CHAPTER 18

Pediatric and Adult Dosage Calculation Based on Weight

LEARNING OBJECTIVES

After reviewing this chapter, you should be able to:

1. convert body weight from pounds to kilograms.
2. convert body weight from kilograms to pounds.
3. calculate dosages based on milligrams per kilogram.
4. determine whether a dosage is safe.

BACKGROUND

- "Pediatric patients are 3 times more likely than adults to experience a harmful medication error or adverse drug reaction" (ISMP)
- Physiological capabilities are different in infants and children than in adults.
- Two methods to calculate pediatric dosages:
  - Body weight (BW)
  - Body surface area (BSA) based on height and weight

    (not used in this course)
- Nurse is responsible for verifying correct dosage before giving.

CALCULATION OF PEDIATRIC DOSAGES BASED ON BODY WEIGHT

- Compare ordered dosage to recommended safe dose range.
- Pounds to kilograms (2.2 lb = 1 kg)
  - To convert pounds to kg, divide pounds by 2.2
  - To convert kg to pounds, multiply kg by 2.2
    - Example 1: Convert child's BW of 30 lb to kg

SAFETY ALERT

As the nurse administering meds to children, you are legally responsible for recognizing incorrect and unsafe dosages and for alerting the prescriber.

Always double check dosages.

CONVERTING: DIMENSIONAL ANALYSIS

- Pounds to kilograms:

  How many kilograms are equal to 30 lb?

  - 30 lb = *x* kg

$$x\ \text{kg} = \frac{1\ \text{kg}}{2.2\ \cancel{\text{lb}}} \times \frac{30\ \cancel{\text{lb}}}{1}$$

$$x\ \text{kg} = \frac{30\ \text{kg}}{2.2}$$

$x = 13.63$ kg $x = \boxed{13.6\ \text{kg}}$ (round to the 10th)

PRINCIPLES RELATING TO BASIC PEDIATRIC CALCULATIONS

1. Use same method (Dimensional Analysis).
2. Pediatric doses are smaller (in mcg).
3. IM dosages rarely exceed 1 mL or 0.5 mL for small infants.
4. Subcutaneous dosages are not to exceed 0.5 mL.
5. For dosages less than 1 mL, use TB syringe.
6. Pediatric doses are ***rarely rounded to tenths***; use TB so hundredths can be given.
7. All answers must be labeled.
8. Know institution policy on rounding dosages.

TB syringe

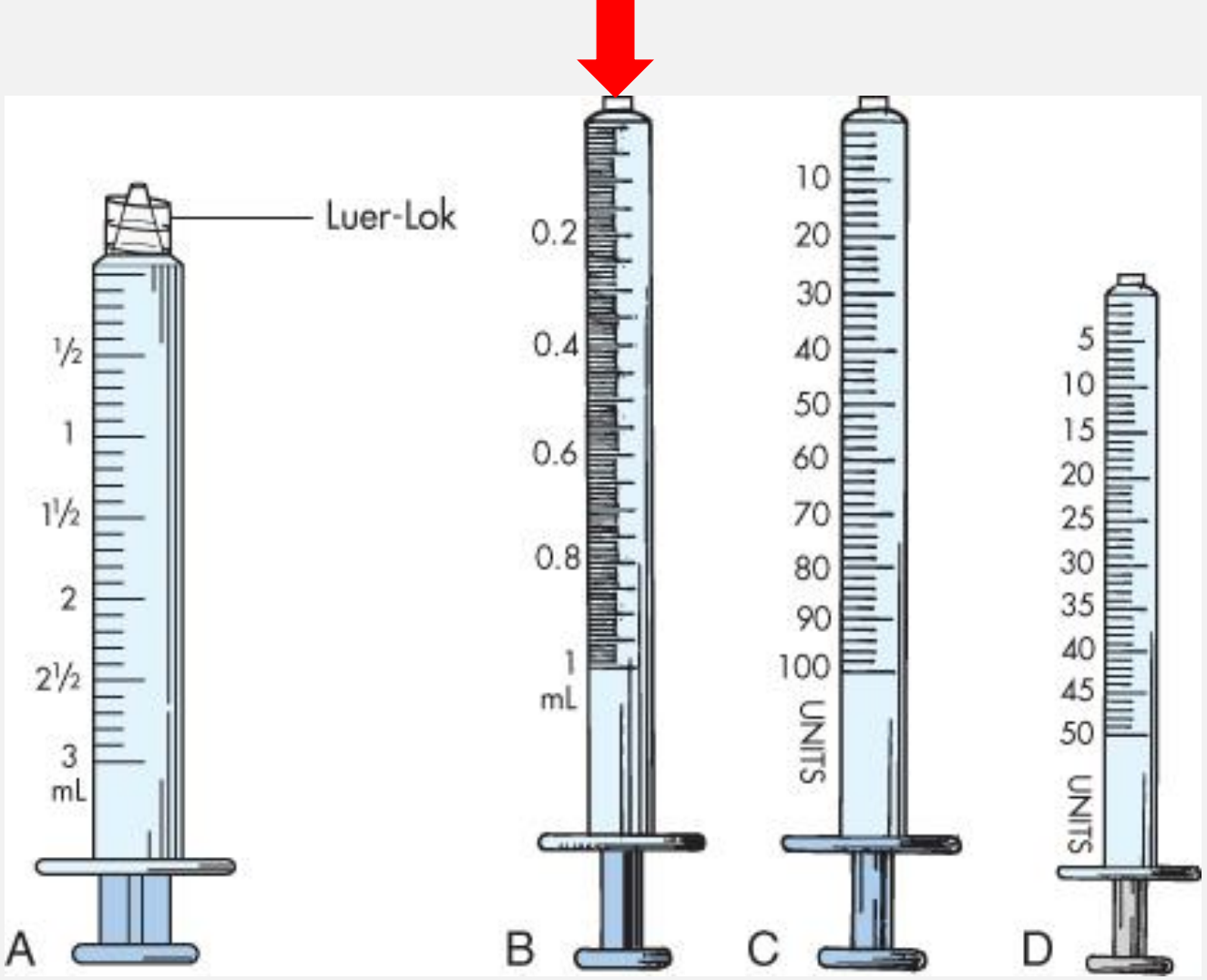

Figure 10-7 Types of syringes. A, Luer-Lok syringe marked in 0.1 (tenths). B, Tuberculin syringe marked in 0.01 (hundredths) for dosages of less than 1 mL. C, Insulin syringe marked in units (100). D, Insulin syringe marked in units (50). (From Potter PA, Perry AG, Stockert P, Hall A: *Fundamentals of nursing,* ed 9, St Louis, 2016, Mosby.)

10
15
20
25
30

1
2
3
4
5
6
7
8
9
10ml

MEDICATION ERRORS

Medication error by nurse:

https://www.youtube.com/watch?v=2ZVO4qqpiH4
(4:21)

Medication error by ICU nurse:

https://www.youtube.com/watch?v=MGT8yoAIun4
(10:26)

Medication error by student nurse:

https://www.youtube.com/watch?v=bFY4YFLfUZk&feature=youtu.be
(21:00)

DIMENSIONAL ANALYSIS

SAFETY ALERT

Use caution when converting ounces to a fraction of a pound. Remember to add the remaining whole pounds to get the total pounds before converting to kilograms.

- Convert 14.4 lb to kg

$$x\ \text{kg} = \frac{1\ \text{kg}}{2.2\ \text{lb}} \times \frac{14.4\ \text{lb}}{1}$$

$$x = \frac{14.4}{2.2}$$

$$x = 6.54\ \text{kg} = 6.5\ \text{kg}$$

REVIEW OF CONCEPTS

- Convert the child's weight in kg — round to 10th.
- **Ordered dose** – obtain from the health care provider (MD/PA/FNP)
- **Recommended dosage** — obtain from a reputable source (Davis Drug Guide, etc.)
- **Total daily dosage** — amount allowed in a 24 hr period
- **Divided doses** — amount of drug from total daily dose divided into various increments

REVIEW OF CONCEPTS (CONT.)

- **Safe dose** — high and low ranges of recommended versus what is ordered
- Calculate safe dose by multiplying weight by recommended dose — round to 10th
- Compare the ordered dose to the recommended dose and determine if the dosage is safe:
  - If safe, calculate the amount and administer.
  - If unsafe, notify the prescriber.

REVIEW OF CONCEPTS (CONT.)

SAFETY ALERT

Before administering any medication to a child, always ask yourself: **Is the dosage is safe?**

When in doubt, contact the prescriber before administering.

Pediatric medications should always be checked by two nurses.

Essentials of Medication Administration

Dimensional Analysis - ORAL & PARENTERAL CALCULATIONS
STUDENT HELP SHEET

A. CONVERTING (See Chapter 8 & 9)

Convert to / Given

unit X = _____ X _____

Example: *Convert 38 lb to kg*

38 lb = _____ kg

$kg(x) = \frac{1\ kg}{2.2\ \cancel{lb}} \times \frac{38\ \cancel{lb}}{1}$

$x = 17.3\ kg$

B. DOSAGE CALCULATIONS (See Chapter 16)

1. No conversion needed:

Available / Order

unit x = _____ X _____

Example:

Order: Vistaril 15 mg IM q4h

Available: Vistaril 30 mg/2mL

$mL(x) = \frac{2\ mL}{30\ \cancel{mg}} \times \frac{15\ \cancel{mg}}{1}$

$x = 1\ mL$

2. Conversion needed:

Available / Conversion / Order

unit x = _____ X _____ X _____

Example:

Order: Ampicillin 0.5 g IM q6h

Available: Ampicillin 250 mg per mL

$mL(x) = \frac{1\ mL}{250\ \cancel{mg}} \times \frac{1{,}000\ \cancel{mg}}{1\ \cancel{g}} \times \frac{0.5\ \cancel{g}}{1}$

$x = 2\ mL$

C. CALCULATE SAFE DOSAGES BY WEIGHT (See Chapter 25)

First – Check - Are the units the same in the Medication ORDER and Medication AVAILABLE?
(If they are the same start at Step #2. – If they are not the same, conversion is needed - start at Step #1)

Step #1: (convert lb to kg) (use format A above & see example)

Step #2: Calculate to see if the ordered dose is safe:
(If the recommend is a range, the calculation below must be performed twice to get the safe range)

Recommend / Weight (in kg)

mg(x) = _____ X _____

Example: *Order: Vistaril 15 mg IM q4h*
Recommend: 0.5 to 1 mg/kg/dose q 4 h
Available: 30 mg/2mL

Weight: ~~38 lb~~ 17.3 kg (see conversion example in format A above)

$mg(x) = \frac{0.5\ mg}{\cancel{kg}/dose} \times \frac{17.3\ \cancel{kg}}{1}$

$x = 8.65\ mg/dose$

$mg(x) = \frac{1\ mg}{\cancel{kg}/dose} \times \frac{17.3\ \cancel{kg}}{1}$

$x = 17.3\ mg/dose$

Safe dose range = 8.65 – 17.3 mg/dose

Step #3: Compare answer in Step #2 to the Order to see if the order is Safe.
If it is not safe – STOP - and call the MD.

Step #4: If it is safe, perform the dosage calculation (use format B above) and administer the medication.
(See dosage calculation in B1 example)

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C. CALCULATE SAFE DOSAGES BY WEIGHT (See Chapter 25)

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(If they are the same start at Step #2. – If they are not the same, conversion is needed - start at Step #1)

Step #1: (convert lb to kg) (use format A above & see example)

Step #2: Calculate to see if the ordered dose is safe:
(If the recommend is a range, the calculation below must be performed twice to get the safe range)

$$mg(x) = \frac{\text{Recommend}}{\text{_____}} \times \frac{\text{Weight (in kg)}}{\text{_____}}$$

Example: *Order: Vistaril 15 mg IM q4h* *Weight: ~~38 lb~~ 17.3 kg (see conversion example in format A above)*
Recommend: 0.5 to 1 mg/kg/dose q 4 h
Available: 30 mg/2mL

$$mg(x) = \frac{0.5\ mg}{kg/dose} \times \frac{17.3\ \cancel{kg}}{1}$$

$$x = 8.65\ mg/dose$$

$$mg(x) = \frac{1\ mg}{kg/dose} \times \frac{17.3\ \cancel{kg}}{1}$$

$$x = 17.3\ mg/dose$$

Safe dose range = 8.65 – 17.3 mg/dose

Step #3: Compare answer in Step #2 to the Order to see if the order is Safe.
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Step #4: If it is safe, perform the dosage calculation (use format B above) and administer the medication.
(See dosage calculation in B1 example)

SINGLE-DOSE MEDICATIONS

Is the dose safe? 1.2 mg YES

- Meds may be ordered as mg/kg/dose
- Multiply the recommended dose by the child's weight

Example 1: Narcan 1.2 mg IV stat for a child who weight 12 kg.

Recommended dosage is 0.1 mg/kg/dose

$$Safe\ mg = \frac{0.1\text{mg}}{1\cancel{\text{kg}}} \times \frac{12\cancel{\text{kg}}}{1}$$

= 1.2 mg, the dose is safe

12 kg x 0.1 mg/kg/dose = 1.2 mg

SINGLE-DOSE MEDICATIONS (CONT.)

How many mL do you give?
3.0 mL

- Now that you have determined the dosage is safe, calculate the number of mL to give

Order: Narcan 1.2 mg IV stat

Available: Narcan 0.4 mg/mL

$$mL = \frac{1\,mL}{0.4\,mg} \times \frac{1.2\,mg}{1} = 3\,mL$$

SINGLE-DOSE RANGE MEDICATIONS

- Some medications can indicate a minimum and a maximum range.

Example 2:

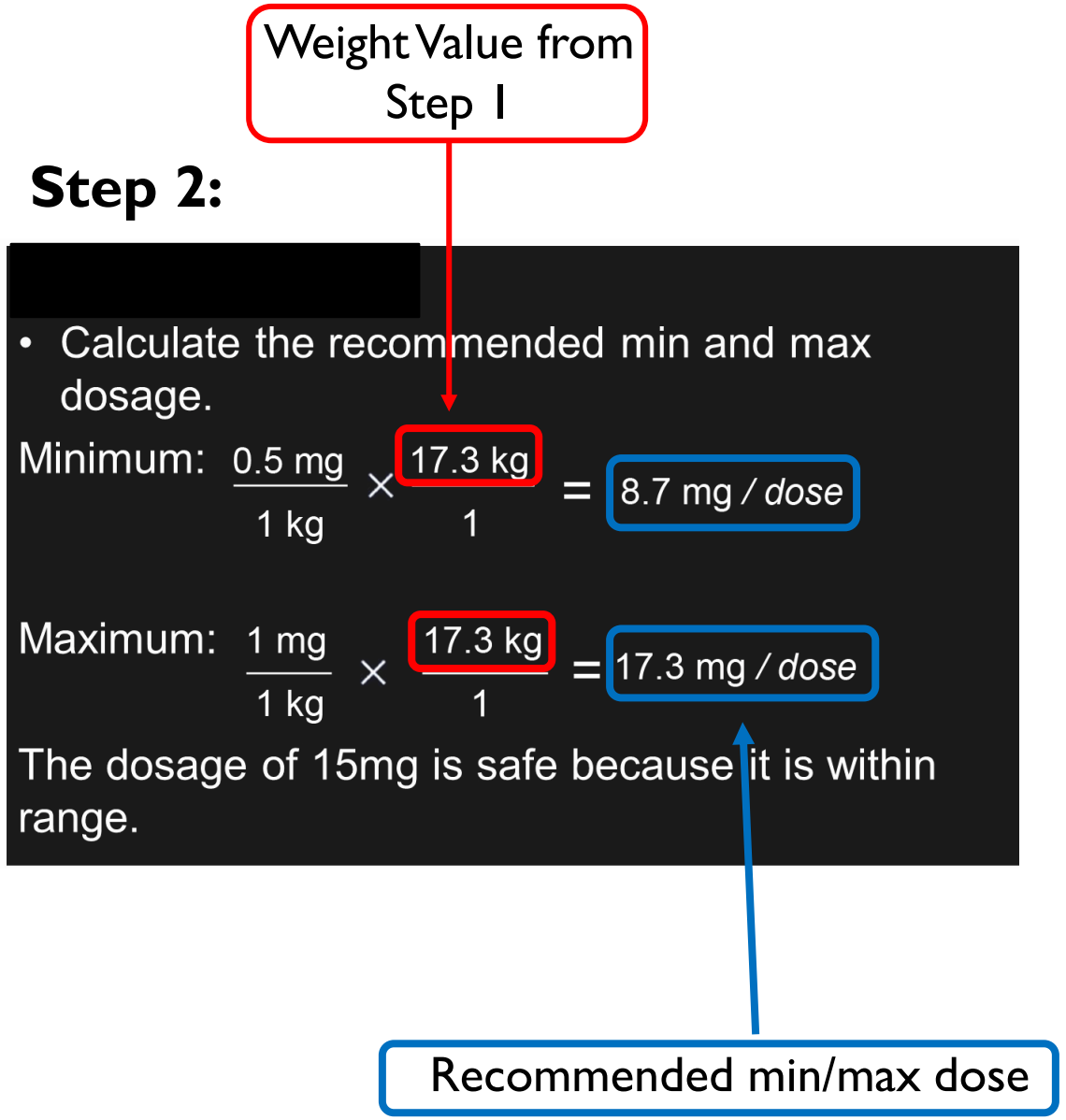
- **Order:** Vistaril 15 mg IM q4h prn nausea
- **Recommended dose:** 0.5 to 1 mg/kg/dose q4h
  - Child weighs 38 lb. Is the dosage safe?

Step 1: Convert lbs to kg:

x kg= 1 kg/ 2.2 lb x 38 lb/1

x = 17.3 kg

SINGLE-DOSE RANGE MEDICATIONS (CONT.)



SINGLE-DOSE RANGE MEDICATIONS (CONT.)

Order of
15 mg is safe

Step 3:

Compare answer in Step 2 to the Order

8.7 mg | 15 mg | 17.3 mg

Is the Order safe?

No – **STOP** and call the Doctor

Yes – Continue to Step 4 (calculate the dosage)

SINGLE-DOSE RANGE MEDICATIONS (CONT.)

Step 4:

- Calculate the amount of mL to administer.

Available: Vistaril 50 mg/mL

$$mL = \frac{1\ mL}{50\ mg} \times \frac{15\ mg}{1} = 0.3\ mL$$

Note: You may use ration proportion, formula, or dimensional analysis method to solve as discussed in previous chapters

CASE STUDY 6

You continue with your assessment of Tara and notice that she feels warm to the touch and her cheeks are flushed. An oral temperature reveals a fever of 101.5° F. You review the chart and find the following order:

Tylenol Elixir (160 mg/5 mL) 150 mg PO q4h prn fever greater than 99° F

The safe dose range reads:

10-15 mg/kg/dose q4-6hr as needed.

Is the dose safe? (Tara weighs 15 kg)

If yes, how much will you administer?

RECOMMENDED DOSE CALCULATION

$$\frac{10\ \text{mg}}{1\ \cancel{\text{kg}}} \times \frac{15\ \cancel{\text{kg}}}{1} = 150\ \text{mg}$$

$$\frac{15\ \text{mg}}{1\ \cancel{\text{kg}}} \times \frac{15\ \cancel{\text{kg}}}{1} = 225\ \text{mg}$$

RECOMMENDED DOSE CALCULATION

$$\frac{10\ \text{mg}}{1\ \cancel{\text{kg}}} \times \frac{15\ \cancel{\text{kg}}}{1} = 150\ \text{mg}$$

$$\frac{15\ \text{mg}}{1\ \cancel{\text{kg}}} \times \frac{15\ \cancel{\text{kg}}}{1} = 225\ \text{mg}$$

150mg PO q 4hr prn if fever greater than 99 degrees F

SAFE

DOSE CALCULATION: DIMENSIONAL ANALYSIS

$$x \text{ mL} = \frac{5 \text{ mL}}{160 \cancel{\text{mg}}} \times \frac{150 \cancel{\text{mg}}}{1} = 4.68 \text{ mL} = 4.7 \text{mL}$$

CASE STUDY 6 (CONT.)

ANSWER:

The dose is safe

Administer 4.7 mL

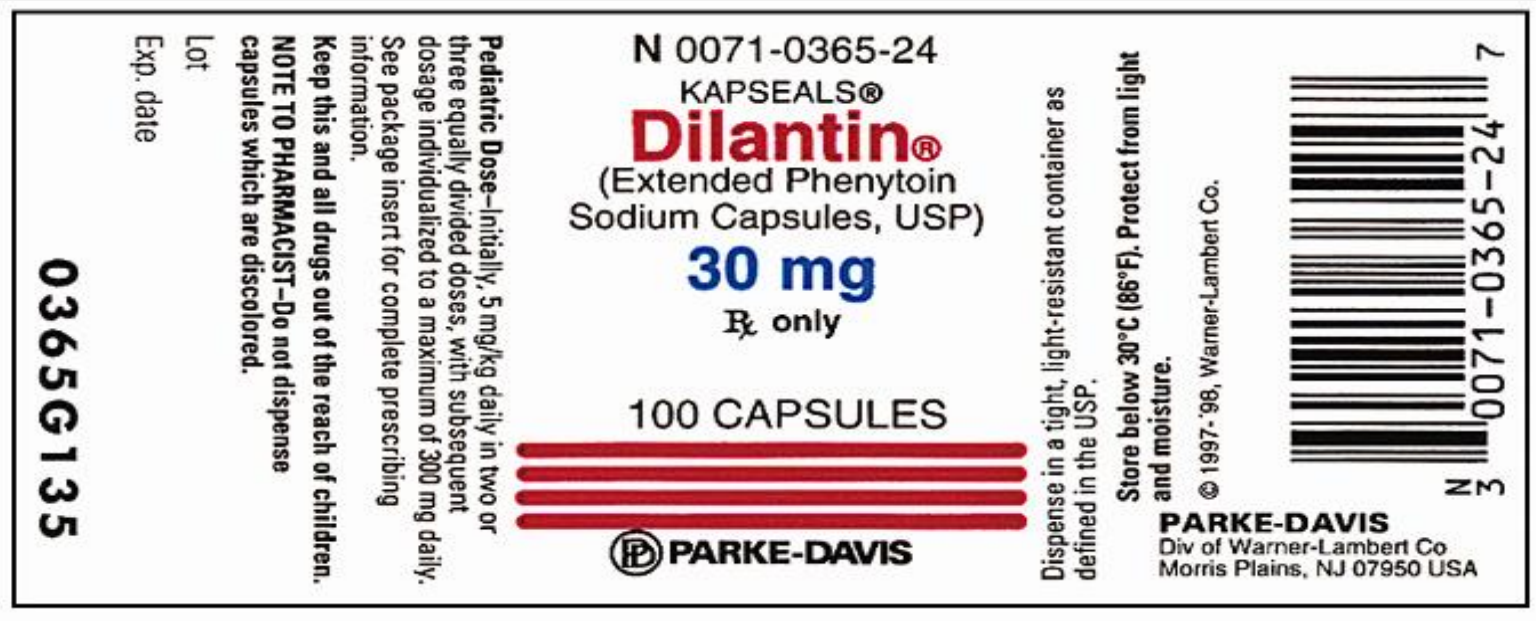
AFTER checking calculations and dosage with another nurse.

PEDIATRIC DAILY DOSAGES

Dosages that are around the clock are recommended as a total daily dosage: mg/kg/day.

1. Calculate total daily dosage.
2. Divide daily dosage by number of doses to be administered.
3. Use Dimensional Analysis to calculate the number of tabs or caps or mL to administer the dose.

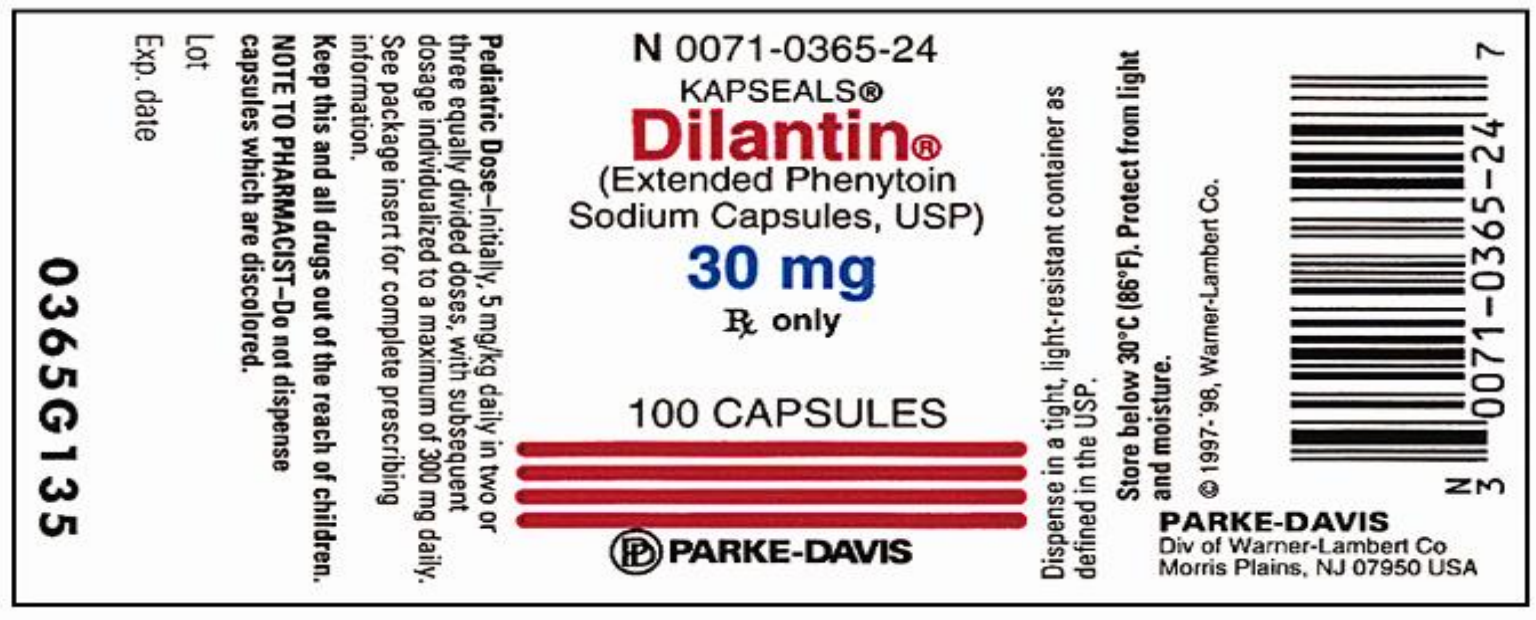
PEDIATRIC DAILY DOSAGES (CONT.)



Order: Dilantin 30 mg p.o. q8h. Child weighs 18 kg. Recommended dosage is 5 mg/kg/day in two or three equally-divided doses. Is the dosage safe?

Max dose for entire day

PEDIATRIC DAILY DOSAGES (CONT.)



Order: Dilantin 30 mg p.o. q8h. Child weighs 18 kg. Recommended dosage is 5 mg/kg/day in two or three equally-divided doses. Is the dosage safe?

Max dose for entire day

PEDIATRIC DAILY DOSAGES (CONT.)

1. Calculate safe total daily dosage:

   5 mg/kg/day x 18 kg = 90 mg per day

2. Determine amount for each dose (3):

3. 90 mg / 3 doses = 30 mg per dose

   30 mg q8h = 30 mg three times daily

   30 mg × 3 = 90 mg daily; therefore it is safe

PEDIATRIC DAILY DOSAGES (CONT.)

1. Calculate safe total daily dosage:

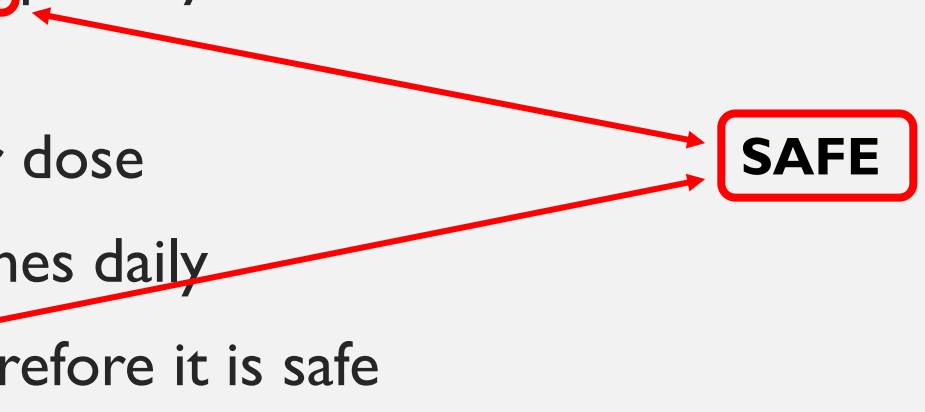
   5 mg/kg/day x 18 kg = 90 mg per day

2. Determine amount for each dose (3):

3. 90 mg / 3 doses = 30 mg per dose

   30 mg q8h = 30 mg three times daily

   30 mg × 3 = 90 mg daily; therefore it is safe



ADULT DOSAGES BASED ON BODY WEIGHT

Information used to calculate dosages for children can also be used for adults.

Example 3:

Order: Ticar 4 g IV q6h. Client weighs 175 lb. Recommended dose is 200 to 300 mg per kg per day given in divided doses every 4 to 6 hr.

Is the dosage safe?

ADULT DOSAGES BASED ON BODY WEIGHT (CONT.)

1. Convert lb to kg

175 lb ÷ 2.2 kg = 79.54 = 79.5 kg

2. Calculate recommended dose

200 mg/~~kg~~/day × 79.5 ~~kg~~ = 15,900 mg/day (Low range)

300 mg/~~kg~~/day × 79.5 ~~kg~~ = 23,850 mg/day (High range)

ADULT DOSAGES BASED ON BODY WEIGHT (CONT.)

3. Determine mg allowed per dose for dosing every 6 hr (4 doses in 24 hr):

Low 15,900 mg/day ÷ 4 doses = 3,975 mg/dose

High 23,850 mg/day ÷ 4 doses = 5,962.5 mg/dose

4. Determine if dose is safe:

Order: 4 g q6h = 4,000 mg q6h

Dose is within safe dose range.

ADULT DOSAGES BASED ON BODY WEIGHT (CONT.)

3. Determine mg allowed per dose for dosing every 6 hr (4 doses in 24 hr):

Low 15,900 mg/day ÷ 4 doses = 3,975 mg/dose

4,000 mg/dose - SAFE

High 23,850 mg/day ÷ 4 doses = 5,962.5 mg/dose

4. Determine if dose is safe:

Order: 4 g q6h = 4,000 mg q6h

Dose is within safe dose range.

REMINDERS: PEDIATRIC ORAL AND PARENTERAL MEDICATIONS

1. Dosages for children are smaller than those for adults.
2. Most medications for children are liquid.
3. Oral route is preferred to parenteral.
4. Not more than 1 mL IM for small children and older infants.
5. Small infants should receive not more than 0.5 mL IM
6. Parenteral doses are usually given with tuberculin (TB) syringes.

PRACTICE PROBLEMS

A child weighing 42 lb 5 oz is prescribed Rocephin 800 mg IV B.I.D. The recommended dosage is 50–75 mg/kg/day.

1. Convert the weight to kg.
2. Determine the safe dose range for the child.
3. Is the ordered dose safe?
4. What is your next step?

CONVERSIONS RELATING TO WEIGHT

Pounds and ounces to kilograms

- A child weighs 42 lb 5 oz

  5 oz ÷16 = 0.31 *rounds to* 0.3 lb

  42 lb + 0.3 lb = 42.3 lb

CONVERTING: DIMENSIONAL ANALYSIS

Pounds and ounces to kilograms

How many kilograms are equal to 42.3 lb?

- Equivalence: 1 kg = 2.2 lb
- 42.3 lb = *x* kg

$$x\ \text{kg} = \frac{1\ \text{kg}}{2.2\ \text{lb}} \times \frac{42.3\ \text{lb}}{1}$$

$$x\ \text{kg} = \frac{42.3\ \text{kg}}{2.2}$$

$x = 19.22$ kg

x = 19.2 kg

RECOMMENDED DOSE CALCULATION

$$\frac{50\ \text{mg}}{1\ \cancel{\text{kg}}} \times \frac{19.2\ \cancel{\text{kg}}}{1} = 960\ \text{mg}$$

$$\frac{75\ \text{mg}}{1\ \cancel{\text{kg}}} \times \frac{19.2\ \cancel{\text{kg}}}{1} = 1440\ \text{mg}$$

Order: 800 mg BID

RECOMMENDED DOSE CALCULATION

$$\frac{50\ \text{mg}}{1\ \text{kg}} \times \frac{19.2\ \text{kg}}{1} = 960\ \text{mg}$$

$$\frac{75\ \text{mg}}{1\ \text{kg}} \times \frac{19.2\ \text{kg}}{1} = 1440\ \text{mg}$$

800mg BID = 2 X 800 mg =1600 mg/day – **NOT SAFE !!!**

CONVERSIONS RELATING TO WEIGHT

Example: A doctor orders 200 mg of Rocephin to be taken by a 15.4 lb infant every 8 hours. The medication label shows that 75-150 mg/kg per day is the appropriate dosage range. Is this doctor's order within the desired range?

Weight in Kg * Dosage Per Kg = Y (Required Dosage)

Convert 15.4 lb to kg.

lb → kg (÷ by 2.2)

15.4 lb ÷ 2.2 = 7 kg

7 kg * 75 mg/kg = 525 mg (Minimum Desired Dosage)

7 kg * 150 mg/kg = 1,050 mg (Maximum Desired Dosage)

24 hours in one day and the medication is ordered every 8 hours.

24 hrs / 8 hrs = 3 times per day doctor ordered medication

200 * 3 = 600 mg ordered per day

600 mg is within the desired range of 525-1,050 mg

Yes doctor has ordered a dosage within the desired range.

CONVERSIONS RELATING TO WEIGHT

www.dosagehelp.com