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Medication Calculations Dimensional Analysis Tutorial

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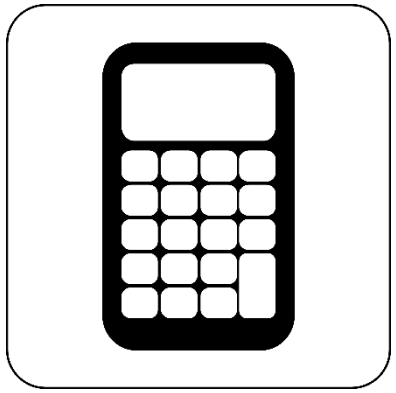

Molloy College
The Barbara H. Hagan School of Nursing

Medication Calculations Dimensional Analysis Self-Paced Tutorial

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Dimensional Analysis

Why?

- Critical thinking approach
- Utilizes the Nursing Process
- One method for all types of calculations
- No formulas to memorize
- Prevent errors

What you need to know:

- Interpreting a medication order
- Multiply fractions
- Metric System and Conversions

What will be covered?

Basic Dosage Calculations
- mcg/dose
- mg/dose
- g/dose
- meq/dose
- unit/dose

Dosage Calculations Based on Body Weight
- mcg/kg/dose
- mg/kg/dose

Basic Infusions: IV and Enteral
- gtts/min
- ml/hr
- Time to infuse
- Left in bag

Dosage Calculations Based on Time
- units/hour
- mUnits/min
- mg/min

Loading Dose & Titration

Dosage Calculations Based on Weight & Time
- mcg/kg/min
- units/kg/hr

Therapeutic & Safe Dosage Range
- High and Low for each dose
- High and Low for day
- Max daily dose

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Medication Calculation Instructions

CALCULATION INSTRUCTIONS

- *Adhere to the following rounding rules. Round your answer at the end of the calculation (except for kilogram conversion).*
- *When completing calculations online: Only enter the numerical answer in the answer space. Otherwise, show your math to receive credit for correct answers. Do all work in the space provided (even scrap work).*

PARENTERAL

Intravenous infusion by gravity (gtts/min)

- round to a whole number

Intravenous infusion by pump (ml/hr)

- round to the nearest tenth

Injectable medications

- For any volume less than 1 ml, round to the nearest hundredth
- For any volume greater than 1 ml, round to the nearest tenth

ENTERAL

Oral/NGT/PEG/J Tube:

- For any volume less than 1 ml, round to the nearest hundredth
- For any volume greater then 1 ml, round to the nearest tenth

WEIGHT

Pounds to Kilograms Conversions

- round to the nearest tenth

DOSE CALCULATIONS (g, mg, mcg)

- **Dose calculations may be rounded to the nearest tenth unless otherwise specified**

Basic Dosage Calculations

- mcg/dose
- mg/dose
- g/dose
- meq/dose
- unit/dose

Just like the Nursing Process, always begin with assessment. Collect data by interpreting the medication order.

Determine the drug (Verapamil HCL), dosage (240 mg), route (PO), frequency (daily), and any special administration instructions (none for this example).

Next determine what medication is available (Verapamil HCL 120 mg tablets).

Then, identify an outcome. For medication calculations that outcome (aka: goal) is usually what you are going to administer to your patient.

In this first example the question being asked is "How many tablets will the nurse administer per dose?" So, your goal is tablets/dose.

Note: even if "per dose" was not explicitly stated you will only be administering one dose at a time, therefore one dose is what you will most often be calculating. There are occasions, safe rages, weight-based dosing, etc.., when you will be asked "How much medication will the patient receive in a day?", but that will be specifically stated.

Order: Verapamil HCL 240 mg PO daily

Available: Verapamil HCL 120 mg tablets

How many tablets will the nurse administer per dose?

1. Start with what you are looking for $\frac{tablets}{dose}$ (this is the same as tablets/dose) on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. See in the example "mg" will cancel out and you will be left with only tablets and dose - just what you are looking for
4. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

Determine the drug (Alprazolam), dosage (1000 mcg), route (PO), frequency (three times a day), and any special administration instructions (none for this example).

Next determine what medication is available (Alprazolam 0.25 mg tablets).

Then, identify an outcome. The question being asked is the same as the previous one, "How many tablets will the nurse administer per dose?" So, your goal is tablets/dose.

There will be times, as in this example, when the ordered medication and available medication are in different metric weights, grams, milligrams, micrograms, therefore you will have to add a converting factor to the equation.

Stick with the same plan, start the equation with what you are looking for and then add factors as needed - tablets in the numerator and dose in the denominator.

Order: Alprazolam 1000 mcg PO three times a day

Available: Alprazolam 0.25 mg tablets

How many tablets will the nurse administer per dose?

1. Start with what you are looking for $\frac{tablets}{dose}$ on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. Notice the medication is ordered in mcg but supplied in mg.
4. Add a converting factor: 1 mg = 1000 mcg. Just be sure to match numerators with denominators so you can cancel
5. See in the example "mg" will cancel out, as will mcg, and you will be left with only tablets and dose - just what you are looking for
6. The final step is to multiply across – numerators first, then denominators, and dived as needed.

$$\frac{1\ tablet}{0.25\ mg} * \frac{1mg}{1000mcg} * \frac{1000\ mcg}{dose} = \frac{tablets}{dose}$$

$$\frac{1\ tablet}{0.25\ \cancel{mg}} * \frac{1\ \cancel{mg}}{1000\ \cancel{mcg}} * \frac{1000\ \cancel{mcg}}{dose} = \frac{1000}{250} = \frac{4\ tablets}{dose}$$

Determine the drug (KCL), dosage (25 meq), route (PO), frequency (daily), and any special administration instructions (none for this example).

Next determine what medication is available (KCL 40 meq/15 ml).

In the first two examples, the medication was available in tablets, so the question was "How many tablets will the nurse administer per dose?"

However, now, we are administering a liquid. The metric measurement for a liquid volume is Liter (L), therefore, liquid medicines will be administered in milliliters (ml).

The question for this example is "How many ml will the nurse administer per dose?" So, your goal is ml/dose.

Order: KCL 25 meq PO daily

Available: KCL 40 meq/15 ml

How many ml will the nurse administer per dose?

1. Start with what you are looking for $\frac{ml}{dose}$ on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. See in the example "meq" will cancel out and you will be left with only ml and dose - just what you are looking for
4. The final step is to multiply across – numerators first, then denominators, and dived as needed

$$\frac{15\ ml}{40\ meq} * \frac{25\ meq}{dose} = \frac{ml}{dose}$$

$$\frac{15\ ml}{40\ \cancel{meq}} * \frac{25\ \cancel{meq}}{dose} = \frac{375}{40} = \frac{9.375}{1} = \frac{9.4\ ml}{dose}$$

Determine the drug (Gentamicin), dosage (115 mg), route (IM), frequency (q8h), and any special administration instructions (none for this example).

Next determine what medication is available (Gentamicin 80 mg/2 ml).

The question for this example is "How many ml will the nurse administer per dose?" So, your goal is ml/dose.

Order: Gentamicin 115 mg IM q8h

Available: Gentamicin 80 mg/2 ml

How many ml will the nurse administer per dose?

1. Start with what you are looking for $\frac{ml}{dose}$ (this is the same as ml/dose) on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. See in the example "mg" will cancel out and you will be left with only tablets and dose - just what you are looking for
4. The final step is to multiply across – numerators first, then denominators, and dived as needed

$$\frac{2\ ml}{80\ mg} * \frac{115\ mg}{dose} = \frac{ml}{dose}$$

$$\frac{2\ ml}{80\ \cancel{mg}} * \frac{115\ \cancel{mg}}{dose} = \frac{230}{80} = \frac{2.875}{1} = \frac{2.9\ ml}{dose}$$

Determine the drug (Oxacillin Sodium), dosage (300 mg), route (IM), frequency (q6h), and any special administration instructions (none for this example).

Next determine what medication available (Oxacillin Sodium 1 gram/6 ml).

Then, identify an outcome. The question being asked is the same as the previous one, "How many ml will the nurse administer per dose?" So, your goal is ml/dose.

And, since the ordered and available medications are in different weights, grams, milligrams, micrograms, the nurse will have to add a converting factor to the equation.

Stick with the same plan, start the equation with what you are looking for and then add factors as needed – ml in the numerator and dose in the denominator.

Order: Oxacillin Sodium 300 mg IM q6h

Available: Oxacillin Sodium 1 gram/ 6 ml

How many ml will the nurse administer per dose?

1. Start with what you are looking for $\frac{ml}{dose}$ on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. Notice the medication is ordered in mg but supplied in gram.
4. Add a converting factor: 1 gram = 1000 mg. Just be sure to match numerators with denominators so you can cancel
5. See in the example "mg" will cancel out, as will "gram", and you will be left with only tablets and dose - just what you are looking for
6. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{6\ ml}{1\ gram} * \frac{1 gram}{1000 mg} * \frac{300\ mg}{dose} = \frac{ml}{dose}$$

$$\frac{6\ ml}{1\ \cancel{gram}} * \frac{1\ \cancel{gram}}{10\cancel{00}\ \cancel{mg}} * \frac{3\cancel{00}\ \cancel{mg}}{dose} = \frac{18}{10} = \frac{1.8\ ml}{dose}$$

Determine the drug (Heparin), dosage (7,500 units), route (SQ), frequency (q12h), and any special administration instructions (none for this example).

Next determine what medication is available (Heparin 10,000 units/ml).

The question for this example is "How many ml will the nurse administer per dose?" So, your goal is ml/dose.

Order: Heparin 7,500 units SQ q12h

Available: Heparin 10,000 units/ml

How many mL will the nurse administer?

1. Start with what you are looking for $\frac{ml}{dose}$ (this is the same as ml/dose) on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. See in the example "mg" will cancel out and you will be left with only tablets and dose - just what you are looking for
4. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{1\ ml}{10{,}000\ units} * \frac{7{,}500\ units}{dose} = \frac{ml}{dose}$$

$$\frac{1\ ml}{10{,}0\cancel{00\ unit}} * \frac{7{,}5\cancel{00\ unit}}{dose} = \frac{75}{100} = \frac{0.75\ ml}{dose}$$

Practice 1 Problems

How many ml will the nurse administer for each dose of medicine?

1. Order Potassium Chloride 30 mEq PO once daily

   Available 40 mEq/5 ml
2. Order Heparin 1250 units SQ once daily

   Available 1000 units/1.5 ml
3. Order Bumex 0.5 mg IM one time now

   Available 0.25 mg/ml
4. Order 0.6 mg Penicillin IM q8h

   Available 1000 mcg/2 ml
5. Order Ampicillin 0.2 gram PO q6h

   Available 125 mg/5 ml

Practice 1 Answers

1. 3.8 mL
2. 1.9 ml
3. 2 mL
4. 1.2 mL
5. 8 mL

Dosage Calculations Based on Body Weight

- mcg/kg/dose
- mg/kg/dose

Determine the drug (Hydrocortisone), dosage (3 mg/kg), route (IVP), frequency (one dose), and any special administration instructions (now).

Next determine what medication is available (Hydrocortisone 100 mg/ml).

Then, identify an outcome. The question being asked is the same as the previous one, "How many ml will the nurse administer per dose?" So, your goal is ml/dose.

In the first four examples, we were looking for a dosage of medicine, when the dosage was identified. Now, let's look to see how we calculate a dosage based on a patient's weight.

To begin, you must first determine the patient's weight in kilograms (kg). Do this by using the converting factor 1 kg = 2.2 lb. This patient weighs 178 lb, divided by 2.2, is 80.9 kg.

Remember the School of Nursing rounding rules! A kg weight is rounded to the tenth.

Order: Hydrocortisone 3 mg/kg IVP one dose now

Available: Hydrocortisone 100 mg/ml

Patient weighs 178 lb

How many ml will the nurse administer per dose?

1. Start with converting the patient's weight to kg. $\frac{178lbs}{1} * \frac{1kg}{2.2lb} = \frac{178}{2.2} = 80.9kg$
2. Identify what you are looking for $\frac{ml}{dose}$ on the right side of the =
3. Then match the dosage that has been ordered, in this example $\frac{3mg}{kg/dose}$ to weight and medication that is available by numerators and denominators
4. See in the example "kg" and "mg" will cancel out and you will be left with only ml and dose - just what you are looking for
5. The final step is to multiply across – numerators first, then denominators, and dived as needed

$$\frac{3\ mg}{kg/dose} * \frac{80.9kg}{1} * \frac{1ml}{100mg} = \frac{ml}{dose}$$

$$\frac{3\ \cancel{mg}}{\cancel{kg}/dose} * \frac{80.9\cancel{kg}}{1} * \frac{1ml}{100\cancel{mg}} = \frac{242.7}{100} = \frac{2.427}{1} = \frac{2.4\ ml}{dose}$$

Determine the drug (Digoxin), dosage (12 mcg/kg), route (IV), frequency (one time), and any special administration instructions (none for this example).

Next determine what medication is available (Digoxin 0.1 mg/ml).

Then, identify an outcome. The question being asked is the same as the previous one, "How many ml will the nurse administer per dose?" So, your goal is ml/dose.

Here, like in previous example, you must first determine the patient's weight in kilograms (kg).

And, since the ordered and available medications are in different weights, grams, milligrams, micrograms, you will have to add a converting factor to the equation.

Stick with the same plan, start the equation with what you are looking for and then add factors as needed – ml in the numerator and dose in the denominator.

Order: **Digoxin 12 mcg/kg IV one time**

Available: **Digoxin 0.1 mg/ml**

Patient weighs 175 lbs

How many ml will the nurse administer per dose?

1. Start with converting the patient's weight to kg. $\frac{175lbs}{1} * \frac{1kg}{2.2lbs} = \frac{175}{2.2} = \frac{79.54}{1} = 79.5\ kg$
2. Identify what you are looking for $\frac{ml}{dose}$ on the right side of the =
3. Then match the dosage that has been ordered, in this example $\frac{12\ mcg}{kg/dose}$ to weight and medication that is available by numerators and denominators
4. Notice the medication is ordered in mcg but supplied in mg.
5. Add a converting factor: 1 mg = 1000 mcg. Just be sure to match numerators with denominators so you can cancel
6. See in the example "kg" , "mg", and "mcg" will cancel out and you will be left with only ml and dose - just what you are looking for
7. The final step is to multiply across – numerators first, then denominators, and dived as needed

$$\frac{12\ mcg}{kg/dose} * \frac{79.5\ kg}{1} * \frac{1\ ml}{0.1\ mg} * \frac{1\ mg}{1000\ mcg} = \frac{ml}{dose}$$

$$\frac{12\ \cancel{mcg}}{\cancel{kg}/dose} * \frac{79.5\ \cancel{kg}}{1} * \frac{1\ ml}{0.1\ \cancel{mg}} * \frac{1\ \cancel{mg}}{1000\ \cancel{mcg}} = \frac{954}{100} = \frac{9.54}{1} = \frac{9.5\ ml}{dose}$$

Practice 2 Problems

1. Order Gentamicin Sulfate 2.4 mg/kg IV q12h

   Available 40 mg/ml Patient weighs 105 lb

   How many ml do you administer ?

2. Order Tobramycin 1.25 mg/kg IM q8h

   Available 0.2 g/ml Patient weighs 183 lb

   How many ml do you administer ?

Practice 2 Answers

1. 2.9 mL
2. 0.52 mL

Basic Infusions: IV and Enteral

- gtts/min
- ml/hr
- Time to infuse
- Left in bag

The examples thus far have been to identify a single dose of medication administered at a single moment in time. Infusions, on the other hand, are given over a period of time, 15 minutes, 30 minutes, 60 minutes (or an hour), two, three, or even twelve hours, etc.

Even though D5W is not technically a "drug", volume to be infused is not technically a "dosage", and the "frequency" has changed to a period of time, we can still follow the same approach. Our assessment, goal identification, and method to calculate will not change.

Determine the drug (D5W), dosage (500 ml), route (IV), frequency (over 6 hours), and any special administration instructions (none for this example).

Next determine what medication is available (D5W 500 bag ml and a 15 gtt/ml administration set).

Then, identify an outcome. The question being asked is, "How many gtts/min will the nurse regulate the IV?" So, your goal is gtts/min.

Stick with the same plan, start the equation with what you are looking for and then add factors as needed – gtts in the numerator and minutes in the denominator.

Order: **D5W 500 ml to infuse over 6 hrs**

Available: **D5W 500 ml bag**

15 gtt/ml administration set

How many gtts/min will the nurse regulate the IV?

1. Start with what you are looking for $\frac{gtts}{minute}$ on the right side of the =
2. Then match what has been ordered and the drop factor that is available by numerators and denominators.
3. Notice the ordered time is in hr, but the question asks for min.
4. Add a converting factor for time: 60 minutes = 1 hour. Just be sure to match numerators with denominators so you can cancel.
5. See in the example "ml" and "hr" will cancel out and you will be left with only gtts and min - just what you are looking for
6. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{500\ ml}{6\ hrs} * \frac{15\ gtt}{ml} * \frac{1\ hr}{60\ min} = \frac{gtts}{min}$$

$$\frac{500\ \cancel{ml}}{6\ \cancel{hr}} * \frac{1\ \cancel{15}\ gtt}{\cancel{ml}} * \frac{1\ \cancel{hr}}{4\ \cancel{60}\ min} = \frac{500}{24} = \frac{20.83}{1} = \frac{21\ gtts}{min}$$

Now here's the same order, but this time the IV fluid is being delivered on an Electronic Infusion Device (EID).

When a fluid and/or medication is ordered as an infusion most often it will be delivered on an EID because it is safer than delivering it by gravity (as was the previous example).

When using an EID, the nurse must program the Rate and Volume. The rate is always ml/hr and the volume is the total amount (in ml) that is being infused.

The questions here are "How many ml/hr will the nurse set the EID?" and "What is the volume to be infused?"

Order: **D5W 500 ml to infuse over 6 hrs**

Available: **Electronic Infusion Device (EID)**

How many ml/hr will the nurse will the nurse set the EID?

What is the volume to be infused?

1. Start with what you are looking for $\frac{ml}{hr}$ on the right side of the =
2. Then match the what has been ordered by numerators and denominators
3. In this example you have just what you are looking for and do not need to add any converting factors
4. The Volume to be infused is the total amount (in ml) 500 ml

$$\frac{500\ ml}{6\ hrs} = \frac{ml}{hr}$$

$$\frac{500\ ml}{6\ hr} = \frac{83.33}{1} = \frac{83.3\ ml}{hr}$$

Time to Infuse

Here's another "infusion example, but this time you are given an infusion rate and asked to calculate the infusion time.

Time is measured in hours and minutes.

The questions here are "How long will the IV take to infuse?" and "What time will it end?"

Order: **500 ml 0.9 NS to infuse at 50 ml/hr**

Calculate the infusion time

1. Start with what you are looking for (hr) on the right side of the =
2. Then match the what has been ordered by numerators and denominators
3. In this example you have just what you are looking for and do not need to add any converting factors.
4. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{500ml}{1} * \frac{1hr}{50\ ml} = \frac{hrs}{1}$$

$$\frac{50\cancel{0ml}}{1} * \frac{1hr}{5\cancel{0ml}} = 10\ hr$$

The infusion time is 10 hrs

If the infusion was started at 8:00 am, what time will the infusion end?

6:00 pm *(10 hrs after from start time)*

Military Time 1800

Time to Infuse

Here's another "Time to Infuse" example, but this time you must calculate both *hours* and *minutes* because the hourly infusion rate does not divide evenly into the total volume.

The questions here are "How long will the IV take to infuse?" and "What time will it end?"

Order: 1000 ml 0.9 NS to infuse at 90 ml/hr

Calculate the infusion time

1. Start with what you are looking for (hr) on the right side of the =
2. Then match the what has been ordered by numerators and denominators
3. In this example you have just what you are looking for and do not need to add any converting factors.
4. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{1000ml}{1} * \frac{1hr}{90ml} = \frac{hrs}{1}$$

$$\frac{1000\cancel{ml}}{1} * \frac{1hr}{90\cancel{ml}} = 11.11hrs$$

5. Remember that .11 hr represents the fraction of an additional hour. Convert this to min by multiplying by the converting factor of 60 minutes/1 hr

$$\frac{60\ min}{1hr} * \frac{0.11\ hr}{1} = \frac{6.6\ min}{1} = 7\ \text{min}$$

6. The final infusion time is 11 hrs and 7 min (11:07)

If the infusion was started at 8:00 am, what time will the infusion end?

7:07 pm *(11 hrs and 7 min after from start time)*

Military Time 1907

Time to Infuse

And yet another "Time to Infuse" example, but this time you are given the drops per minute (gtt/min) and must calculate *hours* it will take for the infusion to run.

The questions here are "How many hours will it take to infuse the IV bolus?"

Order: Infuse 250 mL bolus of 0.9% NS at 33 gtt/min

Supply: 250 mL 0.9% NS with 20 gtt/mL tubing

How many hours will it take to infuse the IV bolus?

1. Start with what you are looking for (hr) on the right side of the =
2. Then match the what has been ordered by numerators and denominators
3. In this example you have just what you are looking for and do not need to add any converting factors.
4. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{250ml}{1} * \frac{20gtt}{ml} * \frac{min}{33gtt} * \frac{1hr}{60min} = \frac{2.5hrs}{1}$$

5. Remember that .5 hr represents the fraction of an additional hour. Convert this to min by multiplying by the converting factor of 60 minutes/1 hr

$$\frac{60\ min}{1hr} * \frac{0.5hr}{1} = \frac{30\ min}{1}$$

6. The final infusion time is 2 hrs and 30 min. Because the question asked for hours keep answer as 2.5

If the infusion was started at 8:00 am, what time will the infusion end?

10:30 am

Military Time 1030

Left in Bag

In this infusion example, you are given the infusion rate and asked to calculate the infusion time, like in the last example, but this time you are also asked to identify the volume left in the bag.

In this example the patient is to receive 750 ml, however IV bags are not supplied in 750 ml so the nurse will need to hang a larger capacity bag and stop the infusion before the entire bag is infused.

The questions here are "How long will the IV take to infuse?"; "What time will it end?"; and "How many ml are left in the bag?"

NOTE: The largest capacity IV solution bag is 1000 ml, but 500 ml, 250 ml, and 50 ml are also available.

Order: **750 ml 0.9 NS to infuse at 80 ml/hr**

Available: **1000 ml NS IV solution**

Calculate the infusion time

1. Start with what you are looking for (hr) on the right side of the =
2. Then match the what has been ordered by numerators and denominators
3. In this example you have just what you are looking for and do not need to add any converting factors.
4. Multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{750ml}{1} * \frac{1hr}{80ml} = \frac{hrs}{1}$$

$$\frac{750\cancel{ml}}{1} * \frac{1hr}{80\cancel{ml}} = 9.38hrs$$

5. Remember that .38 hr represents the fraction of an additional hour. Convert this to min by multiplying by the converting factor of 60 minutes = 1 hr

$$\frac{60\ min}{1hr} * \frac{0.38\ hr}{1} = \frac{22.8\ min}{1} = 23\ \text{min}$$

6. The final infusion time is 9 hrs and 23 min (9:23)

If the infusion was started at 12:00 pm, what time will the infusion end?

9:23 pm *(9 hrs and 23 min after from start time)*

Military time 2123

In this example, since the volume ordered is 750 ml you would choose a 1000 ml bag and discard the remaining solution. How many ml are left in the bag?

1000 ml – 750 ml = 250 ml

Most often you will be given a volume to be infused and a time at which to infuse it, ml/hr or total volume/total time.

In this example, you are given the infusion rate in gtts/min and administration set, but you are asked to calculate the rate in ml/hr.

The questions here are "What rate (ml/hr) is the IV infusing?" and "What time will the bag be empty?"

It is 1:00 pm; you enter your patient's room and see the IV is infusing at 22 gtts/min. There is 300 mL LIB. The IV administration set is 10 gtts/ml

What rate (ml/hr) is the IV infusing?

1. Start with what you are looking for $\frac{ml}{hr}$ on the right side of the =
2. Then match what in infusing and the drop factor that is available by numerators and denominators.
3. Notice you are provided with $\frac{gtts}{min}$ but the question asks for $\frac{ml}{hr}$.
4. Add a converting factor for time: 60 minutes = 1 hour. Just be sure to match numerators with denominators so you can cancel.
5. See in the example "gtts" and "min" will cancel out and you will be left with only ml and hr - just what you are looking for
6. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{22\ gtts}{1\ min} * \frac{1\ ml}{10\ gtts} * \frac{60\ min}{1\ hr} = \frac{ml}{hr}$$

$$\frac{22\ \cancel{gtts}}{1\ \cancel{min}} * \frac{1ml}{10\cancel{gtts}} * \frac{60\ \cancel{min}}{1\ hr} = \frac{132}{1} = \frac{132\ ml}{hr}$$

What time will the bag be empty?

$$\frac{300\ ml}{1} * \frac{1\ hr}{132\ ml} = \frac{300}{132} = 2.27 \text{ hrs}$$

Remember that .27 hr represents the fraction of an additional hour. Convert this to min by multiplying by the converting factor of 60 minutes/1 hr

$$\frac{60\ min}{1hr} * \frac{0.27\ hr}{1} = \frac{16.2\ min}{1} = 16 \text{ min}$$

The final infusion time is 2 hrs and 16 min (2:16).

If at 1:00 there was 300 ml LIB, then the infusion end at 3:16 pm (Military Time 1516).

When using an EID, the nurse must program the Rate and Volume. The rate is always ml/hr and the volume is the total amount (in ml) that is being infused.

The questions here are "How many ml/hr will the nurse set the EID?" and "What is the volume to be infused?"

Order: TPN infusion 1.5 liters to infuse over 24 hrs

Available: Electronic Infusion Device (EID)

How many ml/hr will the nurse will the nurse set the EID?

What is the volume to be infused?

1. Start with what you are looking for $\frac{ml}{hr}$ on the right side of the =
2. Then match the what has been ordered by numerators and denominators
3. In this example you have 2 different volume measurements and need to add a converting factor
4. The final step for calculating rate is to multiply across – numerators first, then denominators, and dived as needed
5. The Volume to be infused is the total amount (in ml) 1500 ml

$$\frac{1.5liters}{24hrs} * \frac{1000ml}{1liter} = \frac{ml}{hr}$$

$$\frac{1500ml}{24hrs} = \frac{62.5ml}{1} = \frac{62.5\ ml}{hr}$$

Patient is receiving enteral feedings via a peg tube. The provider orders a continuous feeding.

An enteral feeding pump, like an IV pump, is programmed in ml/hr.

Add no more than 4 hours of feeding to the feeding bag at a time to prevent bacterial contamination of enteral feeding.

Order: Infuse Jevity tube feeding 200 ml/4 hr

Available: Feeding Pump

How many ml per hour will the nurse set the feeding pump ?

1. Start with what you are looking for $\frac{ml}{hr}$ on the right side of the =
2. Then match the what has been ordered by numerators and denominators
3. In this example you have just what you are looking for and do not need to add any converting factors
4. The final step for calculating rate is to multiply across – numerators first, then denominators, and dived as needed
5. The Volume to be infused is the total amount (in ml) 200 ml

$$\frac{200ml}{4hrs} = \frac{ml}{hr}$$

$$\frac{200ml}{4\ hrs} = \frac{200}{4} = \frac{50\ ml}{hr}$$

Practice 3 Problems

1. Order: Infuse 1000 mL of D5W at 75 ml/hr
   a. Calculate the infusion time. **convert the fractional hr to min*
   b. If it's 5:00 pm, what time will the infusion be complete?
   c. How much solution is left in bag after 5 hours?

2. Order: Infuse 0.9 NS at a rate of 125 ml/hr for four hours
   a. Calculate the gtts/min using a 20 gtt/ml administration set
   b. What is the total volume to be infused?

Practice 3 Answers

1 a. 13.33 hr; 13 hrs 20 min; 13:20 after start of infusion

b. 6:20 am

c. 625 ml left in bag

2 a. 42 gtts/min

b. 500 ml

Dosage Calculations Based on Time

- units/hour
- mUnits/min
- mg/min

Sometimes a medication infusion will be ordered in units/hr, mg/min, and mUnit/min.

Again, we are not going to treat these types of orders any different than we have so far. You will still follow the same approach. Our assessment, goal identification, and method to calculate will not change.

Determine the drug (Heparin), dosage (1500 units/hr), route (IV), frequency (not noted in this example b/c it is a continuous infusion), and any special administration instructions (none for this example). Next determine what medication is available (Heparin 25,000 units in 500 mL of D5W; and an EID).

The question here is "How many ml/hr will the nurse set the EID?"

Order: **Heparin 1500 units/hour to infuse IV**

Available: **Heparin 25,000 units in 500 mL of D5W**

EID

How many ml/hr will the nurse set the EID?

1. Start with what you are looking for $\frac{ml}{hr}$ on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. See in the example "units" will cancel out and you will be left with only $\frac{ml}{hr}$ - just what you are looking for
4. The final step is to multiply across – numerators first, then denominators, and dived as needed *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{1500\ units}{hr} * \frac{500\ ml}{25000\ units} = \frac{ml}{hr}$$

$$\frac{1500\ \cancel{units}}{hr} * \frac{5\cancel{00}\ ml}{25\cancel{000}\ \cancel{units}} = \frac{750}{25} = \frac{30\ ml}{hr}$$

The examples we've been working with thus far have all been looking for a volume of medicine either in a single administration, tablet, ml; or, over a period of time, gtts/min, ml/hr.

Sometimes the question will ask, "How many mg/hr, mcg/hr, units/hr, and even mcg/kg/min, is the medication infusing?

In this example you are asked, "How many units/hour is the heparin infusing?"

No matter what you are asked, you're going to treat those calculations just as we always have, by starting with, what is the question asking?
The question is "How many units/hr is the patient receiving?

Order: **Heparin 20,000 units in 500 mL D5W to infuse at 20 mL/hour.**

Available: **Heparin 20,000 units in 500 mL D5W**

EID

How many units/hour is the heparin infusing?

1. Start with what you are looking for $\frac{units}{hr}$ on the right side of the =
2. Then match what has been ordered and medication that is available by numerators and denominators
3. See in the example "ml" will cancel out and you will be left with only $\frac{units}{hr}$ - just what you are looking for
4. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{20\ ml}{hr} * \frac{20{,}000\ units}{500\ ml} = \frac{units}{hr}$$

$$\frac{20\ \cancel{ml}}{hr} * \frac{20{,}0\cancel{00}\ units}{5\cancel{00}\ \cancel{ml}} = \frac{4000}{5} = \frac{800\ units}{hr}$$

Here's another example. This time the medication is ordered in mg/min.

Again, we are not going to treat these types of orders any different than we have so far.

Determine the drug (Lidocaine), dosage (2 mg/min), route (IV), frequency (not noted in this example b/c it is a continuous infusion), and any special administration instructions (none for this example). Next determine what you have available (Lidocaine 1 gram in 250 mL of D5W; and an EID).

The questions here are "How many ml/hr will the nurse set the EID?"

Notice the ordered medication and the supplied medication come in different metric weights, grams, milligrams, micrograms; And, the ordered time is minutes, but the EID only infuses in ml/hr. You will have to add conversion factors to your equation like we did earlier.

Order: **Lidocaine 2 mg/min IV continuous infusion**

Available: **Lidocaine 1 gram in 250 mL of D5W**

EID

How many ml/hr will the nurse set the EID?

1. Start with what you are looking for $\frac{ml}{hr}$ on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. Notice the medication is ordered in mg but supplied in gram AND the ordered time is in min, but the question asks for hr.
4. Add converting factors: 1 gram = 1000 mg AND 60 minutes = 1 hour. Just be sure to match numerators with denominators so you can cancel
5. See in the example "mg", "gram", and "min" will cancel out and you will be left with only $\frac{ml}{hr}$ - just what you are looking for
6. The final step to determine rate is to multiply across – numerators first, then denominators, and dived as needed *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{2\ mg}{min} * \frac{250\ ml}{1\ gram} * \frac{60\ min}{1\ hr} * \frac{1\ gram}{1000\ mg} = \frac{ml}{hr}$$

$$\frac{2\ \cancel{mg}}{\cancel{min}} * \frac{1\ \cancel{250}\ ml}{1\ \cancel{gram}} * \frac{60\ \cancel{min}}{1\ hr} * \frac{1\ \cancel{gram}}{4\ \cancel{1000}\ \cancel{mg}} = \frac{120}{4} = \frac{30\ ml}{hr}$$

In the previous example you were aske to find how many ml/hr you would infuse when giving a
2 mg/min infusion.

In this example you are asked, "How many mg/min is the patient receiving when the lidocaine is infusing at a rate 45ml/hr?"

No matter what you are asked, you're going to treat those calculations just as we always have, by starting with, what is the question asking?

The question is "How many mg/min is the patient receiving?

Order: **Lidocaine 1 gram in 250 mL D5W to infuse at 45 mL/hour.**

Available: **Lidocaine 1 gram in 250 mL D5W**

EID

How many mg/min is the lidocaine infusing?

1. Start with what you are looking for $\frac{mg}{min}$ on the right side of the =
2. Then match what has been ordered and medication that is available by numerators and denominators
3. See in the example "ml" , "gram", and "hr" will cancel out and you will be left with only $\frac{mg}{min}$ - just what you are looking for
4. Final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{45\ ml}{hr} * \frac{1\ gram}{250\ ml} * \frac{1\ hr}{60min} * \frac{1000\ mg}{1\ gram} = \frac{mg}{min}$$

$$\frac{45\ \cancel{ml}}{\cancel{hr}} * \frac{1\ \cancel{gram}}{250\ \cancel{ml}} * \frac{1\ \cancel{hr}}{60min} * \frac{1000\ mg}{1\ \cancel{gram}} = \frac{3\ mg}{min}$$

And another example. This time the medication is ordered in mUnit/min.

Yep, you guessed it!, not going to calculate these types of orders any different than we have so far.

Determine the drug (Pitocin), dosage (2 mUnit/min), route (IV), frequency (not noted in this example b/c it is a continuous infusion), and any special administration instructions (*titrate 1 mUnit/min q30min until contraction pattern is reached).

Next determine what medication is available (Pitocin 40 units in 1000 mL of NS; and an EID).

The question here is "How many ml/hr will the nurse set the EID?"

**The titration rate will be addressed on the next slide.*

Order: **Pitocin 2 mUnit/min to infuse IV titrate 1 mUnit/min q30min until contraction pattern is reached**

Available: **Pitocin 40 units in 1000 mL of NS**

EID

How many ml/hr will the nurse set the EID?

1. Start with what you are looking for $\frac{ml}{hr}$ on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. Notice the medication is ordered in mUnit but supplied in units AND the ordered time is in min, but the question asks for hr.
4. Add a converting factors: 1 unit = 1000 mUnit AND 60 minutes = 1 hour. Just be sure to match numerators with denominators so you can cancel
5. See in the example "mUnit", "unit", and "min" will cancel out and you will be left with only $\frac{ml}{hr}$ - just what you are looking for
6. The final step to determine rate is to multiply across – numerators first, then denominators, and dived as needed *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{2\ mUnit}{min} * \frac{1000\ ml}{40\ units} * \frac{60\ min}{1\ hr} * \frac{1\ unit}{1000\ mUnit} = \frac{ml}{hr}$$

$$\frac{2\ \cancel{mUnit}}{\cancel{min}} * \frac{\cancel{1000}\ ml}{\cancel{40}\ \cancel{units}} * \frac{\cancel{60}\ \cancel{min}}{1\ hr} * \frac{1\ \cancel{unit}}{\cancel{1000}\ \cancel{mUnit}} = \frac{12}{4} = \frac{3\ ml}{hr}$$

Titration of Medications

"titrate 1 mUnit/min q30min until contraction pattern is reached"

These instructions tell the nurse to increase the dose so as to bring about an effect. Increasing the dose will intensify uterine contractions. In this example the nurse begins the infusion at 3 ml/hr and then will increase by 1.5 ml every 30 min according to the patient's contraction pattern. Careful nursing assessments and documentation are extremely important when titrating medications.

Whether the nurse is increasing (or sometimes decreasing) a medication, the calculation method will be the same.

Order: **Pitocin 2 mUnit/min to infuse IV titrate 1 mUnit/min q30min until contraction pattern is reached**

Available: **Pitocin 40 units in 1000 mL of NS**

EID

How many ml/hr will the nurse set the EID for the titration?

We are using the same information and following the same steps as the previous slide, however now we are now calculating the titration rate which is 1 mUnit/min.

$$\frac{1\ mUnit}{min} * \frac{1000\ ml}{40\ unit} * \frac{60\ min}{1\ hr} * \frac{1\ unit}{1000\ mUnit} = \frac{ml}{hr}$$

$$\frac{1\ \cancel{mUnit}}{\cancel{min}} * \frac{1\cancel{000}\ ml}{4\cancel{0}\ \cancel{unit}} * \frac{6\cancel{0}\ \cancel{min}}{1\ hr} * \frac{1\ \cancel{unit}}{1\cancel{000}\ \cancel{mUnit}} = \frac{6}{4} = \frac{1.5\ ml}{hr}$$

From the previous slide we learned the initial rate was 3 ml/hr. Here we learn the titration rate is 1.5 ml/hr. Therefore, after the first 30 minutes the pump will be set to 4.5 ml (3 + 1.5 = 4.5) and be increased an additional 1.5 ml every 30 minutes until the contraction pattern is reached.

Note: sometimes a new calculation is not needed. Consider that 2 mUnit/min was achieved by administering 3 ml/hr (on previous slide), then 1 mUnit/min would be achieved by 1.5 ml/hr.

Loading Dose of Medications

A Loading Dose of medication is ordered to achieve a rapid therapeutic concentration.

The loading dose is often administered as an IV bolus.

Order: **Magnesium Sulfate 5 grams over 30 minutes**

and then maintain infusion at 2 grams/hour for 24 hours

Available: **Magnesium Sulfate 40 grams in 1000 ml 0.9 NaCl**

How many ml/hr will the nurse set the EID to deliver the loading dose?

Loading Dose

1. Start with what you are looking for $\frac{ml}{hr}$ on the right side of the =
2. Then match the dosage that has been ordered and medication that is available by numerators and denominators
3. See in the example "gm" will cancel out and you will be left with only mL and hr - just what you are looking for
4. The final step to determine rate is to multiply across – numerators first, then denominators, and dived as needed *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{5\ gram}{30\ min} * \frac{1000\ ml}{40\ gram} * \frac{60\ min}{1\ hr} = \frac{ml}{hr}$$

$$\frac{5\ \cancel{gram}}{1\ \cancel{30min}} * \frac{1000\ ml}{40\ \cancel{gram}} * \frac{2\ \cancel{60\ min}}{1\ hr} = \frac{10000}{40} = \frac{250\ ml}{hr}$$

*The loading dose rate is 250 mL/hr. *Remember – to change the loading dose rate after 30 min to deliver the maintenance infusion. See next slide*

Maintenance Infusion of Medications

After the loading dose is complete, recalculate and reprogram the EID to deliver the maintenance infusion.

Order: **Magnesium Sulfate 5 grams over 30 minutes**

and then maintain infusion at 2 grams/hour for 24 hours

Available: **Magnesium Sulfate 40 grams in 1000 ml 0.9 NaCl**

How many ml/hr will the nurse set the EID to deliver the maintenance infusion?

Maintenance Dose

1. Identify what you are looking for $\frac{mL}{hr}$ on the right side of the =
2. Then match the dosage that has been ordered, in this example $\frac{2\ gm}{hr}$ and what is available by numerators and denominators
3. See in the example "gm" will cancel out and you will be left with only mL and hr - just what you are looking for
4. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{2gm}{hr} * \frac{1000\ ml}{40\ gm} = \frac{2000\ ml}{40\ hr} = \frac{50\ ml}{hr}$$

Practice 4 Problems

1. Order: Lidocaine infusion at 15 ml/hr
   Available: Lidocaine infusion 2 grams/500 ml D5W
   How many mg/min is the patient receiving?

2. Order: Pitocin 6 mu/min to infuse IV titrate 3 mUnit/min q30min until contraction are 2 - 3 minutes apart.
   Available: Pitocin 20 Units in 1000 mL of NS
   a. How many ml/hr you will start the infusion?
   b. Calculate the titration rate.

3. Order: Magnesium Sulfate 4 gm over 30 minutes followed by a maintenance rate of 0.5 gram/hr
   Available: Magnesium Sulfate 30 gm in 1000 ml of D5W.
   a. Calculate the loading dose rate.
   b. How many ml/hr is the maintenance rate?

Practice 4 Answers

1. 1 mg/min

2. a. 18 ml/hr for initial infusion

   b. 9 ml/hr for titration

3. a. 266.7 ml/hr

   b. 16.7 ml/hr

Dosage Calculations
Based on Weight and Time

- mcg/kg/min
- units/kg/hr

Determine the drug (Dopamine), dosage (15 mcg/kg/min), route (IV), frequency (continuous IV infusion), and any special administration instructions (none for this example). Next determine what medication is available (Dopamine 320 mg/100 ml D5W).

Then, identify an outcome. The question being asked is "How many ml/hr will the nurse set the EID?"

Here, like in previous weight-based examples, you must first determine the patient's weigh in kilograms (kg).

And, since the ordered and available medications are in different weights, grams, milligrams, micrograms, you will have to add a converting factor to the equation.

Stick with the same plan, start the equation with what you are looking for and then add factors as needed – ml in the numerator and dose in the denominator.

Order: **Dopamine 15 mcg/kg/min**

Available: **Dopamine 320 mg/100 ml D5W**

Patient weighs 238 lb

How many ml/hr will the nurse set the EID?

1. Start with converting the patient's weight to kg. $\frac{238\ lbs}{1} * \frac{1kg}{2.2lbs} = \frac{238}{2.2} = \frac{108.18}{1} = 108.2\ kg$
2. Identify what you are looking for $\frac{ml}{hr}$ on the right side of the =
3. Then match the dosage that has been ordered, in this example $\frac{15\ mcg}{kg/min}$ to weight and medication that is available by numerators and denominators
4. Notice the medication is ordered in mcg but supplied in mg AND the ordered time is in min, but the question asks for hr.
5. Add a converting factors: 1 mg = 1000 mcg AND 60 minutes = 1 hour. Just be sure to match numerators with denominators so you can cancel
6. See in the example "kg" , "mg", and "mcg" will cancel out and you will be left with only ml and dose - just what you are looking for
7. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{15\ mcg}{kg/min} * \frac{108.2\ kg}{1} * \frac{100\ ml}{320\ mg} * \frac{1\ mg}{1000\ mcg} * \frac{60\ min}{1\ hr} = \frac{ml}{hr}$$

$$\frac{15\ \cancel{mcg}}{\cancel{kg}/\cancel{min}} * \frac{108.2\ \cancel{kg}}{1} * \frac{\cancel{100}\ ml}{\cancel{320}\ \cancel{mg}} * \frac{1\ \cancel{mg}}{\cancel{1000}\ \cancel{mcg}} * \frac{\cancel{60}\ \cancel{min}}{1\ hr} = \frac{9738}{320} = \frac{30.43}{1} = \frac{30.4\ ml}{hr}$$

Determine the drug (heparin), dosage (18 units/kg/hr), route (IV), frequency (continuous infusion) , and any special administration instructions (none for this example). Next determine what medication is available (Heparin 25,000/250 ml).

Then, identify an outcome. The question being asked is the same as the previous one, "How many ml/hour will the IV infuse?"

Here, like in previous weight based examples, you must first determine the patient's weight in kilograms (kg).

Stick with the same plan, start the equation with what you are looking for and then add factors as needed – ml in the numerator and hour in the denominator.

Order: **IV Heparin drip at 18 units/kg/hr**

Available: **Heparin 25,000 units/250 ml**

Patient weighs 189 lbs

How many ml/hr will the nurse set the EID?

1. Start with converting the patient's weight to kg. $\frac{189\ lbs}{1} * \frac{1kg}{2.2lbs} = \frac{189}{2.2} = \frac{85.909}{1} = 85.9\ kg$
2. Identify what you are looking for $\frac{ml}{hr}$ on the right side of the =
3. Then match the dosage that has been ordered, in this example $\frac{18\ units}{kg/hr}$,to weight and medication that is available by numerators and denominators
4. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{18\ units}{kg/hr} * \frac{85.9\ kg}{1} * \frac{250\ ml}{25{,}000\ units} = \frac{ml}{hr}$$

$$\frac{18\ \cancel{units}}{\cancel{kg}/hr} * \frac{85.9\ \cancel{kg}}{1} * \frac{250\ ml}{25{,}000\ \cancel{units}} = \frac{38655}{2500} = 15.46 = \frac{15.5\ ml}{hr}$$

Most often you will be supplied with a dose of medication (mg, mcg, etc.) and asked to determine a volume (tablet, ml) to be administered.

In this example, you are given the volume to be administered, but you are asked to determine the dose.

The question here is "How many mcg/kg/min is the patient receiving?"

Order: **Dopamine 400 mg/250 ml D5W is infusing at 18 ml/hr**

Patient weighs 98 lb

How many mcg/kg/min is the patient receiving?

1. Start with converting the patient's weight to kg. $\frac{98\ lbs}{1} * \frac{1kg}{2.2lbs} = \frac{98}{2.2} = \frac{44.5}{1} = 44.5\ kg$
2. Identify what you are looking for $\frac{mcg}{kg/min}$ on the right side of the =
3. Then match the infusion rate, in this example $\frac{18\ ml}{hr}$ to weight and medication that is available by numerators and denominators
4. Notice the medication is ordered in mcg but supplied in mg AND the infusion time is in hrs, but the question asks for min.
5. Add a converting factors: 1 mg = 1000 mcg AND 60 minutes = 1 hour. Just be sure to match numerators with denominators so you can cancel
6. See in the example "kg" , "mg", and "mcg" will cancel out and you will be left with only ml and dose - just what you are looking for
7. The final step is to multiply across – numerators first, then denominators, and dived as needed. *(if you notice a simple cancelation, I recommend doing it to keep your numbers smaller and avoid calculation errors)*

$$\frac{400\ mg}{250\ ml} * \frac{1000\ mcg}{1\ mg} * \frac{1}{44.5\ kg} * \frac{18\ ml}{hr} * \frac{1\ hr}{60\ min} = \frac{mcg}{kg/min}$$

$$\frac{400\ \cancel{mg}}{1\ 250\ \cancel{ml}} * \frac{4\ \cancel{1000}\ mcg}{1\ \cancel{mg}} * \frac{1}{44.5\ kg} * \frac{18\ \cancel{ml}}{\cancel{hr}} * \frac{1\ \cancel{hr}}{60\ min} = \frac{2880}{267} = 10.78 = \frac{10.8\ mcg}{kg/min}$$

Practice 5 Problems

1. Order: Milrinone 20 mg/100 ml D5W at 0.4 mcg/kg/min

   Patient weighs 264 lbs.

   How many ml/hr will you set the EID?

2. Order: Dopamine 800 mg/500 ml NS at 16 ml/hr

   Patient weighs 186 lbs.

   How many mcg/kg/min is the patient receiving?

Practice 5 Answers

1. 14.4 ml/hr
2. 5 mcg/kg/min

Therapeutic & Safe Dosage Range

- High and low for individual doses
- High and low for daily doses
- Max daily dose

As nursing students you've been taught about the patient "rights" of medication administration and understand that the "right dose" does not simply mean, what the provider ordered.

To confirm what has been ordered is therapeutic and within a safe dosage rage, nurses must verify this information for each medication and each patient.

The therapeutic and safe range information has been provided for you, but in practice the nurse would have to look it up in a drug reference book/electronic source.

NOTE: sometimes the ordered dosing schedule is different from the therapeutic dosing schedule. Be sure to compare.

Order: **Cefaclor 500 mg PO q8h**
Available: **Cefaclor 125 mg/5 ml**
Therapeutic Range: Cefaclor 20-40 mg/kg/day in three divided doses
Patient weighs 40 lb
Is this order Therapeutic?

1. Start with converting the patient's weight to kg. $\frac{40\ lbs}{1} * \frac{1kg}{2.2lbs} = \frac{40}{2.2} = \frac{18.18}{1} = 18.2\ kg$

2. Identify what you are looking for $\frac{mg}{day}$ on the right side of the =

3. Then match the high and low therapeutic dosages, in this example $\frac{20\ mg}{kg/day}$ and $\frac{40\ mg}{kg/day}$ to the patient's weight to find the daily dosage

$$\frac{20\ mg}{kg/day} * \frac{18.2\ kg}{1} = \frac{mg}{day} = \frac{364\ mg}{day}$$ Low daily dose

$$\frac{40\ mg}{kg/day} * \frac{18.2\ kg}{1} = \frac{mg}{day} = \frac{728\ mg}{day}$$ Upper daily dose

4. The next step is to find the higher and lower individual doses. Do this by multiplying by the converting factor of 1 day = 3 doses.

$$\frac{364\ mg}{day} * \frac{1\ day}{3\ doses} = \frac{364}{3} = \frac{121.3\ mg}{dose}$$ Low individual dose

$$\frac{728\ mg}{day} * \frac{1\text{day}}{3\text{doses}} = \frac{728}{3} = \frac{242.7\ \text{mg}}{\text{dose}}$$ Upper individual dose

5. The final step would be to determine if the ordered dose falls within the therapeutic rage for the entire day and individual doses

6. The patient is ordered to receive 500 mg q8h which is means they will receive $\frac{500\ mg}{dose}$ and $\frac{1500\ mg}{day}$

The order is **NOT** within the therapeutic range

How many ml will the nurse administer?

STOP! THE PATIENT IS ORDERED TO RECEIVE TOO MUCH MEDICINE!

In the previous example you were required to calculate the low and high individual and daily doses, and compare those to the ordered dosage.

In this example you'll need to determine if the ordered dosage has exceeded the maximum recommended dosage.

This is particularly important when administering medications by weight and/or pain medications prn .

Order: **Tylenol (acetaminophen) 650 mg PO q4h PRN for headache**

Available: Acetaminophen 325 mg tablets

The maximum safe dose of acetaminophen is 4 gram/day.

How many tablets will the patient receive with each request?

$$\frac{650\ mg}{dose} * \frac{1\ tablet}{325\ mg} = \frac{2\ tablets}{dose}$$

If the patient received medication q4h, would they exceed the maximum dosage for the day?

$$\frac{650\ mg}{dose} * \frac{6\ doses}{day} = \frac{3900\ mg}{day}$$

Practice 6 Problem

1. Cefazolin 25-50 mg/kg/day given in 4 equal doses. May be increased to 100 mg/kg/day for severe infections.
   Child weighs 35 lb and has a moderate ear infection.
   a. How many kg does the child weigh?
   b. What is the daily dosage range for this patient?
   c. What is the individual dosage range for this patient?
   d. What is maximum dosage per day?

2. Order: Ampicillin 1000 mg PO q6h
   Available: Ampicillin 250 mg/5 ml
   Therapeutic Range: Ampicillin 15-45 mg/kg q6h; not to exceed 12 g/day
   Patient weighs 140 lb
   a. How many kg does the patient weigh?
   b. What is the individual dosage range? (low and high per dose)
   c. What is the daily dosage range? (low and high per day)
   d. What is the patient ordered to receive per dose? Per day?
   e. If the medication ordered is within the therapeutic range, what do you administer to your patient?

Practice 6 Answer

1. a. 15.9 kg
   b. 397.5 - 795 mg/day
   c. 99.4 - 198.8 mg/dose
   d. 1590 mg/day

2. a. 63.6 kg
   b. 954 - 2862 mg/dose
   c. 3816 - 11,448 mg/day
   d. 1000 mg/dose; 4000 mg/day
   e. 20 ml/dose

Practice, Practice, Practice

The medication calculation examples provided in this tutorial have been straight forward in identifying the:

1. Drug; 2. Dosage; 3. Route; 4. Frequency; 5. any special administration instructions; and 6. what medication is available

The outcome was also easily identified by the questions asked: ex. *How many ml/hr will the nurse set the EID?*

However, questions in calculation texts, those written by faculty, and in practice, orders written by providers, are not always that straight forward and "easy" to interpret. Nursing students and nurses alike, must always go back to the basics and use the Nursing Process.

Assess first, collect your data by interpreting the medication order; and then identify your Goal.

Practice your assessment skills by interpreting questions/orders and identifying outcomes. Circle/highlight/underline or otherwise identify the information you need. Once you have that, implementing the DA approach will be a breeze!