps:
  1. Establish team of appropriate personnel
  2. Describe event in detail
  3. Diagram steps that led up to error to determine root cause
  4. Develop specific action plan
  5. Develop outcome measures
Med Error Review

• Identifying Trends
• Make Necessary Changes
• Monitor Impact of Change
• Liability Issues